



# Cisco HyperFlex 2.6 for Virtual Server Infrastructure

仮想サーバインフラ環境向け Cisco HyperFlex 2.6 構築ガイド

最終更新日： 2018 年 2 月 2 日



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## エグゼクティブ サマリー

ほとんどの IT 環境で仮想環境が利用、拡大化されています。これに伴い、これまで仮想化コンピューティング プラットフォームと同レベルの簡易性、柔軟性、迅速な導入が難しかった IT プラットフォームは見直されています。特にネットワークとストレージ システムは、ハイパーバイザや仮想サーバのような俊敏性に欠けていました。シスコは Cisco HyperFlex を市場に送り出すことで、現代のデータセンターでハイパーコンバージェンスを劇的に強化しました。Cisco HyperFlex システムは Cisco UCS プラットフォームをベースにしており、Cisco UCS ファブリック インターコネクトを通じて、Cisco HX シリーズ x86 サーバと統合ネットワーク技術を単一の管理ドメインに取り入れます。これには、業界をリードする VMware の仮想化ハイパーバイザ ソフトウェアと、次世代のソフトウェア デファインド ストレージ技術も含まれます。この組み合わせにより、すべてのインフラスタックが統合された仮想化プラットフォームが構築され、ゲスト仮想マシン (VM) のネットワーク接続が容易になります。その際、VM を配置する分散ストレージをすべての Cisco UCS x86 サーバに配置する、あるいは特定のストレージまたはネットワーク コンポーネントを使用します。HyperFlex は、ログベース ファイル システム独自のストレージ機能により、従来のようなパフォーマンスへのマイナス影響や、VM スナップショットのためにインラインデータの重複排除と圧縮を行うことなく、迅速に複製できます。システムの設定、導入、管理、監視は、すべて Cisco UCS Manager や VMware vCenter など、Cisco UCS/VMware 環境で利用される既存のツールで行うことができます (新しい管理ツールを利用する必要がありません)。このように高度なテクノロジー スタックを、迅速に導入可能でシンプルな単一ソリューションに統合したことで、Cisco HyperFlex は真の次世代ハイパーコンバージド プラットフォームになっています。

HyperFlex HXDP 2.5 では、スナップショットベースの仮想マシン複製、ストア データの暗号化を含む、基幹インフラに求められる、より高度なデータ保護機能が導入されました。仮想マシンの複製により、ディザスタ リカバリ用のセカンダリ HyperFlex サイトを簡単に設定できます。ストア データの暗号化では、ディスク上のすべてのデータが暗号化され、データ損失や盗難から保護されます。すべてのストレージが SSD のみで構成されるオールフラッシュ HyperFlex クラスタでは、より高速なパフォーマンス・密度の向上、遅延の低減を図れます。高性能 SSD とコスト メリットのある大容量の HDD を組み合わせた HyperFlex ハイブリッド クラスタでは、データの保存コストを最適化できます。その他の拡張機能としては、管理権限に基づくアクセス制御、40 GbE 接続のサポート、16 ノードのクラスタ、キャッシュ ドライブ用の SAS ベース SSD だけでなく、NVMe ベース SSD のサポート、ローカル言語 (日本語) 表示にも対応したネイティブ HTML5 ベースの HyperFlex Connect 管理ツールの提供などがあります。また Cisco HyperFlex HXDP 2.6 では、コンバージド ストレージ ノードまたはコンピューティング専用ノードとして、2017 年に提供開始された最新プロセッサである Xeon スケーラブルシリーズに対応する M5 世代サーバがサポートされました。構成の柔軟性として、Cisco M5 世代サーバのみで構成する HyperFlex クラスタはもちろん、M4 世代サーバとの混在クラスタとしても構成できます。

## ソリューション概要

### はじめに

Cisco HyperFlex システムは、冗長化・拡張性を考慮した Cisco UCS HX シリーズ x86 ラックマウント サーバの上に、ハイパーバイザ ホスト、ネットワーク接続、仮想サーバ ストレージを 1 つのインフラで提供し、よりスマートで使いやすい仮想化サーバ プラットフォームを実現します。従来のデータセンターは各種の異なるテクノロジーに依存、積み上げて構成されており、エンドポイントを接続してイーサネット ネットワーク トラフィックを転送するネットワーク スイッチや、専用のストレージ アレイ ネットワーク (SAN) を通じてブロック ベースのストレージを提供するファイバ チャンネル (FC) ストレージ アレイなど、それぞれが別個に特化した機能を実行していました。これらのシステムには、ハードウェア、接続性、管理ツール、運用上の知識、監視、継続的なサポート (製品ライフタイム) など、それぞれに固有の要件があります。そのため、従来の仮想サーバ環境は一般的に「サイロ」と呼ばれ、個別にシステム化されています。その中では特定範囲のアプリケーションのみが運用され、ソフトウェア ツールやサポート スタッフが関連付けられていました。サイロは、x86 コンピューティング ハードウェア、それら x86 サーバのネットワーク接続、SAN 接続、ストレージ端末のプレゼンテーション、ハイパーバイザおよび仮想プラットフォーム管理、そしてゲスト VM 自体とその OS やアプリケーションなどに分割されます。このモデルは柔軟性に乏しく、移動も困難で、運用上の非効率が多発する可能性があります。

そこで、コンバージド インフラストラクチャという、より現代的なデータセンター システム化モデルが開発されました。コンバージド インフラストラクチャは、これらのテクノロジーを単一環境として統合することで従来のサイロを解消し、各テクノロジーが定義・検証済みの設計で運用されるようにします。コンバージド インフラストラクチャの主要なコンポーネントは、x86 ラック サーバ・ブレード サーバで筐体・モデルの違いを意識する必要がない組み合わせと、Cisco UCS プラットフォームによって実現する、コンバージド イーサネットとファイバ チャンネルによるネットワークングでした。コンバージド インフラストラクチャでは、Cisco UCS と新しい導入ツール、管理ソフトウェア、自動化プロセス、オーケストレーション ツールを使用することで、従来環境における困難な課題を大幅に克服しています。こうした新しいツールにより、システムの継続的な管理と運用を少数のスタッフで実施できるようになり、ビジネス ニーズに応じてアプリケーション サービスをさらに迅速に導入しながら、最高度の柔軟性と最大限のパフォーマンスを実現できます。シスコは多様なストレージ パートナーとともに、Cisco FlexPod、FlashStack、VersaStack、VxBlock アーキテクチャなどの優れたソリューションを開発し、この分野で著しい成功を収めてきました。一方で、コンバージド インフラストラクチャは (特にストレージ サブシステム) と組み合わせるというテクノロジー スタックのため、依然としてサーバとストレージなど複数のチームの管理者に責任が分散される場合がありました。加えて、コンバージド インフラストラクチャではコンポーネントが複雑に組み合わせられているという認識があり、要求されるアプリケーション サービスはもっとシンプルなシステムでも十分に対応できると考えられるようになってきました。

ストレージ市場の大きな変化により、ソフトウェア デファインド ストレージ (SDS) システムが注目を集めています。従来の FC ストレージ アレイでは、Fibre Channel Arbitrated Loop (FC-AL) ベースのコントローラやディスクの筐体、最適化された Application Specific Integrated Circuits (ASIC)、読み取り/書き込みデータ キャッシュ モジュール/カードなど、ハードウェアの特殊なサブセットが含まれ、高度にカスタマイズされたソフトウェアによってアレイを運用していました。Serial Attached SCSI (SAS) バス テクノロジーが登場し、その価値が認識されることで、ストレージ アレイ ベンダーはハードウェア アーキテクチャを SAS に移行し始めました。そして最新の x86 プロセッサ アーキテクチャによって処理能力が劇的に増大した結果、カスタム ASIC の使用は激減しています。ディスクが物理的に小型化するにつれ、x86 サーバのラック ユニット (RU) あたりのストレージ密度がアレイ自体と同じになってきました。さらに NAND ベースの SSD の急増により、専用のキャッシュ ドライブに匹敵する入出力 (IO) 速度で利用できるようになりました。従来の専用ストレージアレイに匹敵するストレージ容量とテクノロジーがサーバ自体に組み込まれたことで、主要な差別化要因は、多数のベンダーが提供するストレージの割り当て、状態表示や管理などを担うソフトウェア・高度な機能へと移りました。そして、それがソフトウェア デファインド ストレージの登場につながりました。ここでは、ストレージ機能を搭載した x86 サーバが、ソフトウェアを実行して効率的に各サーバを連携させることで、従来のアレイと同様のストレージ アレイとして動作します。

このような技術集結の結果、一部の主要なストレージ アレイ ベンダー自体がこの分野のパイオニアになり、市場での技術的な転換を認識し、以前のような特殊ハードウェアではなく、ソフトウェア機能によって利益を得ることを目指すようになったのです。

先述したように、初期の SDS システムは、コンバージド アーキテクチャ内のレガシー ストレージの部分をサーバに搭載、置き換えるものでした。その中には、SDS ソリューションによって仮想サーバ ハイパーバイザ プラットフォームから独立したストレージ システムが含まれましたが、ネットワークは分離されたままでした。VM をホストするサーバと SDS 環境を提供するサーバが 1 つの物理同サーバであった場合に両方を同時に処理し、2 つの機能を 1 つに統合する、このようなリソースの最終形態が、業界で「ハイパーコンバージド インフラストラクチャ」と呼ばれる組み合わせ方式です。ハイパーコンバージド インフラストラクチャは、サーバのコンピューティング、メモリ、ハイパーバイザ、ストレージ機能を、仮想サーバのプラットフォームとして 1 つに融合させます。ハイパーバイザを実行するサーバが仮想サーバを保存するソフトウェア デファインド ストレージ リソースを提供し、サーバ自体が仮想マシンを効果的に搭載できるため、ストレージ システムを個別に用意する必要がなくなります。現在ではサイロの発生がほぼすべて解消されています。ハイパーコンバージド インフラストラクチャについても、ほぼ完全に自己完結型になり、使いやすく導入・利用が簡単で、柔軟性もある非常に高性能なものになりました。多くのハイパーコンバージド システムのネットワーク部分は x86 サーバ上のオンボードのネットワーク カードや Top-of-Rack 型スイッチなど、標準的なネットワークング コンポーネントを使用しています。Cisco HyperFlex システムでは、Cisco UCS によるコンピューティングとネットワークングの統合に、次世代ハイパーコンバージド ストレージ ソフトウェアを組み合わせることで、コンピューティング リソース、ネットワーク接続、ストレージ、ハイパーバイザ プラットフォームを提供し、仮想環境全体を 1 つの統一システム内で稼働させます。

ハイパーコンバージド インフラストラクチャの主な利点としては、導入や日常の管理作業の簡素化に加え、俊敏性の向上による運用コストの低減などが挙げられます。ハイパーコンバージド ストレージは 一般的な IT 管理者でも簡単に管理できるため、専任の管理チームやスキルセットが必要とするストレージ システム導入での、技術面での負担も軽減されます。

## 対象読者

本書の対象読者としては、セールス エンジニア、フィールド コンサルタント、プロフェッショナル サービス、IT マネージャ、パートナー エンジニアリング、および Cisco HyperFlex システムを導入するお客様などが挙げられます。該当・補足情報について一部は外部参照を示していますが、VMware 固有のテクノロジー、インフラストラクチャの概念、ネットワーク接続、およびインストール環境のセキュリティ ポリシーについて十分な知識を持っている読者が対象です。

## このドキュメントの使用目的

本書では、Cisco HyperFlex システムの導入、設定、管理に必要な手順を説明します。本書の内容は、本書内で指定されるソフトウェア、ハードウェア、ファームウェア バージョンを使用した、既知のベスト プラクティスに基づいています。そのため、記載バージョン以降での推奨事項やベスト プラクティスは修正される可能性があります。本書では、一般的なお客様のデータセンター環境における Cisco HyperFlex Standard のインストール、設定、拡張について説明します。また、コンバージド ノードおよびコンピューティング専用ノードの両方を含む拡張クラスタについても説明します。本書の読者には、使用される製品のインストールと設定に関する知識を持っていることが前提で記載されていますが、ソリューション導入で重要になる設定については本書でも詳細に説明されます。

## バージョン 2.5 の拡張機能

Cisco HyperFlex システムのバージョン 2.5 では、新機能と拡張機能が追加されています。

- 2 つの HyperFlex クラスタ間で仮想マシン スナップショットによるネイティブ レプリケーションを利用できます。1 つの VM、複数 VM、またはサイト全体のディザスタ リカバリが可能になります。

- ハードウェア ベースの自己暗号化 (SED) を使用した、ストア データの暗号化により、ディスクに書き込まれたデータを保護し、データ漏洩やデータの盗難防止対策のひとつになります。
- 大規模なクラスタをサポートします。オールフラッシュ クラスタ構成では 1 つのクラスタあたり最大 16 のコンバージド ノードと最大 16 のコンピューティング専用ノードをサポートし、VMware vCenter インスタンスあたり最大 100 の HyperFlex クラスタ管理に対応します。
- Cisco HyperFlex オールフラッシュ コンバージド ノードは、NVMe SSD をキャッシュ ドライブとして使用できます。
- 管理担当別のアクセス制御 (変更の参照・変更もしくは参照のみ) が可能。HyperFlex 2.5 よりサポートされた HyperFlex Connect のネイティブ HTML5 対応の管理 GUI。
- プログラミングによる管理、クラスタと機能の監視が可能な、HyperFlex REST API を完全にサポート
- HX240c オールフラッシュ コンバージド ノード (HXAF240c-M4SX) では、ノードあたり 23 台の SSD を割り当て可能
- コンピューティング専用ノード向けに、Cisco UCS ブレードおよびラックマウントサーバ モデルがオプションで利用可能
- Cisco スマート ライセンス対応
- 情報処理規格 FIPS/CC 認定取得済み
- VMware vSphere 6.5 サポート

## バージョン 2.6 の拡張機能

Cisco HyperFlex システムのバージョン 2.6 では、いくつかの新機能と拡張機能が追加されています。

- 新しい Cisco M5 世代 HyperFlex サーバ モデル (HX220c M5SX、HX240c M5SX、HXAF220c M5SX、HXAF240c M5SX) をサポート。
- Cisco M4 世代および M5 世代サーバを 1 つの HyperFlex クラスタで構成する混合クラスタをサポート。
- コンピューティング専用ノードとしての標準 Cisco M5 世代ラック マウントおよびブレード サーバをサポート。
- Cisco Intersight クラウドベース リモート監視および管理をサポート。
- HyperFlex Connect HTML5 管理 GUI に VM 管理機能を追加。
- オールフラッシュ HyperFlex クラスタとハイブリッド HyperFlex クラスタ間のネイティブ レプリケーション。

## ドキュメント ロードマップ

包括的なドキュメント体系については、下記にアクセスして Cisco UCS HX シリーズのドキュメント ロードマップを参照してください。

[https://www.cisco.com/c/en/us/td/docs/hyperconverged\\_systems/HyperFlex\\_HX\\_DataPlatformSoftware/HX\\_Documentation\\_Roadmap/HX\\_Series\\_Doc\\_Roadmap.html](https://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HyperFlex_HX_DataPlatformSoftware/HX_Documentation_Roadmap/HX_Series_Doc_Roadmap.html)



注：ドキュメント ロードマップでは Cisco サイトへのログインが必要です。

ハイパーコンバージド インフラストラクチャの Web リンク :

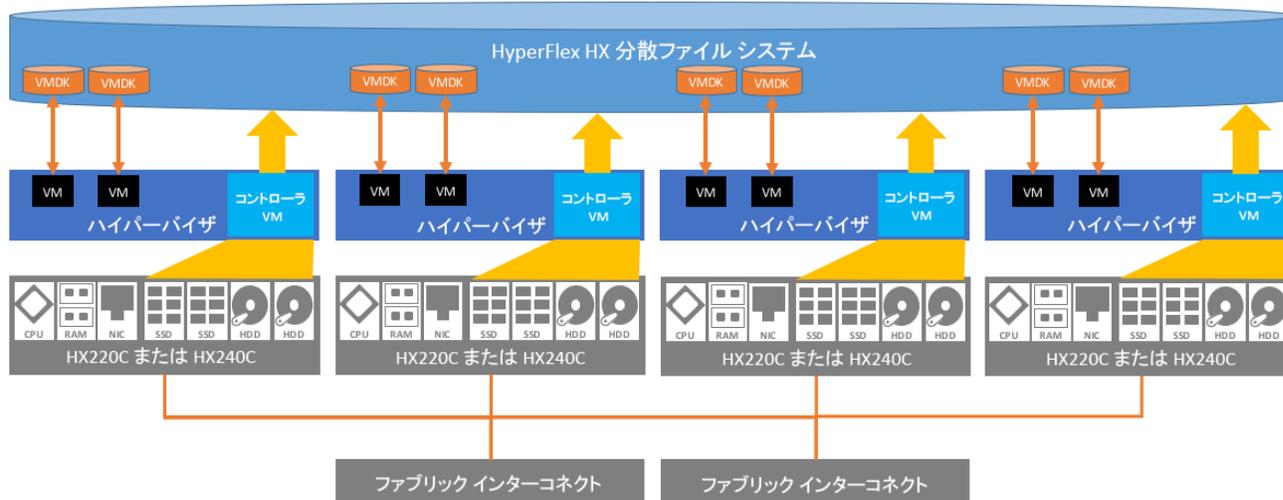
日本語 : <http://www.cisco.com/jp/go/hyperflex>

英語 : <http://hyperflex.io>

## ソリューションの概要

Cisco HyperFlex システムは、サーバおよびメモリ リソース、統合されたネットワーク接続、VM ストレージ用の高性能の分散ログ ファイル システム、仮想化サーバ用のハイパーバイザ ソフトウェア、これらが単一の Cisco UCS 管理ドメインに統合された、完結型の仮想サーバ プラットフォームです。

図 1. HyperFlex システムの概要



HyperFlex システムには、以下のコンポーネントがあります。

- Cisco UCS ファブリック インターコネクトでは、次のモデルを選択できます。
  - Cisco UCS 6248UP ファブリック インターコネクト
  - Cisco UCS 6296UP ファブリック インターコネクト
  - Cisco UCS 6332 ファブリック インターコネクト
  - Cisco UCS 6332-16UP ファブリック インターコネクト
- HyperFlex HX シリーズ ラックマウント サーバでは、次のモデルを選択できます。
  - Cisco HyperFlex HX220c-M5SX ラックマウント サーバ
  - Cisco HyperFlex HX240c-M5SX ラックマウント サーバ
  - Cisco HyperFlex HXAF220c-M5SX オールフラッシュ ラック サーバ
  - Cisco HyperFlex HXAF240c-M5SX オールフラッシュ ラック サーバ
  - Cisco HyperFlex HX220c-M4S ラックマウント サーバ
  - Cisco HyperFlex HX240c-M4SX ラックマウント サーバ
  - Cisco HyperFlex HXAF220c-M4S オールフラッシュ ラック サーバ

- Cisco HyperFlex HXAF240c-M4SX オールフラッシュ ラック サーバ
- Cisco HyperFlex データ プラットフォーム ソフトウェア
- VMware vSphere ESXi Hypervisor
- VMware vCenter サーバ（既存環境を利用可能 もしくは別途新規構築が必要）

コンピューティング専用リソースを追加するオプションのコンポーネント

- Cisco UCS 5108 ブレード シャーシ
- Cisco UCS 2204XP、2208XP、2304 モデルのファブリック エクステンダ
- Cisco UCS B200-M3、B200-M4、B200-M5、B260-M4、B420-M4、B460-M4、B480-M5 ブレード サーバ
- Cisco UCS C220-M3、C220-M4、C220-M5、C240-M3、C240-M4、C240-M5、C460-M4、C480-M5 ラックマウント サーバ

## オールフラッシュとハイブリッド

当初の HyperFlex ハイブリッドシステムでは、一次ストレージ キャッシュ層では SSD を使用し、長期ストレージ データストア層では HDD を使用するハイブリッド コンバージドノードが特徴でした。HyperFlex ハイブリッド システムは、エン트리～ミッドレンジのストレージソリューションに適しています。ハイブリッド ソリューションは、ディスクに高パフォーマンスが追求されない仮想環境で多く導入されています。一方で、高パフォーマンスが要求されるクリティカルなアプリケーション用途での導入も大幅に増えています。高パフォーマンスが要求される用途でハイブリッド HyperFlex システムを使うことの課題は、ストレージ遅延の増大による影響を受けやすいことです。ハード ディスクの物理特性により、遅延の増大がボトルネックになることは避けられません。理想的には、すべてのストレージ運用がキャッシュ SSD 層で行われれば、ハイブリッド システムのパフォーマンスは非常に高くなります。しかしシナリオによっては、読み書きされるデータ量がキャッシュ層の容量を超過し、HDD データストア層の負荷が増加して遅延も増大し、パフォーマンスが低下します。

HyperFlex オールフラッシュシステムでは、遅延の影響を受けやすい、高パフォーマンスを必要とする用途に最適です。フラッシュに最適化された専用的高パフォーマンス ログファイル システムを備えた HyperFlex オールフラッシュシステムでは、次のことが実現されます。

- クラスタ内の HyperFlex オールフラッシュ モデルおよびコンピューティング専用ノードの仮想マシンすべてにおいて、安定した高パフォーマンスを実現
- Microsoft SQL や Oracle などのデータ集約型のアプリケーションやデータベースで、高い安定性と低遅延を実現
- NVMe キャッシュ SSD のサポートによりパフォーマンスが向上
- フラッシュ メモリ構成に適した、将来を見越したアーキテクチャ：
  - クラスタ全体の SSD をプーリングすることでパフォーマンスを最大化し、SSD 使用率のバランスをとって SSD ライフ負荷を分散
  - 分散対応したログファイル システムにより、データ パスが最適化され、書き込み回数の増加を抑制
  - 書き込みは、順次書き込み主体の処理によりフラッシュ ドライブの劣化（ライftime消費）を軽減し、コンポーネントの寿命を延長
  - 重複排除や圧縮などによるインライン スペースでの最適化によりデータ操作を最小化し、劣化を軽減

- 高密度ドライブによってシステム容量が増加し、運用コストを削減
- スケールアウトが容易な分散インフラストラクチャと、個々のリソースを別個にスケールアウトできる柔軟性を備えたクラウド スケール ソリューション

Cisco HyperFlex でハイブリッド モデルとオールフラッシュ モデルがサポートされたことで、容量、アプリケーション、パフォーマンス、予算の要件に基づいて、適切なプラットフォーム構成を選択できるようになりました。オールフラッシュ構成では、反復可能かつ持続可能な高パフォーマンスが得られます。これは、多くのデータ セットを扱うシナリオ、つまり稼働中に多量のデータを扱うシナリオに特に最適です。ハイブリッド構成は、Cisco HyperFlex ソリューションのシンプルさを求めると同時に、容量の影響を受けやすいソリューション、低予算、パフォーマンスの影響を受けやすいアプリケーション数の抑制を必要とするお客様に適しています。

## Technology Overview

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### Cisco Unified Computing System

The Cisco Unified Computing System (Cisco UCS) is a next-generation data center platform that unites compute, network, and storage access. The platform, optimized for virtual environments, is designed using open industry-standard technologies and aims to reduce total cost of ownership (TCO) and increase business agility. The system integrates a low-latency, lossless 10 Gigabit Ethernet or 40 Gigabit Ethernet unified network fabric with enterprise-class, x86-architecture servers. It is an integrated, scalable, multi chassis platform in which all resources participate in a unified management domain.

The main components of Cisco Unified Computing System are:

- **Computing:** The system is based on an entirely new class of computing system that incorporates rack-mount and blade servers based on Intel Xeon Processors.
- **Network:** The system is integrated onto a low-latency, lossless, 10-Gbps or 40-Gbps unified network fabric. This network foundation consolidates LANs, SANs, and high-performance computing networks which are often separate networks today. The unified fabric lowers costs by reducing the number of network adapters, switches, and cables, and by decreasing the power and cooling requirements.
- **Virtualization:** The system unleashes the full potential of virtualization by enhancing the scalability, performance, and operational control of virtual environments. Cisco security, policy enforcement, and diagnostic features are now extended into virtualized environments to better support changing business and IT requirements.
- **Storage access:** The system provides consolidated access to both SAN storage and Network Attached Storage (NAS) over the unified fabric. By unifying storage access, the Cisco Unified Computing System can access storage over Ethernet, Fibre Channel, Fibre Channel over Ethernet (FCoE), and iSCSI. This provides customers with their choice of storage protocol and physical architecture, and enhanced investment protection. In addition, the server administrators can pre-assign storage-access policies for system connectivity to storage resources, simplifying storage connectivity, and management for increased productivity.
- **Management:** The system uniquely integrates all system components which enable the entire solution to be managed as a single entity by the Cisco UCS Manager (UCSM). The Cisco UCS Manager has an intuitive graphical user interface (GUI), a command-line interface (CLI), and a robust application programming interface (API) to manage all system configuration and operations.

The Cisco Unified Computing System is designed to deliver:

- A reduced Total Cost of Ownership and increased business agility.
- Increased IT staff productivity through just-in-time provisioning and mobility support.
- A cohesive, integrated system which unifies the technology in the data center. The system is managed, serviced and tested as a whole.
- Scalability through a design for hundreds of discrete servers and thousands of virtual machines and the capability to scale I/O bandwidth to match demand.
- Industry standards supported by a partner ecosystem of industry leaders.

## Cisco UCS Fabric Interconnect

The Cisco UCS Fabric Interconnect (FI) is a core part of the Cisco Unified Computing System, providing both network connectivity and management capabilities for the system. Depending on the model chosen, the Cisco UCS Fabric Interconnect offers line-rate, low-latency, lossless 10 Gigabit or 40 Gigabit Ethernet, Fibre Channel over Ethernet (FCoE) and Fibre Channel connectivity. Cisco UCS Fabric Interconnects provide the management and communication backbone for the Cisco UCS C-Series, S-Series and HX-Series Rack-Mount Servers, Cisco UCS B-Series Blade Servers and Cisco UCS 5100 Series Blade Server Chassis. All servers and chassis, and therefore all blades, attached to the Cisco UCS Fabric Interconnects become part of a single, highly available management domain. In addition, by supporting unified fabrics, the Cisco UCS Fabric Interconnects provide both the LAN and SAN connectivity for all servers within its domain.

From a networking perspective, the Cisco UCS 6200 Series uses a cut-through architecture, supporting deterministic, low latency, line rate 10 Gigabit Ethernet on all ports, up to 1.92 Tbps switching capacity and 160 Gbps bandwidth per chassis, independent of packet size and enabled services. The product family supports Cisco low-latency, lossless 10 Gigabit Ethernet unified network fabric capabilities, which increase the reliability, efficiency, and scalability of Ethernet networks. The Fabric Interconnect supports multiple traffic classes over the Ethernet fabric from the servers to the uplinks. Significant TCO savings come from an FCoE-optimized server design in which network interface cards (NICs), host bus adapters (HBAs), cables, and switches can be consolidated.

The Cisco UCS 6300 Series offers the same features while supporting even higher performance, low latency, lossless, line rate 40 Gigabit Ethernet, with up to 2.56 Tbps of switching capacity. Backward compatibility and scalability are assured with the ability to configure 40 Gbps quad SFP (QSFP) ports as breakout ports using 4x10GbE breakout cables. Existing Cisco UCS servers with 10GbE interfaces can be connected in this manner, although Cisco HyperFlex nodes must use a 40GbE VIC adapter in order to connect to a Cisco UCS 6300 Series Fabric Interconnect.

### Cisco UCS 6248UP Fabric Interconnect

The Cisco UCS 6248UP Fabric Interconnect is a one-rack-unit (1RU) 10 Gigabit Ethernet, FCoE and Fiber Channel switch offering up to 960 Gbps throughput and up to 48 ports. The switch has 32 1/10-Gbps fixed Ethernet, FCoE, or 1/2/4/8 Gbps FC ports, plus one expansion slot.

#### 2. Cisco UCS 6248UP Fabric Interconnect



### Cisco UCS 6296UP Fabric Interconnect

The Cisco UCS 6296UP Fabric Interconnect is a two-rack-unit (2RU) 10 Gigabit Ethernet, FCoE, and native Fibre Channel switch offering up to 1920 Gbps of throughput and up to 96 ports. The switch has 48 1/10-Gbps fixed Ethernet, FCoE, or 1/2/4/8 Gbps FC ports, plus three expansion slots.

#### 3. Cisco UCS 6296UP Fabric Interconnect



## Cisco UCS 6332 Fabric Interconnect

The Cisco UCS 6332 Fabric Interconnect is a one-rack-unit (1RU) 40 Gigabit Ethernet and FCoE switch offering up to 2560 Gbps of throughput. The switch has 32 40-Gbps fixed Ethernet and FCoE ports. Up to 24 of the ports can be reconfigured as 4x10Gbps breakout ports, providing up to 96 10-Gbps ports.

### 4. Cisco UCS 6332 Fabric Interconnect



## Cisco UCS 6332-16UP Fabric Interconnect

The Cisco UCS 6332-16UP Fabric Interconnect is a one-rack-unit (1RU) 10/40 Gigabit Ethernet, FCoE, and native Fibre Channel switch offering up to 2430 Gbps of throughput. The switch has 24 40-Gbps fixed Ethernet and FCoE ports, plus 16 1/10-Gbps fixed Ethernet, FCoE, or 4/8/16 Gbps FC ports. Up to 18 of the 40-Gbps ports can be reconfigured as 4x10Gbps breakout ports, providing up to 88 total 10-Gbps ports.

### 5. Cisco UCS 6332-16UP Fabric Interconnect



**Note:** When used for a Cisco HyperFlex deployment, due to mandatory QoS settings in the configuration, the 6332 and 6332-16UP will be limited to a maximum of four 4x10Gbps breakout ports.

## Cisco HyperFlex HX-Series Nodes

A HyperFlex cluster requires a minimum of three HX-Series “converged” nodes (with disk storage). Data is replicated across at least two of these nodes, and a third node is required for continuous operation in the event of a single-node failure. Each node that has disk storage is equipped with at least one high-performance SSD drive for data caching and rapid acknowledgment of write requests. Each node also is equipped with additional disks, up to the platform’s physical limit, for long term storage and capacity.

## Cisco HyperFlex HXAF220c-M5SX All-Flash Node

This small footprint Cisco HyperFlex all-flash model contains a 240 GB M.2 form factor solid-state disk (SSD) that acts as the boot drive, a 240 GB housekeeping SSD drive, either a single 1.6 TB NVMe SSD or 400GB SAS SSD write-log drive, and six to eight 960 GB or 3.8 TB SATA SSD drives for storage capacity. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are also replaced with either 800 GB, 960 GB or 3.8 TB SED SSDs. A minimum of three nodes and a maximum of sixteen nodes can be configured in one HX all-flash cluster.

### 6. HXAF220c-M5SX All-Flash Node



## Cisco HyperFlex HXAF240c-M5SX All-Flash Node

This capacity optimized Cisco HyperFlex all-flash model contains a 240 GB M.2 form factor solid-state disk (SSD) that acts as the boot drive, a 240 GB housekeeping SSD drive, either a single 1.6 TB NVMe SSD or 400GB SAS SSD write-log drive installed in a rear hot swappable slot, and six to twenty-three 960 GB or 3.8 TB SATA SSD drives for storage capacity. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are also replaced with either 800 GB, 960 GB or 3.8 TB SED SSDs. A minimum of three nodes and a maximum of sixteen nodes can be configured in one HX all-flash cluster.

### 7. HXAF240c-M5SX Node



Note: Either a 400 GB SAS SSD or 1.6 TB NVMe SSD caching drive may be chosen. While the NVMe option can provide a higher level of performance, the partitioning of the two disks is the same, therefore the amount of cache available on the system is the same regardless of the model chosen.

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## Cisco HyperFlex HX220c-M5SX Hybrid Node

This small footprint Cisco HyperFlex hybrid model contains a minimum of six, and up to eight 1.8 terabyte (TB) or 1.2 TB SAS hard disk drives (HDD) that contribute to cluster storage capacity, a 240 GB SSD housekeeping drive, a 480 GB or 800 GB SSD caching drive, and a 240 GB M.2 form factor SSD that acts as the boot drive. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are replaced with 1.2TB SAS SED HDDs. A minimum of three nodes and a maximum of eight nodes can be configured in one HX hybrid cluster.

**8. HX220c-M5SX Node**

Note: Either a 480 GB or 800 GB caching SAS SSD may be chosen. This option is provided to allow flexibility in ordering based on product availability, pricing and lead times. There is no performance, capacity, or scalability benefit in choosing the larger disk.

**Cisco HyperFlex HX240c-M5SX Hybrid Node**

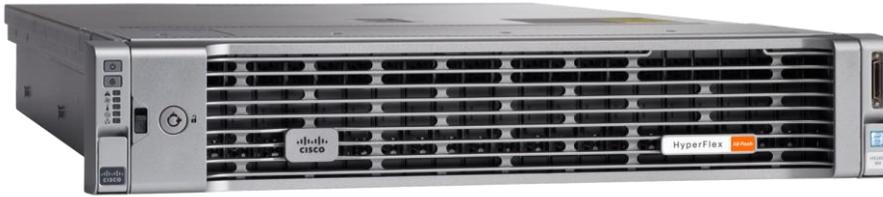
This capacity optimized Cisco HyperFlex hybrid model contains a minimum of six and up to twenty-three 1.8 TB or 1.2 TB SAS hard disk drives (HDD) that contribute to cluster storage, a 240 GB SSD housekeeping drive, a single 1.6 TB SSD caching drive installed in a rear hot swappable slot, and a 240 GB M.2 form factor SSD that acts as the boot drive. For configurations requiring self-encrypting drives, the caching SSD is replaced with a 1.6 TB SAS SED SSD, and the capacity disks are replaced with 1.2TB SAS SED HDDs. A minimum of three nodes and a maximum of eight nodes can be configured in one HX hybrid cluster.

**9. HX240c-M5SX Node****Cisco HyperFlex HXAF220c-M4S All-Flash Node**

This small footprint Cisco HyperFlex all-flash model contains two Cisco Flexible Flash (FlexFlash) Secure Digital (SD) cards that act as the boot drives, a single 120 GB or 240 GB solid-state disk (SSD) data-logging drive, a single 400 GB NVMe or a 400GB or 800 GB SAS SSD write-log drive, and six 960 GB or 3.8 terabyte (TB) SATA SSD drives for storage capacity. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are also replaced with either 800 GB, 960 GB or 3.8 TB SED SSDs. A minimum of three nodes and a maximum of sixteen nodes can be configured in one HX all-flash cluster.

**10. HXAF220c-M4S All-Flash Node****Cisco HyperFlex HXAF240c-M4SX All-Flash Node**

This capacity optimized Cisco HyperFlex all-flash model contains two FlexFlash SD cards that act as boot drives, a single 120 GB or 240 GB solid-state disk (SSD) data-logging drive, a single 400 GB NVMe or a 400GB or 800 GB SAS SSD write-log drive, and six to twenty-three 960 GB or 3.8 terabyte (TB) SATA SSD drives for storage capacity. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are also replaced with either 800 GB, 960 GB or 3.8 TB SED SSDs. A minimum of three nodes and a maximum of sixteen nodes can be configured in one HX all-flash cluster.

**11. HXAF240c-M4SX Node**

Note: In M4 generation server all-flash configurations, either a 400 GB or 800 GB caching SAS SSD may be chosen. This option is provided to allow flexibility in ordering based on product availability, pricing and lead times. There is no performance, capacity, or scalability benefit in choosing the larger disk.

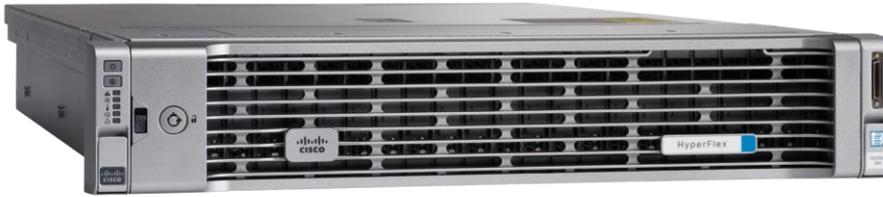
**Cisco HyperFlex HX220c-M4S Hybrid Node**

This small footprint Cisco HyperFlex hybrid model contains six 1.8 terabyte (TB) or 1.2 TB SAS HDD drives that contribute to cluster storage capacity, a 120 GB or 240 GB SSD housekeeping drive, a 480 GB SAS SSD caching drive, and two Cisco Flexible Flash (FlexFlash) Secure Digital (SD) cards that act as boot drives. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are replaced with 1.2TB SAS SED HDDs. A minimum of three nodes and a maximum of eight nodes can be configured in one HX hybrid cluster.

**12. HX220c-M4S Node****Cisco HyperFlex HX240c-M4SX Hybrid Node**

This capacity optimized Cisco HyperFlex hybrid model contains a minimum of six and up to twenty-three 1.8 TB or 1.2 TB SAS HDD drives that contribute to cluster storage, a single 120 GB or 240 GB SSD housekeeping drive, a single 1.6 TB SAS SSD caching drive, and two FlexFlash SD cards that act as the boot drives. For configurations requiring self-encrypting drives, the caching SSD is replaced with a 1.6 TB SAS SED SSD, and the capacity disks are replaced with 1.2TB SAS SED HDDs. A minimum of three nodes and a maximum of eight nodes can be configured in one HX hybrid cluster.

### 13. HX240c-M4SX Node



Note: In all M4 generation server configurations, either a 120 GB or 240 GB housekeeping disk may be chosen. This option is provided to allow flexibility in ordering based on product availability, pricing and lead times. There is no performance, capacity or scalability benefit in choosing the larger disk.

### Cisco VIC 1227 and 1387 MLOM Interface Cards

The Cisco UCS Virtual Interface Card (VIC) 1227 is a dual-port Enhanced Small Form-Factor Pluggable (SFP+) 10-Gbps Ethernet and Fibre Channel over Ethernet (FCoE)-capable PCI Express (PCIe) modular LAN-on-motherboard (mLOM) adapter installed in the Cisco UCS HX-Series Rack Servers. The VIC 1227 is used in conjunction with the Cisco UCS 6248UP or 6296UP model Fabric Interconnects.

The Cisco UCS VIC 1387 Card is a dual-port Enhanced Quad Small Form-Factor Pluggable (QSFP+) 40-Gbps Ethernet and Fibre Channel over Ethernet (FCoE)-capable PCI Express (PCIe) modular LAN-on-motherboard (mLOM) adapter installed in the Cisco UCS HX-Series Rack Servers. The VIC 1387 is used in conjunction with the Cisco UCS 6332 or 6332-16UP model Fabric Interconnects.

The mLOM slot can be used to install a Cisco VIC without consuming a PCIe slot, which provides greater I/O expandability. It incorporates next-generation converged network adapter (CNA) technology from Cisco, providing investment protection for future feature releases. The card enables a policy-based, stateless, agile server infrastructure that can present up to 256 PCIe standards-compliant interfaces to the host, each dynamically configured as either a network interface card (NICs) or host bus adapter (HBA). The personality of the interfaces is set programmatically using the service profile associated with the server. The number, type (NIC or HBA), identity (MAC address and World Wide Name [WWN]), failover policy, adapter settings, bandwidth, and quality-of-service (QoS) policies of the PCIe interfaces are all specified using the service profile.

### 14. Cisco VIC 1227 mLOM Card



## 15. Cisco VIC 1387 mLOM Card



**Note:** Hardware revision V03 or later of the Cisco VIC 1387 card is required for the Cisco HyperFlex HX-series servers.

## Cisco HyperFlex Compute-Only Nodes

HyperFlex 2.6 expands the number of options available for using standard model Cisco UCS Rack-Mount and Blade Servers as compute-only nodes. All current model Cisco UCS M<sub>4</sub> and M<sub>5</sub> generation servers, except the C880 M<sub>4</sub>, may be used as compute-only nodes connected to a Cisco HyperFlex cluster, along with a limited number of previous M<sub>3</sub> generation servers. Any valid CPU and memory configuration is allowed in the compute-only nodes, and the servers can be configured to boot from SAN, local disks, or internal SD cards. The following servers may be used as compute-only nodes:

- Cisco UCS B200 M<sub>3</sub> Blade Server
- Cisco UCS B200 M<sub>4</sub> Blade Server
- Cisco UCS B200 M<sub>5</sub> Blade Server
- Cisco UCS B260 M<sub>4</sub> Blade Server
- Cisco UCS B420 M<sub>4</sub> Blade Server
- Cisco UCS B460 M<sub>4</sub> Blade Server
- Cisco UCS B480 M<sub>5</sub> Blade Server
- Cisco UCS C220 M<sub>3</sub> Rack-Mount Servers
- Cisco UCS C220 M<sub>4</sub> Rack-Mount Servers
- Cisco UCS C220 M<sub>5</sub> Rack-Mount Servers
- Cisco UCS C240 M<sub>3</sub> Rack-Mount Servers
- Cisco UCS C240 M<sub>4</sub> Rack-Mount Servers
- Cisco UCS C240 M<sub>5</sub> Rack-Mount Servers
- Cisco UCS C460 M<sub>4</sub> Rack-Mount Servers
- Cisco UCS C480 M<sub>5</sub> Rack-Mount Servers

## Cisco HyperFlex Data Platform Software

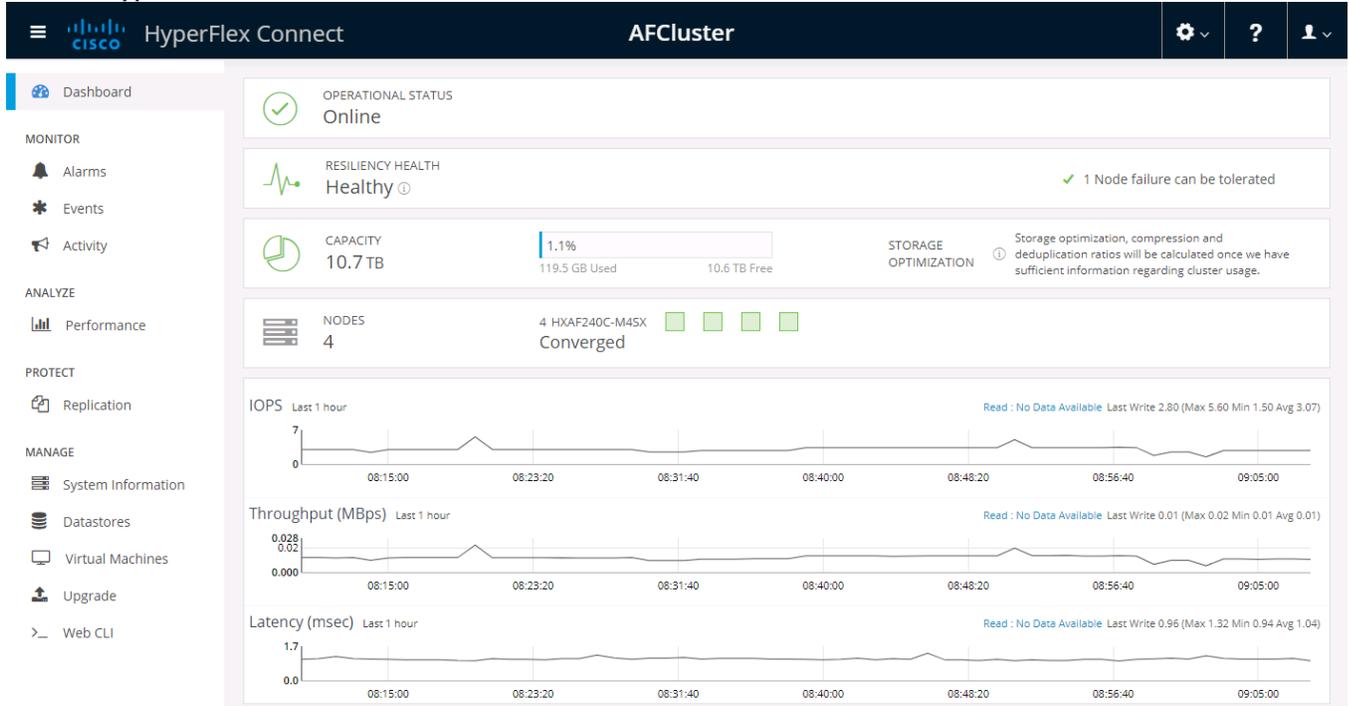
The Cisco HyperFlex HX Data Platform is a purpose-built, high-performance, distributed file system with a wide array of enterprise-class data management services. The data platform's innovations redefine distributed storage technology, exceeding the boundaries of first-generation hyperconverged infrastructures. The data platform has all the features expected in an enterprise shared storage system, eliminating the need to configure and maintain complex Fibre Channel storage networks and devices. The platform simplifies operations and helps ensure data availability. Enterprise-class storage features include the following:

- **Data protection** creates multiple copies of the data across the cluster so that data availability is not affected if a single or multiple components fail (depending on the replication factor configured).
- **Deduplication** is always on, helping reduce storage requirements in virtualization clusters in which multiple operating system instances in guest virtual machines result in large amounts of replicated data.
- **Compression** further reduces storage requirements, reducing costs, and the log-structured file system is designed to store variable-sized blocks, reducing internal fragmentation.
- **Replication** copies virtual machine level snapshots from one Cisco HyperFlex cluster to another, to facilitate recovery from a cluster or site failure, via a failover to the secondary site of all VMs.
- **Encryption** stores all data on the caching and capacity disks in an encrypted format, to prevent accidental data loss or data theft. Key management can be done using local Cisco UCS Manager managed keys, or third-party Key Management Systems (KMS) via the Key Management Interoperability Protocol (KMIP).
- **Thin provisioning** allows large volumes to be created without requiring storage to support them until the need arises, simplifying data volume growth and making storage a “pay as you grow” proposition.
- **Fast, space-efficient clones** rapidly duplicate virtual storage volumes so that virtual machines can be cloned simply through metadata operations, with actual data copied only for write operations.
- **Snapshots** help facilitate backup and remote-replication operations, which are needed in enterprises that require always-on data availability.

## Cisco HyperFlex Connect HTML5 Management Web Page

An all-new HTML 5 based Web UI is available for use as the primary management tool for Cisco HyperFlex. Through this centralized point of control for the cluster, administrators can create volumes, monitor the data platform health, and manage resource use. Administrators can also use this data to predict when the cluster will need to be scaled. To use the HyperFlex Connect UI, connect using a web browser to the HyperFlex cluster IP address: <http://<hx controller cluster ip>>.

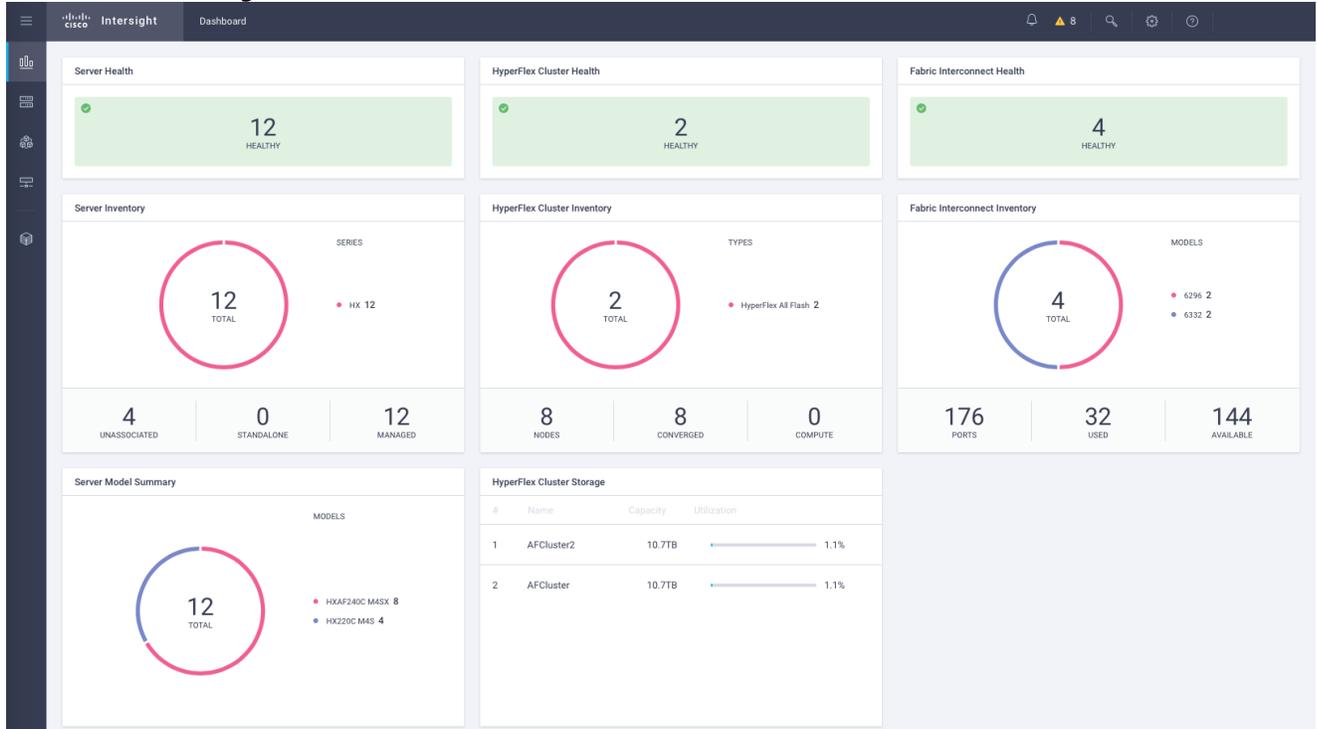
## 16. HyperFlex Connect GUI



## Cisco Intersight Cloud Based Management

Cisco Intersight (<https://intersight.com>), previously known as Starship, is the latest visionary cloud-based management tool, designed to provide a centralized off-site management, monitoring and reporting tool for all of your Cisco UCS based solutions. In the initial release of Cisco Intersight, monitoring and reporting is enabled against Cisco HyperFlex clusters. The Cisco Intersight website and framework can be upgraded with new and enhanced features independently of the products that are managed, meaning that many new features and capabilities can come with no downtime or upgrades required by the end users. Future releases of Cisco HyperFlex will enable further functionality along with these upgrades to the Cisco Intersight framework. This unique combination of embedded and online technologies will result in a complete cloud-based management solution that can care for Cisco HyperFlex throughout the entire lifecycle, from deployment through retirement.

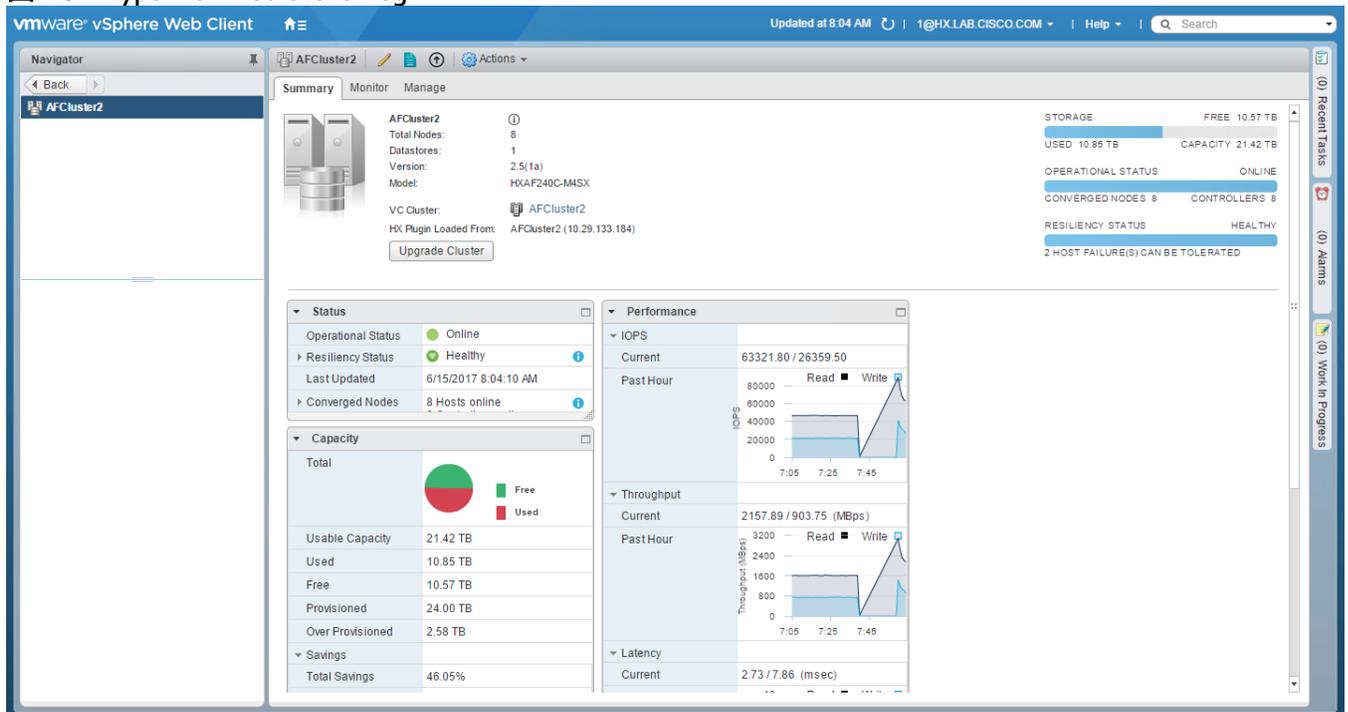
## 17. Cisco Intersight



## Cisco HyperFlex HX Data Platform Administration Plug-in

The Cisco HyperFlex HX Data Platform is also administered secondarily through a VMware vSphere web client plug-in.

## 18. HyperFlex Web Client Plugin



## Cisco HyperFlex HX Data Platform Controller

A Cisco HyperFlex HX Data Platform controller resides on each node and implements the distributed file system. The controller runs as software in user space within a virtual machine, and intercepts and handles all I/O from the guest virtual machines. The Storage Controller Virtual Machine (SCVM) uses the VMDirectPath I/O feature to provide PCI passthrough control of the physical server's SAS disk controller. This method gives the controller VM full control of the physical disk resources, utilizing the SSD drives as a read/write caching layer, and the HDDs or SDDs as a capacity layer for distributed storage. The controller integrates the data platform into the VMware vSphere cluster through the use of three preinstalled VMware ESXi vSphere Installation Bundles (VIBs) on each node:

- **IO Visor:** This VIB provides a network file system (NFS) mount point so that the ESXi hypervisor can access the virtual disks that are attached to individual virtual machines. From the hypervisor's perspective, it is simply attached to a network file system. The IO Visor intercepts guest VM IO traffic, and intelligently redirects it to the HyperFlex SCVMs.
- **VMware API for Array Integration (VAAI):** This storage offload API allows vSphere to request advanced file system operations such as snapshots and cloning. The controller implements these operations via manipulation of the filesystem metadata rather than actual data copying, providing rapid response, and thus rapid deployment of new environments.
- **stHypervisorSvc:** This VIB adds enhancements and features needed for HyperFlex data protection and VM replication.

## Data Operations and Distribution

The Cisco HyperFlex HX Data Platform controllers handle all read and write operation requests from the guest VMs to their virtual disks (VMDK) stored in the distributed datastores in the cluster. The data platform distributes the data across multiple nodes of the cluster, and also across multiple capacity disks of each node, according to the replication level policy selected during the cluster setup. This method avoids storage hotspots on specific nodes, and on specific disks of the nodes, and thereby also avoids networking hotspots or congestion from accessing more data on some nodes versus others.

### Replication Factor

The policy for the number of duplicate copies of each storage block is chosen during cluster setup, and is referred to as the replication factor (RF).

- **Replication Factor 3:** For every I/O write committed to the storage layer, 2 additional copies of the blocks written will be created and stored in separate locations, for a total of 3 copies of the blocks. Blocks are distributed in such a way as to ensure multiple copies of the blocks are not stored on the same disks, nor on the same nodes of the cluster. This setting can tolerate simultaneous failures of 2 entire nodes in a cluster of 5 nodes or greater, without losing data and resorting to restore from backup or other recovery processes. RF3 is recommended for all production systems.
- **Replication Factor 2:** For every I/O write committed to the storage layer, 1 additional copy of the blocks written will be created and stored in separate locations, for a total of 2 copies of the blocks. Blocks are distributed in such a way as to ensure multiple copies of the blocks are not stored on the same disks, nor on the same nodes of the cluster. This setting can tolerate a failure of 1 entire node without losing data and resorting to restore from backup or other recovery processes. RF2 is suitable for non-production systems, or environments where the extra data protection is not needed.

### Data Write and Compression Operations

Internally, the contents of each virtual disk are subdivided and spread across multiple servers by the HXDP software. For each write operation, the data is intercepted by the IO Visor module on the node where the VM is running, a primary node is determined for that particular operation via a hashing algorithm, and then sent to the primary node via the network. The primary node compresses the data in real time, writes the compressed data to its caching SSD, and replica copies of that compressed data are written to the caching SSD of the remote nodes in the cluster, according to the replication factor setting. For example, at RF=3 a write will be written to the primary node for that virtual disk address, and two additional

writes will be committed in parallel on two other nodes. Because the virtual disk contents have been divided and spread out via the hashing algorithm, this method results in all writes being spread across all nodes, avoiding the problems with data locality and “noisy” VMs consuming all the IO capacity of a single node. The write operation will not be acknowledged until all three copies are written to the caching layer SSDs. Written data is also cached in a write log area resident in memory in the controller VM, along with the write log on the caching SSDs. This process speeds up read requests when reads are requested of data that has recently been written.

### Data Destaging and Deduplication

The Cisco HyperFlex HX Data Platform constructs multiple write caching segments on the caching SSDs of each node in the distributed cluster. As write cache segments become full, and based on policies accounting for I/O load and access patterns, those write cache segments are locked and new writes roll over to a new write cache segment. The data in the now locked cache segment is destaged to the HDD capacity layer of the nodes for the Hybrid system or to the SDD capacity layer of the nodes for the All-Flash system. During the destaging process, data is deduplicated before being written to the capacity storage layer, and the resulting data can now be written to the HDDs or SDDs of the server. On hybrid systems, the now deduplicated and compressed data is also written to the dedicated read cache area of the caching SSD, which speeds up read requests of data that has recently been written. When the data is destaged to a HDD, it is written in a single sequential operation, avoiding disk head seek thrashing on the spinning disks and accomplishing the task in the minimal amount of time. Since the data is already deduplicated and compressed before being written, the platform avoids additional I/O overhead often seen on competing systems, which must later do a read/dedupe/compress/write cycle. Deduplication, compression and destaging take place with no delays or I/O penalties to the guest VMs making requests to read or write data, which benefits both the HDD and SDD configurations.



- In an All-Flash configuration, the data platform provides a dedicated caching layer using high endurance SSDs to accelerate write responses, and it implements a storage capacity layer also using SSDs. Read requests are fulfilled directly from the capacity SSDs, as a dedicated read cache is not needed to accelerate read operations.

## Solution Design

### Requirements

The following sections detail the physical hardware, software revisions, and firmware versions required to install the Cisco HyperFlex system. Maximum cluster size of 32 nodes can be obtained by combining 16 converged nodes (storage nodes), and 16 compute-only nodes (all-flash only, hybrid cluster maximum size is 8 converged nodes, plus 8 compute-only nodes).

### Physical Components

**Table 1 HyperFlex System Components**

Component	Hardware Required
Fabric Interconnects	Two Cisco UCS 6248UP Fabric Interconnects, or Two Cisco UCS 6296UP Fabric Interconnects, or Two Cisco UCS 6332 Fabric Interconnects, or Two Cisco UCS 6332-16UP Fabric Interconnects
Servers	Three to Sixteen Cisco HyperFlex HXAF220c-M5SX All-Flash rack servers, or Three to Sixteen Cisco HyperFlex HXAF240c-M5SX All-Flash rack servers, or Three to Eight Cisco HyperFlex HX220c-M5SX Hybrid rack servers, or Three to Eight Cisco HyperFlex HX240c-M5SX Hybrid rack servers, or Three to Sixteen Cisco HyperFlex HXAF220c-M4S All-Flash rack servers, or Three to Sixteen Cisco HyperFlex HXAF240c-M4SX All-Flash rack servers, or Three to Eight Cisco HyperFlex HX220c-M4S Hybrid rack servers, or Three to Eight Cisco HyperFlex HX240c-M4SX Hybrid rack servers

For complete server specifications and more information, please refer to the links below:

Compare models:

<http://www.cisco.com/c/en/us/products/hyperconverged-infrastructure/hyperflex-hx-series/index.html#compare-models>

HXAF220c-M5SX Spec Sheet:

<https://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/hxaf-220c-m5-specsheet.pdf>

HXAF240c-M5SX Spec Sheet:

<https://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/hxaf-240c-m5-specsheet.pdf>

HX220c-M5SX Spec Sheet:

<https://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/hx-220c-m5-specsheet.pdf>

HX240c-M5SX Spec Sheet:

<https://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/hx-240c-m5-specsheet.pdf>

HXAF220c-M4S Spec Sheet:

[http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/HXAF220c\\_M4\\_SpecSheet.pdf](http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/HXAF220c_M4_SpecSheet.pdf)

HXAF240c-M4S Spec Sheet:

[http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/HXAF240c\\_M4\\_SpecSheet.pdf](http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/HXAF240c_M4_SpecSheet.pdf)

HX220c-M4S Spec Sheet:

<http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/datasheet-c78-736817.pdf>

HX240c-M4SX Spec Sheet:

<http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/datasheet-c78-736818.pdf>

Table 2 lists the hardware component options for the HXAF220c-M5SX server model:

**Table 2 HXAF220c-M5SX Server Options**

HXAF220c-M5SX options		Hardware Required
Processors		Chose a matching pair of Intel Xeon Processor Scalable Family CPUs
Memory		192 GB to 3 TB of total memory using 16 GB, 32 GB, 64 GB, or 128 GB DDR4 2666 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 400 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 1.6 TB</li> </ul>

HXAF220c-M5SX options		Hardware Required
		2.5 Inch Enterprise Performance NVMe SSD <ul style="list-style-type: none"> <li>Six to eight 3.8 TB 2.5 Inch Enterprise Value 6G SATA SSDs, or Six to eight 960 GB 2.5 Inch Enterprise Value 6G SATA SSDs</li> </ul>
	SED	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSD</li> <li>Six to eight 3.8 TB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or Six to eight 960 GB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or six to eight 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs</li> </ul>
Network		Cisco UCS VIC1387 VIC MLOM
Boot Device		One 240 GB M.2 form factor SATA SSD
microSD Card		One 32GB microSD card for local host utilities storage
Optional		Cisco QSA module to convert 40 GbE QSFP+ to 10 GbE SFP+

Table 3 lists the hardware component options for the HXAF240c-M5SX server model:

**Table 3 HXAF240c-M5SX Server Options**

HXAF240c-M5SX Options		Hardware Required
Processors		Chose a matching pair of Intel Xeon Processor Scalable Family CPUs
Memory		192 GB to 3 TB of total memory using 16 GB, 32 GB, 64 GB, or 128 GB DDR4 2666 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSD	Standard	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 400 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 1.6 TB 2.5 Inch Enterprise Performance NVMe SSD</li> <li>Six to twenty-three 3.8 TB 2.5 Inch Enterprise Value 6G SATA SSDs, or Six to twenty-three 960 GB 2.5 Inch Enterprise Value 6G SATA SSDs</li> </ul>

HXAF240c-M5SX Options		Hardware Required
	SED	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSD</li> <li>Six to twenty-three 3.8 TB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or Six to twenty-three 960 GB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or six to twenty-three 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs</li> </ul>
Network		Cisco UCS VIC1387 VIC MLOM
Boot Device		One 240 GB M.2 form factor SATA SSD
microSD Card		One 32GB microSD card for local host utilities storage
Optional		Cisco QSA module to convert 40 GbE QSFP+ to 10 GbE SFP+

Table 4 lists the hardware component options for the HX220c-M5SX server model:

**Table 4 HX220c-M5SX Server Options**

HX220c-M5SX Options		Hardware Required
Processors		Chose a matching pair of Intel Xeon Processor Scalable Family CPUs
Memory		192 GB to 3 TB of total memory using 16 GB, 32 GB, 64 GB, or 128 GB DDR4 2666 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 480 GB 2.5 Inch Enterprise Performance 6G SATA SSD, or One 800 GB 2.5 Inch Enterprise Performance 12G SAS SSD</li> </ul>
	SED	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSD</li> </ul>
HDDs	Standard	Six to eight 1.8 TB or 1.2 TB SAS 12Gbps 10K rpm SFF HDD
	SED	Six to eight 1.2 TB SAS 12Gbps 10K rpm SFF SED HDD

HX220c-M5SX Options	Hardware Required
Network	Cisco UCS VIC1387 VIC MLOM
Boot Device	One 240 GB M.2 form factor SATA SSD
microSD Card	One 32GB microSD card for local host utilities storage
Optional	Cisco QSA module to convert 40 GbE QSFP+ to 10 GbE SFP+

Table 5 lists the hardware component options for the HX240c-M5SX server model:

**Table 5 HX240c-M5SX Server Options**

HX240c-M5SX Options		Hardware Required
Processors		Chose a matching pair of Intel Xeon Processor Scalable Family CPUs
Memory		192 GB to 3 TB of total memory using 16 GB, 32 GB, 64 GB, or 128 GB DDR4 2666 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 1.6 TB 2.5 Inch Enterprise Performance 12G SAS SSD</li> </ul>
	SED	<ul style="list-style-type: none"> <li>One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 1.6 TB 2.5 Inch Enterprise Performance 12G SAS SED SSD</li> </ul>
HDDs	Standard	Six to twenty-three 1.8 TB or 1.2 TB SAS 12Gbps 10K rpm SFF HDD
	SED	Six to twenty-three 1.2 TB SAS 12Gbps 10K rpm SFF SED HDD
Network		Cisco UCS VIC1387 VIC MLOM
Boot Device		One 240 GB M.2 form factor SATA SSD
microSD Card		One 32GB microSD card for local host utilities storage
Optional		Cisco QSA module to convert 40 GbE QSFP+ to 10 GbE SFP+

Table 6 lists the hardware component options for the HXAF220c-M4S server model:

**Table 6 HXAF220c-M4S Server Options**

HXAF220c-M4S options		Hardware Required
Processors		Chose a matching pair of Intel E5-2600 v4 CPUs
Memory		128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 400 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 800 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 400 GB 2.5 Inch Enterprise Performance NVMe SSD</li> <li>Six 3.8 TB 2.5 Inch Enterprise Value 6G SATA SSDs, or Six 960 GB 2.5 Inch Enterprise Value 6G SATA SSDs</li> </ul>
	SED	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs</li> <li>Six 3.8 TB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or Six 960 GB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or Six 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs</li> </ul>
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM
Boot Devices		Two 64GB Cisco FlexFlash SD Cards for UCS Servers

Table 7 lists the hardware component options for the HXAF240c-M4SX server model:

**Table 7 HXAF240c-M4SX Server Options**

HXAF240c-M4SX Options		Hardware Required
Processors		Chose a matching pair of Intel E5-2600 v4 CPUs
Memory		128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules

HXAF240c-M4SX Options		Hardware Required
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSD	Standard	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in the rear disk enclosure)</li> <li>One 400 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 800 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 400 GB 2.5 Inch Enterprise Performance NVMe SSD</li> <li>Six to Twenty-three 3.8 TB 2.5 Inch Enterprise Value 6G SATA SSDs, or Six to Twenty-three 960 GB 2.5 Inch Enterprise Value 6G SATA SSDs</li> </ul>
	SED	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in a front disk bay)</li> <li>One 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs</li> <li>Six to Twenty-two 3.8 TB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or Six to Twenty-two 960 GB 2.5 Inch Enterprise Value 6G SATA SED SSDs, or Six to Twenty-two 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs</li> </ul>
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM
Boot Devices		Two 64GB Cisco FlexFlash SD Cards for UCS Servers

Table 8 lists the hardware component options for the HX220c-M4S server model:

**Table 8 HX220c-M4S Server Options**

HX220c-M4S Options		Hardware Required
Processors		Chose a matching pair of Intel E5-2600 v4 CPUs
Memory		128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 480 GB 2.5 Inch Enterprise Performance 6G SATA SSD</li> </ul>

HX220c-M4S Options		Hardware Required
	SED	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD</li> <li>One 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs</li> </ul>
HDDs	Standard	Six 1.8 TB or 1.2 TB SAS 12Gbps 10K rpm SFF HDD
	SED	Six 1.2 TB SAS 12Gbps 10K rpm SFF SED HDD
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM
Boot Devices		Two 64GB Cisco FlexFlash SD Cards for Cisco UCS Servers

Table 9 lists the hardware component options for the HX240c-M4SX server model:

**Table 9 HX240c-M4SX Server Options**

HX240c-M4SX Options		Hardware Required
Processors		Chose a matching pair of Intel E5-2600 v4 CPUs
Memory		128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in the rear disk enclosure)</li> <li>One 1.6 TB 2.5 Inch Enterprise Performance 6G SATA SSD</li> </ul>
	SED	<ul style="list-style-type: none"> <li>One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in a front disk bay)</li> <li>One 1.6 TB 2.5 Inch Enterprise Performance 12G SAS SED SSD</li> </ul>
HDDs	Standard	Six to twenty-three 1.8 TB or 1.2 TB SAS 12Gbps 10K rpm SFF HDD
	SED	Six to twenty-two 1.2 TB SAS 12Gbps 10K rpm SFF SED HDD
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM

HX240c-M4SX Options	Hardware Required
Boot Devices	Two 64GB Cisco FlexFlash SD Cards for Cisco UCS Servers

## Software Components

Table 10 lists the software components and the versions required for the Cisco HyperFlex system:

**Table 10 Software Components**

Component	Software Required
Hypervisor	<p>VMware ESXi 6.0 U1b, 6.0 U2, 6.0 U2 Patch 3, 6.0 U2 Patch 4, 6.0 U3</p> <p>or</p> <p>VMware ESXi 6.5 Patch 1a, VMware 6.5 U1</p> <p>ESXi 6.5 U1 is recommended (CISCO Custom Image for ESXi 6.5 Update 1: HX-Vmware-ESXi-6.5U1-5969303-Cisco-Custom-6.5.1.1.iso)</p> <hr/> <p> <b>Note:</b> Use of a published Cisco custom ESXi ISO installer file is required when installing/reinstalling ESXi, or upgrading to a newer version prior to installing HyperFlex. An offline bundle file is also provided to upgrade ESXi on running clusters.</p> <hr/> <p> <b>Note:</b> VMware vSphere Standard, Essentials Plus, ROBO, Enterprise or Enterprise Plus licensing is required from VMware.</p>
Management Server	<p>VMware vCenter Server for Windows or vCenter Server Appliance 6.0 U1 or later.</p> <p>Refer to <a href="http://www.vmware.com/resources/compatibility/sim/interop_matrix.php">http://www.vmware.com/resources/compatibility/sim/interop_matrix.php</a> for interoperability of your ESXi version and vCenter Server.</p> <hr/> <p> <b>Note:</b> Using ESXi 6.5 on the HyperFlex nodes also requires using vCenter Server 6.5.</p>
Cisco HyperFlex HX Data Platform	Cisco HyperFlex HX Data Platform Software 2.6.1b
Cisco UCS Firmware	<p>Cisco UCS Infrastructure software, B-Series and C-Series bundles, revision 3.2(2d) or later.</p> <hr/> <p> <b>Note:</b> Cisco UCS Firmware 3.2(2d) is the minimum version required for any cluster containing Cisco HX-series M5 generation servers.</p>

	For UCS domains that have only Cisco HX-series M4 generation servers, Cisco UCS Firmware 3.1(3c) or later is required.
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## Considerations

### Version Control

The software revisions listed in Table 10 are the only valid and supported configuration at the time of the publishing of this validated design. Special care must be taken not to alter the revision of the hypervisor, vCenter server, Cisco HX platform software, or the Cisco UCS firmware without first consulting the appropriate release notes and compatibility matrixes to ensure that the system is not being modified into an unsupported configuration.

### vCenter Server

The vCenter Server must be installed and operational prior to the installation of the Cisco HyperFlex HX Data Platform software. The following best practice guidance applies to installations of HyperFlex 2.5:

- Do not modify the default TCP port settings of the vCenter installation. Using non-standard ports can lead to failures during the installation.
- It is recommended to build the vCenter server on a physical server or in a virtual environment outside of the HyperFlex cluster. Building the vCenter server as a virtual machine inside the HyperFlex cluster environment is highly discouraged. There is a tech note for multiple methods of deployment if no external vCenter server is already available:

[http://www.cisco.com/c/en/us/td/docs/hyperconverged\\_systems/HyperFlex\\_HX\\_DataPlatformSoftware/TechNotes/Nested\\_vcenter\\_on\\_hyperflex.html](http://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HyperFlex_HX_DataPlatformSoftware/TechNotes/Nested_vcenter_on_hyperflex.html)



Note: This document does not cover the installation and configuration of VMware vCenter Server for Windows, or the vCenter Server Appliance.

### Scale

Cisco HyperFlex clusters currently scale up from a minimum of 3 to a maximum of 16 converged nodes per all-flash cluster, i.e. 16 nodes providing storage resources to the HX Distributed Filesystem. For clusters with HX hybrid nodes, the limit is 8 converged nodes. For the compute intensive “extended” cluster design, a configuration with 3-16 Cisco HX-series all-flash converged nodes can be combined with up to 16 compute nodes. Since the quantity of compute-only nodes cannot exceed the quantity of converged nodes, in clusters with hybrid HX converged servers, the maximum number of compute-only nodes is 8. Cisco blade servers and rack-mount servers can be used for the compute only nodes. It is required that the number of compute-only nodes should always be less than or equal to number of converged nodes.

Once the maximum size of a cluster has been reached, the environment can be “scaled out” by adding additional HX model servers to the Cisco UCS domain, installing an additional HyperFlex cluster on them, and controlling them via the same vCenter server. A maximum of 8 clusters can be created in a single UCS domain, and up to 100 HyperFlex clusters can be managed by a single vCenter server.

### Capacity

Overall usable cluster capacity is based on a number of factors. The number of nodes in the cluster must be considered, plus the number and size of the capacity layer disks. Caching disk sizes are not calculated as part of the cluster capacity. The replication factor of the HyperFlex HX Data Platform also affects the cluster capacity as it defines the number of copies of each block of data written.

Disk drive manufacturers have adopted a size reporting methodology using calculation by powers of 10, also known as decimal prefix. As an example, a 120 GB disk is listed with a minimum of  $120 \times 10^9$  bytes of usable addressable capacity, or 120 billion bytes. However, many operating systems and filesystems report their space based on standard computer binary exponentiation, or calculation by powers of 2, also called binary prefix. In this example,  $2^{10}$  or 1024 bytes make up a kilobyte,  $2^{10}$  kilobytes make up a megabyte,  $2^{10}$  megabytes make up a gigabyte, and  $2^{10}$  gigabytes make up a terabyte. As the values increase, the disparity between the two systems of measurement and notation get worse, at the terabyte level, the deviation between a decimal prefix value and a binary prefix value is nearly 10 percent.

The International System of Units (SI) defines values and decimal prefix by powers of 10 as follows:

**Table 11 SI Unit Values (Decimal Prefix)**

Value	Symbol	Name
1000 bytes	kB	Kilobyte
1000 kB	MB	Megabyte
1000 MB	GB	Gigabyte
1000 GB	TB	Terabyte

The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) defines values and binary prefix by powers of 2 in ISO/IEC 80000-13:2008 Clause 4 as follows:

**Table 12 IEC unit values (binary prefix)**

Value	Symbol	Name
1024 bytes	KiB	Kibibyte
1024 KiB	MiB	Mebibyte
1024 MiB	GiB	Gibibyte
1024 GiB	TiB	Tebibyte

For the purpose of this document, the decimal prefix numbers are used only for raw disk capacity as listed by the respective manufacturers. For all calculations where raw or usable capacities are shown from the perspective of the HyperFlex software, filesystems or operating systems, the binary prefix numbers are used. This is done primarily to show a consistent set of values as seen by the end user from within the HyperFlex vCenter Web Plugin and HyperFlex Connect GUI when viewing cluster capacity, allocation and consumption, and also within most operating systems.

Table 13 lists a set of HyperFlex HX Data Platform cluster usable capacity values, using binary prefix, for an array of cluster configurations. These values are useful for determining the appropriate size of HX cluster to initially purchase, and how much capacity can be gained by adding capacity disks. The calculations for these values are listed in [Appendix A: Cluster Capacity Calculations](#). The HyperFlex tool to help with sizing is listed in [Appendix B: HyperFlex Sizer](#).

**Table 13 Cluster Usable Capacities**

HX-Series Server Model	Node Quantity	Capacity Disk Size (each)	Capacity Disk Quantity (per node)	Cluster Usable Capacity at RF=2	Cluster Usable Capacity at RF=3
HXAF220c-M4S	8	3.8 TB	6	77.1 TiB	51.4 TiB
		960 GB	6	19.3 TiB	12.9 TiB
		800 GB	6	16.1 TiB	10.7 TiB
HXAF240c-M4SX	8	3.8 TB	6	77.1 TiB	51.4 TiB
			15	192.8 TiB	128.5 TiB
			23	295.7 TiB	197.1 TiB
		960 GB	6	19.3 TiB	12.9 TiB
			15	48.2 TiB	32.1 TiB
			23	73.9 TiB	49.3 TiB
		800 GB	6	16.1 TiB	10.7 TiB
			15	40.2 TiB	26.8 TiB
			22	58.9 TiB	39.3 TiB
HX220c-M4S	8	1.2 TB	6	24.1 TiB	16.1 TiB
		1.8 TB	6	36.2 TiB	24.1 TiB
HX240c-M4SX	8	1.2 TB	6	24.1 TiB	16.1 TiB
			15	60.2 TiB	40.2 TiB
			23	92.4 TiB	61.6 TiB
		1.8 TB	6	36.2 TiB	24.1 TiB
			15	90.4 TiB	60.2 TiB

HX-Series Server Model	Node Quantity	Capacity Disk Size (each)	Capacity Disk Quantity (per node)	Cluster Usable Capacity at RF=2	Cluster Usable Capacity at RF=3
			23	138.6 TiB	92.4 TiB



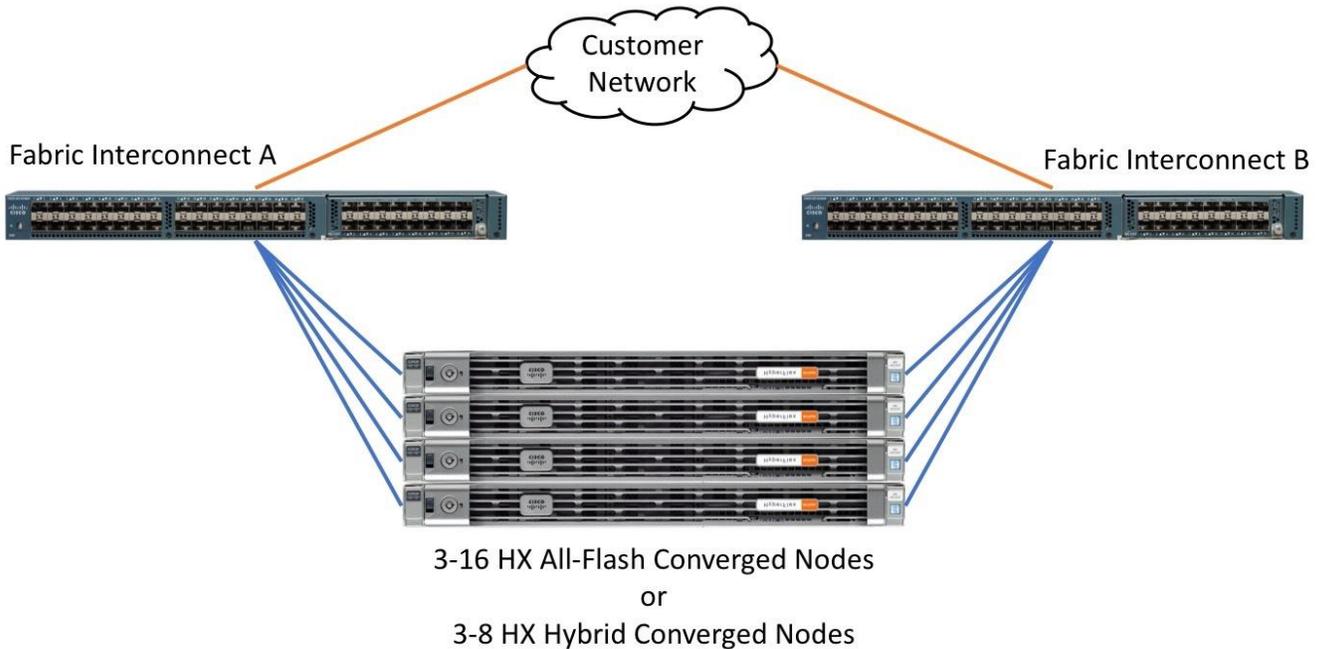
Note: Capacity calculations for M4 generation and M5 generation servers are identical.

## Physical Topology

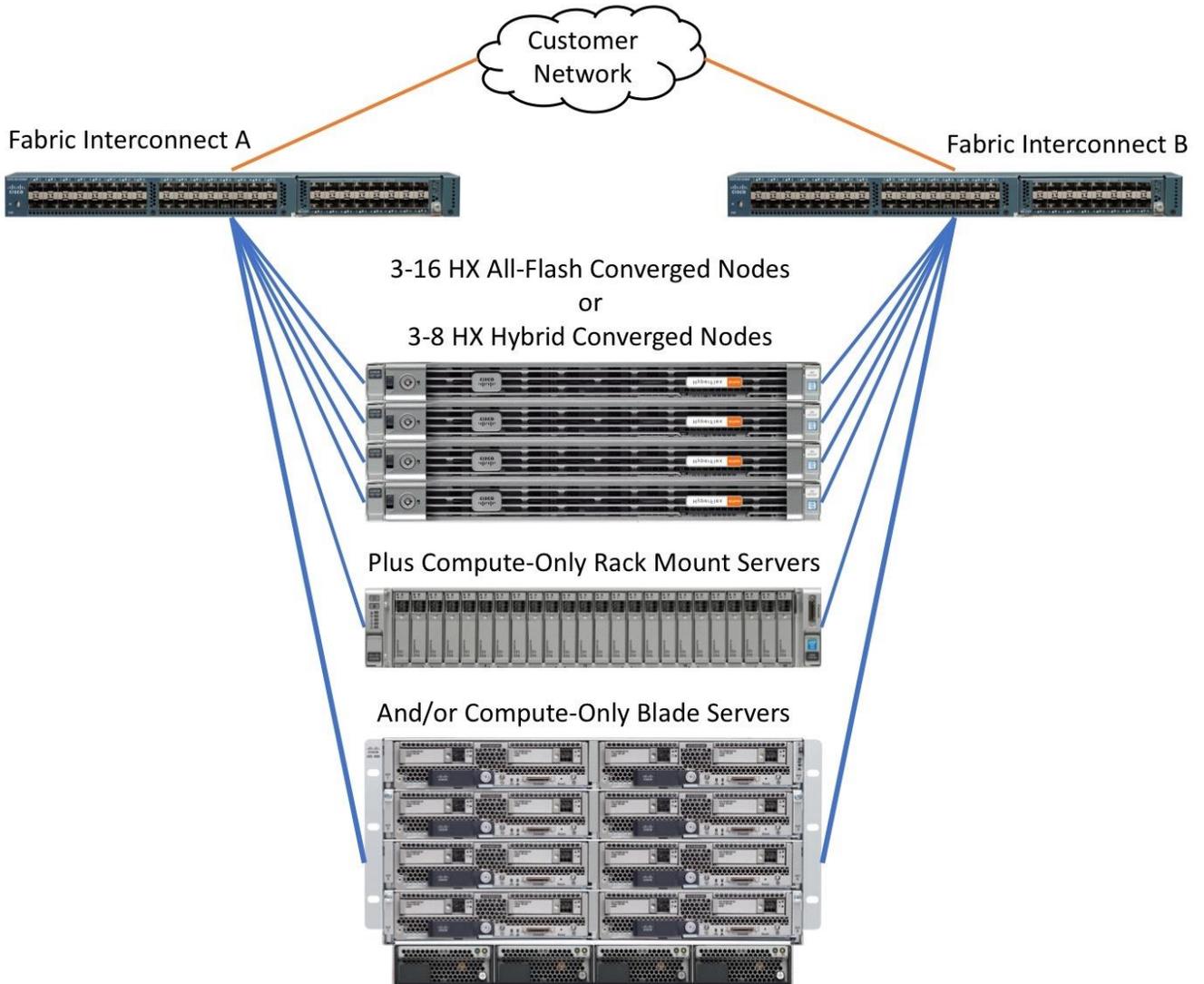
### Topology Overview

The Cisco HyperFlex system is composed of a pair of Cisco UCS Fabric Interconnects along with up to sixteen HX-Series rack-mount servers per cluster. Up to sixteen compute-only servers can also be added per HyperFlex cluster. Adding Cisco UCS rack-mount servers and/or Cisco UCS 5108 Blade chassis, which house Cisco UCS blade servers, allows for additional compute resources in an extended cluster design. Up to eight separate HX clusters can be installed under a single pair of Fabric Interconnects. The two Fabric Interconnects both connect to every HX-Series rack-mount server, and both connect to every Cisco UCS 5108 blade chassis, and Cisco UCS rack-mount server. Upstream network connections, also referred to as “northbound” network connections are made from the Fabric Interconnects to the customer datacenter network at the time of installation.

#### 20. HyperFlex Standard Cluster Topology



## 21. HyperFlex Extended Cluster Topology



### Fabric Interconnects

Fabric Interconnects (FI) are deployed in pairs, wherein the two units operate as a management cluster, while forming two separate network fabrics, referred to as the A side and B side fabrics. Therefore, many design elements will refer to FI A or FI B, alternatively called fabric A or fabric B. Both Fabric Interconnects are active at all times, passing data on both network fabrics for a redundant and highly available configuration. Management services, including Cisco UCS Manager, are also provided by the two FIs but in a clustered manner, where one FI is the primary, and one is secondary, with a roaming clustered IP address. This primary/secondary relationship is only for the management cluster, and has no effect on data transmission.

Fabric Interconnects have the following ports, which must be connected for proper management of the Cisco UCS domain:

- **Mgmt:** A 10/100/1000 Mbps port for managing the Fabric Interconnect and the Cisco UCS domain via GUI and CLI tools. This port is also used by remote KVM, IPMI and SoL sessions to the managed servers within the domain. This is typically connected to the customer management network.

- **L1:** A cross connect port for forming the Cisco UCS management cluster. This port is connected directly to the L1 port of the paired Fabric Interconnect using a standard CAT5 or CAT6 Ethernet cable with RJ45 plugs. It is not necessary to connect this to a switch or hub.
- **L2:** A cross connect port for forming the Cisco UCS management cluster. This port is connected directly to the L2 port of the paired Fabric Interconnect using a standard CAT5 or CAT6 Ethernet cable with RJ45 plugs. It is not necessary to connect this to a switch or hub.
- **Console:** An RJ45 serial port for direct console access to the Fabric Interconnect. This port is typically used during the initial FI setup process with the included serial to RJ45 adapter cable. This can also be plugged into a terminal aggregator or remote console server device.

## HX-Series Rack-Mount Servers

The HX-Series converged servers are connected directly to the Cisco UCS Fabric Interconnects in Direct Connect mode. This option enables Cisco UCS Manager to manage the HX-Series Rack-Mount Servers using a single cable for both management traffic and data traffic. All the Cisco HyperFlex M4 generation servers are configured with the Cisco VIC 1227 or Cisco VIC 1387 network interface card (NIC) installed in a modular LAN on motherboard (MLOM) slot, which has dual 10 Gigabit Ethernet (GbE) or 40 Gigabit Ethernet (GbE) ports. Cisco HyperFlex M5 generation servers can be configured only with the Cisco VIC 1387 card. The standard and redundant connection practice is to connect port 1 of the VIC card (the right-hand port) to a port on FI A, and port 2 of the VIC card (the left-hand port) to a port on FI B (Figure 22. ). The HyperFlex installer checks for this configuration, and that all servers' cabling matches. Failure to follow this cabling practice can lead to errors, discovery failures, and loss of redundant connectivity.

Various combinations of physical connectivity between the Cisco HX-series servers and the Fabric Interconnects are possible, but only specific combinations are supported. For example, use of the Cisco QSA module to convert a 40 GbE QSFP+ port into a 10 GbE SFP+ port is not allowed for use in M4 generation servers, but is allowed for M5 generation servers in order to configure a mixed cluster of M4 and M5 generation servers along with model 6248 or 6296 Fabric Interconnects. Table 14 lists the possible connections, and which of these methods is supported.

**Table 14 Supported Physical Connectivity**

Fabric Interconnect Model	6248	6296	6332		6332-16UP		
Port Type	10GbE	10GbE	40GbE	10GbE Breakout	40GbE	10GbE Breakout	10GbE onboard
M4 with VIC 1227	✓	✓	✗	✗	✗	✗	✗
M4 with VIC 1387	✗	✗	✓	✗	✓	✗	✗
M4 with VIC 1387 + QSA	✗	✗	✗	✗	✗	✗	✗
M5 with VIC 1387	✗	✗	✓	✗	✓	✗	✗
M5 with VIC 1387 + QSA	✓	✓	✗	✗	✗	✗	✗

### Figure 22. HX-Series Server Connectivity

Fabric Interconnect A



Fabric Interconnect B

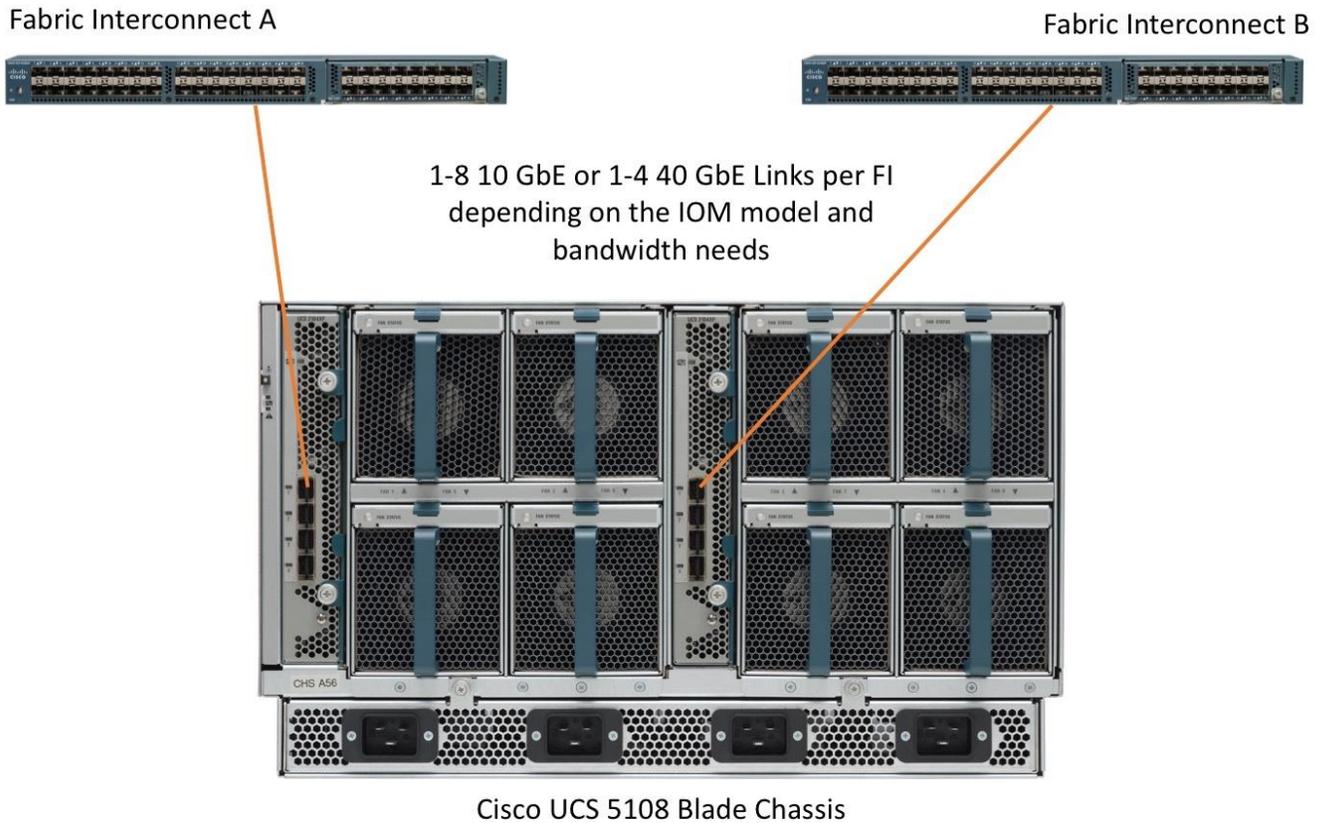


HyperFlex Converged Node

### Cisco UCS B-Series Blade Servers

HyperFlex extended clusters also incorporate 1-16 Cisco UCS blade servers for additional compute capacity. The blade chassis comes populated with 1-4 power supplies, and 8 modular cooling fans. In the rear of the chassis are two bays for installation of Cisco Fabric Extenders. The Fabric Extenders (also commonly called IO Modules, or IOMs) connect the chassis to the Fabric Interconnects. Internally, the Fabric Extenders connect to the Cisco VIC card installed in each blade server across the chassis backplane. The standard connection practice is to connect 1-8 10 GbE links, or 1-4 40 GbE links (depending on the IOMs and FIs purchased) from the left-side IOM, or IOM 1, to FI A, and to connect the same number of 10 GbE or 40 GbE links from the right-side IOM, or IOM 2, to FI B (Figure 23). All other cabling configurations are invalid, and can lead to errors, discovery failures, and loss of redundant connectivity.

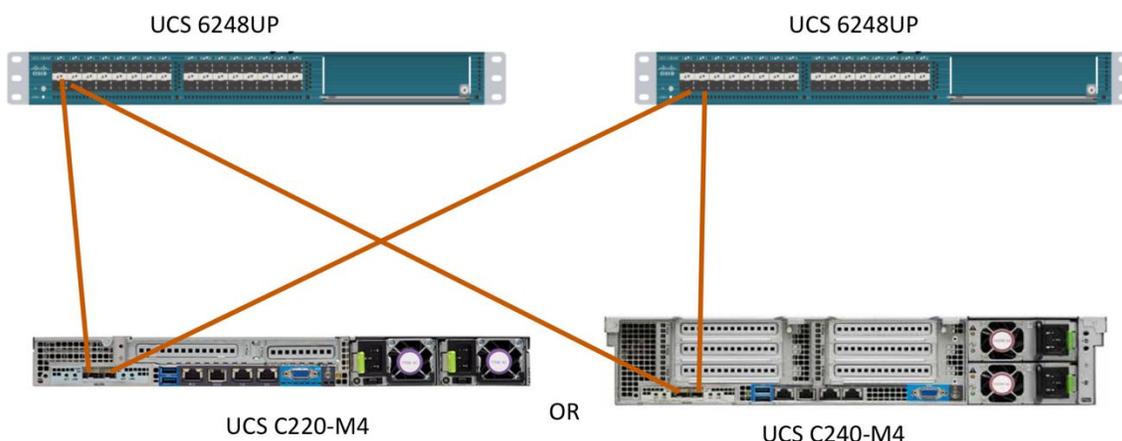
## 23. Cisco UCS 5108 Chassis Connectivity



### Cisco UCS C-Series Rack-Mount Servers

HyperFlex extended clusters also incorporate 1-16 Cisco UCS Rack-Mount Servers for additional compute capacity. The Cisco UCS C-Series Rack-Mount Servers are connected directly to the Cisco UCS Fabric Interconnects in Direct Connect mode. Internally the Cisco UCS C-Series servers are configured with the Cisco VIC 1227 or Cisco VIC 1387 network interface card (NIC) installed in a modular LAN on motherboard (MLOM) slot, which has dual 10 Gigabit Ethernet (GbE) ports or 40 Gigabit Ethernet (GbE) ports. The standard and redundant connection practice is to connect port 1 of the VIC card to a port on FI A, and port 2 of the VIC card to a port on FI B. Failure to follow this cabling practice can lead to errors, discovery failures, and loss of redundant connectivity.

## 24. Cisco UCS C-Series Server Connectivity



## Logical Topology

### Logical Network Design

The Cisco HyperFlex system has communication pathways that fall into four defined zones (25):

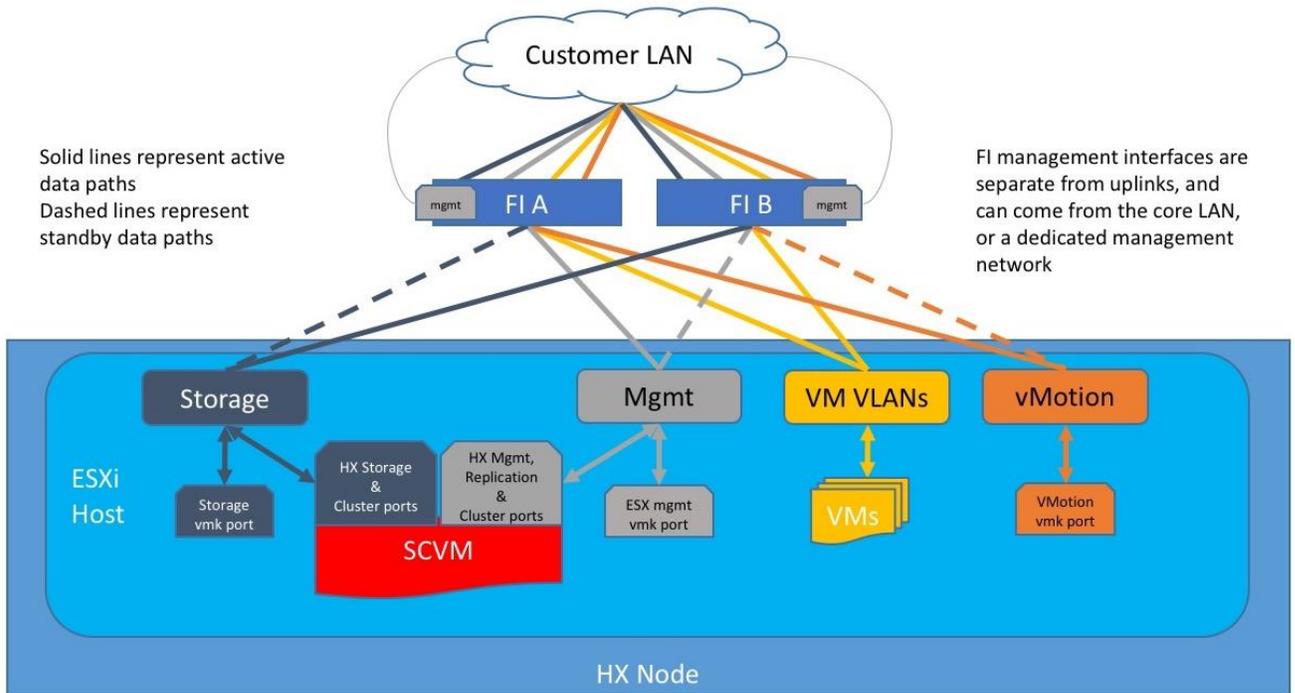
- **Management Zone:** This zone comprises the connections needed to manage the physical hardware, the hypervisor hosts, and the storage platform controller virtual machines (SCVM). These interfaces and IP addresses need to be available to all staff who will administer the HX system, throughout the LAN/WAN. This zone must provide access to Domain Name System (DNS) and Network Time Protocol (NTP) services, and allow Secure Shell (SSH) communication. In this zone are multiple physical and virtual components:
  - Fabric Interconnect management ports.
  - Cisco UCS external management interfaces used by the servers and blades, which answer via the FI management ports.
  - ESXi host management interfaces.
  - Storage Controller VM management interfaces.
  - A roaming HX cluster management interface.
  - Storage Controller VM replication interfaces.
  - A roaming HX cluster replication interface.
- **VM Zone:** This zone comprises the connections needed to service network IO to the guest VMs that will run inside the HyperFlex hyperconverged system. This zone typically contains multiple VLANs, that are trunked to the Cisco UCS Fabric Interconnects via the network uplinks, and tagged with 802.1Q VLAN IDs. These interfaces and IP addresses need to be available to all staff and other computer endpoints which need to communicate with the guest VMs in the HX system, throughout the LAN/WAN.
- **Storage Zone:** This zone comprises the connections used by the Cisco HX Data Platform software, ESXi hosts, and the storage controller VMs to service the HX Distributed Data Filesystem. These interfaces and IP addresses need to be able to communicate with each other at all times for proper operation. During normal operation, this traffic all occurs within the Cisco UCS domain, however there are hardware failure scenarios where this traffic would need to traverse the network northbound of the Cisco UCS domain. For that reason, the VLAN used for HX storage traffic

must be able to traverse the network uplinks from the Cisco UCS domain, reaching FI A from FI B, and vice-versa. This zone is primarily jumbo frame traffic therefore jumbo frames must be enabled on the Cisco UCS uplinks. In this zone are multiple components:

- A VMkernel interface used for storage traffic on each ESXi host in the HX cluster.
- Storage Controller VM storage interfaces.
- A roaming HX cluster storage interface.
- **VMotion Zone:** This zone comprises the connections used by the ESXi hosts to enable vMotion of the guest VMs from host to host. During normal operation, this traffic all occurs within the Cisco UCS domain, however there are hardware failure scenarios where this traffic would need to traverse the network northbound of the Cisco UCS domain. For that reason, the VLAN used for HX vMotion traffic must be able to traverse the network uplinks from the Cisco UCS domain, reaching FI A from FI B, and vice-versa.

☒ 25. illustrates the logical network design.

☒ **25. Logical Network Design**



## Design Elements

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Installing the HyperFlex system is primarily done through a deployable HyperFlex installer virtual machine, available for download at [cisco.com](https://www.cisco.com) as an OVA file. The installer VM performs most of the Cisco UCS configuration work, it can be leveraged to simplify the installation of ESXi on the HyperFlex hosts, and also performs significant portions of the ESXi configuration. Finally, the installer VM is used to install the HyperFlex HX Data Platform software and create the HyperFlex cluster. Because this simplified installation method has been developed by Cisco, this CVD will not give detailed manual steps for the configuration of all the elements that are handled by the installer. Instead, the elements configured will be described and documented in this section, and the subsequent sections will guide you through the manual steps needed for installation, and how to utilize the HyperFlex Installer for the remaining configuration steps.

## Network Design

### Cisco UCS Uplink Connectivity

Cisco UCS network uplinks connect “northbound” from the pair of Cisco UCS Fabric Interconnects to the LAN in the customer datacenter. All Cisco UCS uplinks operate as trunks, carrying multiple 802.1Q VLAN IDs across the uplinks. The default Cisco UCS behavior is to assume that all VLAN IDs defined in the Cisco UCS configuration are eligible to be trunked across all available uplinks.

Cisco UCS Fabric Interconnects appear on the network as a collection of endpoints versus another network switch. Internally, the Fabric Interconnects do not participate in spanning-tree protocol (STP) domains, and the Fabric Interconnects cannot form a network loop, as they are not connected to each other with a layer 2 Ethernet link. All link up/down decisions via STP will be made by the upstream root bridges.

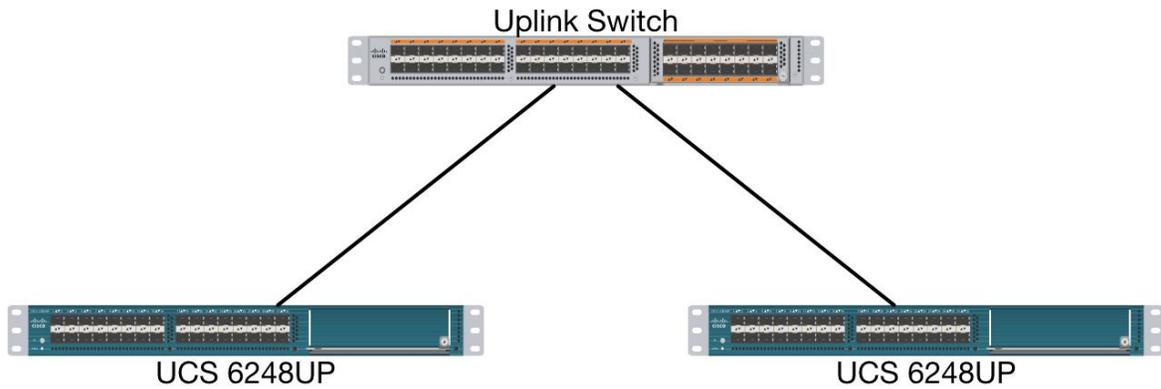
Uplinks need to be connected and active from both Fabric Interconnects. For redundancy, multiple uplinks can be used on each FI, either as 802.3ad Link Aggregation Control Protocol (LACP) port-channels, or using individual links. For the best level of performance and redundancy, uplinks can be made as LACP port-channels to multiple upstream Cisco switches using the virtual port channel (vPC) feature. Using vPC uplinks allows all uplinks to be active passing data, plus protects against any individual link failure, and the failure of an upstream switch. Other uplink configurations can be redundant, but spanning-tree protocol loop avoidance may disable links if vPC is not available.

All uplink connectivity methods must allow for traffic to pass from one Fabric Interconnect to the other, or from fabric A to fabric B. There are scenarios where cable, port or link failures would require traffic that normally does not leave the Cisco UCS domain, to now be forced over the Cisco UCS uplinks. Additionally, this traffic flow pattern can be seen briefly during maintenance procedures, such as updating firmware on the Fabric Interconnects, which requires them to be rebooted. The following sections and figures detail several uplink connectivity options.

### Single Uplinks to Single Switch

This connection design is susceptible to failures at several points; single uplink failures on either Fabric Interconnect can lead to connectivity losses or functional failures, and the failure of the single uplink switch will cause a complete connectivity outage.

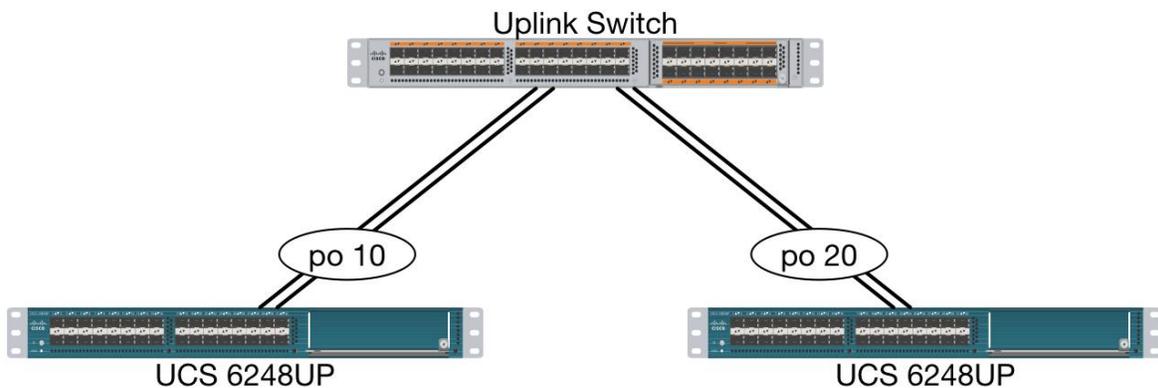
## ☒ 26. Connectivity with Single Uplink to Single Switch



### Port Channels to Single Switch

This connection design is now redundant against the loss of a single link, but remains susceptible to the failure of the single switch.

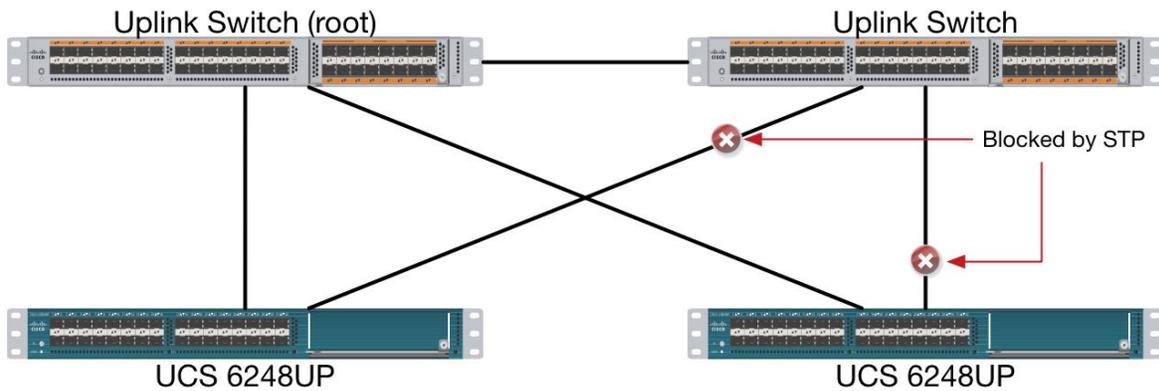
## ☒ 27. Connectivity with Port-Channels to Single Switch



### Single Uplinks or Port Channels to Multiple Switches

This connection design is redundant against the failure of an upstream switch, and redundant against a single link failure. In normal operation, STP is likely to block half of the links to avoid a loop across the two upstream switches. The side effect of this is to reduce bandwidth between the Cisco UCS domain and the LAN. If any of the active links were to fail, STP would bring the previously blocked link online to provide access to that Fabric Interconnect via the other switch. It is not recommended to connect both links from a single FI to a single switch, as that configuration is susceptible to a single switch failure breaking connectivity from fabric A to fabric B. For enhanced redundancy, the single links in the figure below could also be port-channels.

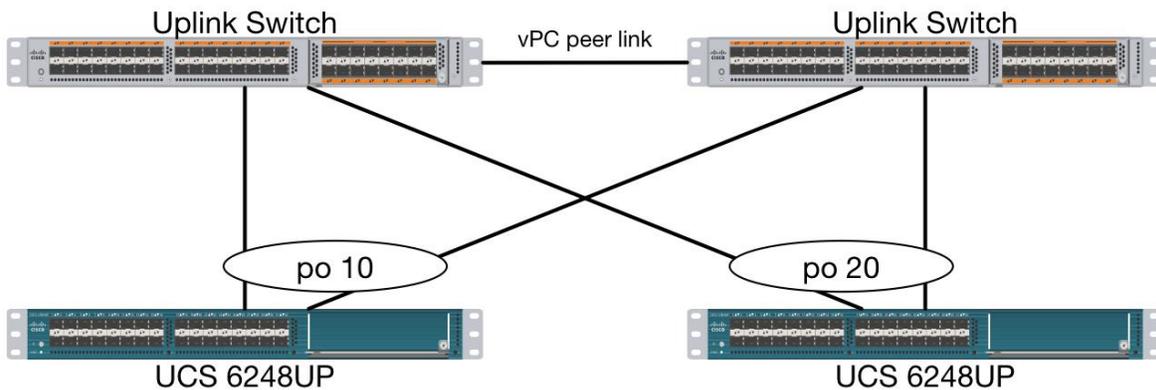
**28. Connectivity with Multiple Uplink Switches**



vPC to Multiple Switches

This recommended connection design relies on using Cisco switches that have the virtual port channel feature, such as Catalyst 6000 series switches running VSS, Cisco Nexus 5000 series, and Cisco Nexus 9000 series switches. Logically the two vPC enabled switches appear as one, and therefore spanning-tree protocol will not block any links. This configuration allows for all links to be active, achieving maximum bandwidth potential, and multiple redundancy at each level.

**29. Connectivity with vPC**



VLANs and Subnets

For the base HyperFlex system configuration, multiple VLANs need to be carried to the Cisco UCS domain from the upstream LAN, and these VLANs are also defined in the Cisco UCS configuration. The hx-storage-data VLAN must be a separate VLAN ID from the remaining VLANs. Table 15 lists the VLANs created by the HyperFlex installer in Cisco UCS, and their functions:

**Table 15 VLANs**

VLAN Name	VLAN ID	Purpose
hx-inband-mgmt	Customer supplied	ESXi host management interfaces HX Storage Controller VM management interfaces HX Storage Cluster roaming management interface
hx-inband-repl	Customer supplied	HX Storage Controller VM Replication interfaces HX Storage Cluster roaming replication interface
hx-storage-data	Customer supplied	ESXi host storage VMkernel interfaces HX Storage Controller storage network interfaces HX Storage Cluster roaming storage interface
hx-vm-data	Customer supplied	Guest VM network interfaces
hx-vmotion	Customer supplied	ESXi host vMotion VMkernel interfaces



Note: A dedicated network or subnet for physical device management is often used in datacenters. In this scenario, the mgmt0 interfaces of the two Fabric Interconnects would be connected to that dedicated network or subnet. This is a valid configuration for HyperFlex installations with the following caveat; wherever the HyperFlex installer is deployed it must have IP connectivity to the subnet of the mgmt0 interfaces of the Fabric Interconnects, and also have IP connectivity to the subnets used by the hx-inband-mgmt VLANs listed above.

## Jumbo Frames

All HyperFlex storage traffic traversing the hx-storage-data VLAN and subnet is configured by default to use jumbo frames, or to be precise, all communication is configured to send IP packets with a Maximum Transmission Unit (MTU) size of 9000 bytes. In addition, the default MTU for the hx-vmotion VLAN is also set to use jumbo frames. Using a larger MTU value means that each IP packet sent carries a larger payload, therefore transmitting more data per packet, and consequently sending and receiving data faster. This requirement also means that the Cisco UCS uplinks must be configured to pass jumbo frames. Failure to configure the Cisco UCS uplink switches to allow jumbo frames can lead to service interruptions during some failure scenarios, including Cisco UCS firmware upgrades, or when a cable or port failure would cause storage traffic to traverse the northbound Cisco UCS uplink switches.

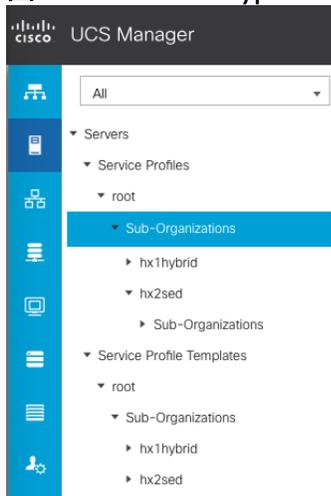
## Cisco UCS Design

This section describes the elements within Cisco UCS Manager that are configured by the Cisco HyperFlex installer. Many of the configuration elements are fixed in nature, meanwhile the HyperFlex installer does allow for some items to be specified at the time of creation, for example VLAN names and IDs, external management IP pools and more. Where the elements can be manually set during the installation, those items will be noted in << >> brackets.

## Cisco UCS Organization

During the HyperFlex installation a Cisco UCS Sub-Organization is created. You must specify a unique Sub-Organization name for each cluster during the installation, for example “hx1hybrid” , or “hx2sed” . The sub-organization is created underneath the root level of the Cisco UCS hierarchy, and is used to contain all policies, pools, templates and service profiles used by HyperFlex. This arrangement allows for organizational control using Role-Based Access Control (RBAC) and administrative locales at a later time if desired. In this way, control can be granted to administrators of only the HyperFlex specific elements of the Cisco UCS domain, separate from control of root level elements or elements in other sub-organizations.

**30. Cisco UCS HyperFlex Sub-Organization**



## Cisco UCS LAN Policies

### QoS System Classes

Specific Cisco UCS Quality of Service (QoS) system classes are defined for a Cisco HyperFlex system. These classes define Class of Service (CoS) values that can be used by the uplink switches north of the Cisco UCS domain, plus which classes are active, along with whether packet drop is allowed, the relative weight of the different classes when there is contention, the maximum transmission unit (MTU) size, and if there is multicast optimization applied. QoS system classes are defined for the entire Cisco UCS domain, the classes that are enabled can later be used in QoS policies, which are then assigned to Cisco UCS vNICs. The following table and figure details the QoS System Class settings configured for HyperFlex:

**Table 16 QoS System Classes**

Priority	Enabled	CoS	Packet Drop	Weight	MTU	Multicast Optimized
Platinum	Yes	5	No	4	9216	No
Gold	Yes	4	Yes	4	Normal	No
Silver	Yes	2	Yes	Best-effort	Normal	Yes
Bronze	Yes	1	Yes	Best-effort	9216	No

Priority	Enabled	CoS	Packet Drop	Weight	MTU	Multicast Optimized
Best Effort	Yes	Any	Yes	Best-effort	Normal	No
Fibre Channel	Yes	3	No	5	FC	N/A

**31. QoS System Classes**

Priority	Enabled	CoS	Packet Drop	Weight	Weight (%)	MTU	Multicast Optimized
Platinum	<input checked="" type="checkbox"/>	5	<input type="checkbox"/>	4	25	9216	<input type="checkbox"/>
Gold	<input checked="" type="checkbox"/>	4	<input checked="" type="checkbox"/>	4	25	normal	<input type="checkbox"/>
Silver	<input checked="" type="checkbox"/>	2	<input checked="" type="checkbox"/>	best-effort	6	normal	<input checked="" type="checkbox"/>
Bronze	<input checked="" type="checkbox"/>	1	<input checked="" type="checkbox"/>	best-effort	6	9216	<input type="checkbox"/>
Best Effort	<input checked="" type="checkbox"/>	Any	<input checked="" type="checkbox"/>	best-effort	6	normal	<input type="checkbox"/>
Fibre Channel	<input checked="" type="checkbox"/>	3	<input type="checkbox"/>	5	32	fc	N/A



Note: Changing the QoS system classes on a Cisco UCS 6332 or 6332-16UP model Fabric Interconnect requires both FIs to reboot in order to take effect.

**QoS Policies**

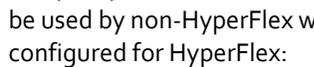
In order to apply the settings defined in the Cisco UCS QoS System Classes, specific QoS Policies must be created, and then assigned to the vNICs, or vNIC templates used in Cisco UCS Service Profiles. Table 17 details the QoS Policies configured for HyperFlex, and their default assignment to the vNIC templates created:

**Table 17 HyperFlex QoS Policies**

Policy	Priority	Burst	Rate	Host Control	Used by vNIC Template
Platinum	Platinum	10240	Line-rate	None	storage-data-a storage-data-b
Gold	Gold	10240	Line-rate	None	vm-network-a vm-network-b
Silver	Silver	10240	Line-rate	None	hv-mgmt-a hv-mgmt-b

Policy	Priority	Burst	Rate	Host Control	Used by vNIC Template
Bronze	Bronze	10240	Line-rate	None	hv-vmotion-a hv-vmotion-b
Best Effort	Best Effort	10240	Line-rate	None	N/A

### Multicast Policy

A Cisco UCS Multicast Policy is configured by the HyperFlex installer, which is referenced by the VLANs that are created. The policy allows for future flexibility if a specific multicast policy needs to be created and applied to other VLANs, that may be used by non-HyperFlex workloads in the Cisco UCS domain. Table 18 and  details the Multicast Policy configured for HyperFlex:

**Table 18 Multicast Policy**

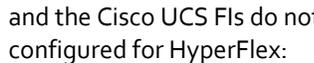
Name	IGMP Snooping State	IGMP Snooping Querier State
HyperFlex	Enabled	Disabled

### 32. Multicast Policy

#### Properties

Name : **HyperFlex**  
 IGMP Snooping State :  Enabled  Disabled  
 IGMP Snooping Querier State :  Enabled  Disabled  
 Owner : **Local**

### VLANs

VLANs are created by the HyperFlex installer to support a base HyperFlex system, with a VLAN for vMotion, and a single or multiple VLANs defined for guest VM traffic. Names and IDs for the VLANs are defined in the Cisco UCS configuration page of the HyperFlex installer web interface. The VLANs listed in Cisco UCS must already be present on the upstream network, and the Cisco UCS FIs do not participate in VLAN Trunk Protocol (VTP). Table 19 and  details the VLANs configured for HyperFlex:

**Table 19 Cisco UCS VLANs**

Name	ID	Type	Transport	Native	VLAN Sharing	Multicast Policy
<<hx-inband-mgmt>>	<user_defined>	LAN	Ether	No	None	HyperFlex
<<hx-inband-repl>>	<user_defined>	LAN	Ether	No	None	HyperFlex
<<hx-storage-data>>	<user_defined>	LAN	Ether	No	None	HyperFlex
<<hx-vm-data>>	<user_defined>	LAN	Ether	No	None	HyperFlex

Name	ID	Type	Transport	Native	VLAN Sharing	Multicast Policy
<<hx-vmotion>>	<user_defined>	LAN	Ether	No	None	HyperFlex

### 33. Cisco UCS VLANs

LAN / LAN Cloud / VLANs

VLANs

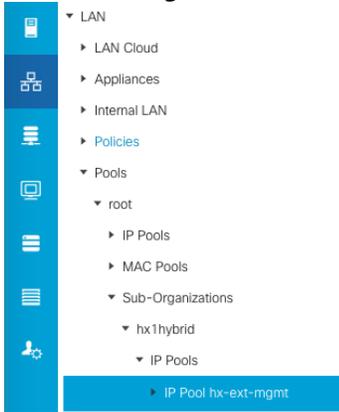
Name	ID	Type	Transport	Native	VLAN Sharing	Primary VLAN ...	Multicast Policy...
VLAN default (1)	1	Lan	Ether	Yes	None		
VLAN hx-storage-data (52)	52	Lan	Ether	No	None		HyperFlex
VLAN vm-network (100)	100	Lan	Ether	No	None		HyperFlex
VLAN hx-inband-mgmt (133)	133	Lan	Ether	No	None		HyperFlex
VLAN hx-vmotion (200)	200	Lan	Ether	No	None		HyperFlex

 Add
  Delete
  Info

### Management IP Address Pool

A Cisco UCS Management IP Address Pool must be populated with a block of IP addresses. These IP addresses are assigned to the Cisco Integrated Management Controller (CIMC) interface of the rack mount and blade servers that are managed in the Cisco UCS domain. The IP addresses are the communication endpoints for various functions, such as remote KVM, virtual media, Serial over LAN (SoL), and Intelligent Platform Management Interface (IPMI) for each rack mount or blade server. Therefore, a minimum of one IP address per physical server in the domain must be provided. The IP addresses are considered to be an “out-of-band” address, meaning that the communication pathway uses the Fabric Interconnects’ mgmt ports, which answer ARP requests for the management addresses. Because of this arrangement, the IP addresses in this pool must be in the same IP subnet as the IP addresses assigned to the Fabric Interconnects’ mgmt ports. A new IP pool, named “hx-ext-mgmt” is created in the HyperFlex sub-organization, and populated with a block of IP addresses, a subnet mask, and a default gateway by the HyperFlex installer. The default IP pool named “ext-mgmt”, in the root organization is no longer used as of HyperFlex 2.5 for new installations.

### 34. Management IP Address Pool



### MAC Address Pools

One of the core benefits of the Cisco UCS and Virtual Interface Card (VIC) technology is the assignment of the personality of the card via Cisco UCS Service Profiles. The number of virtual NIC (vNIC) interfaces, their VLAN associations, MAC addresses, QoS policies and more are all applied dynamically as part of the service profile association process. Media Access Control (MAC) addresses use 6 bytes of data as a unique address to identify the interface on the layer 2 network. All devices are assigned a unique MAC address, which is ultimately used for all data transmission and reception. The Cisco UCS and VIC technology picks a MAC address from a pool of addresses, and assigns it to each vNIC defined in the service profile when that service profile is created.

Best practices mandate that MAC addresses used for Cisco UCS domains use 00:25:B5 as the first three bytes, which is one of the Organizationally Unique Identifiers (OUI) registered to Cisco Systems, Inc. The fourth byte (e.g. 00:25:B5:xx) is specified during the HyperFlex installation. The fifth byte is set automatically by the HyperFlex installer, to correlate to the Cisco UCS fabric and the vNIC placement order. Finally, the last byte is incremented according to the number of MAC addresses created in the pool. To avoid overlaps, when you define the values in the HyperFlex installer you must ensure that the first four bytes of the MAC address pools are unique for each HyperFlex cluster installed in the same layer 2 network, and also different from MAC address pools in other Cisco UCS domains which may exist.

Table 20 details the MAC Address Pools configured for HyperFlex and their default assignment to the vNIC templates created:

**Table 20 MAC Address Pools**

Name	Block Start	Size	Assignment Order	Used by vNIC Template
hv-mgmt-a	00:25:B5:<xx>:A1:01	100	Sequential	hv-mgmt-a
hv-mgmt-b	00:25:B5:<xx>:B2:01	100	Sequential	hv-mgmt-b
hv-vmotion-a	00:25:B5:<xx>:A7:01	100	Sequential	hv-vmotion-a
hv-vmotion-b	00:25:B5:<xx>:B8:01	100	Sequential	hv-vmotion-b
storage-data-a	00:25:B5:<xx>:A3:01	100	Sequential	storage-data-a

Name	Block Start	Size	Assignment Order	Used by vNIC Template
storage-data-b	00:25:B5:<xx>:B4:01	100	Sequential	storage-data-b
vm-network-a	00:25:B5:<xx>:A5:01	100	Sequential	vm-network-a
vm-network-b	00:25:B5:<xx>:B6:01	100	Sequential	vm-network-b

### 35. MAC Address Pools

- ▶ IP Pools
- ▶ MAC Pools
- ▼ Sub-Organizations
  - ▼ hx1hybrid
    - ▶ IP Pools
    - ▼ MAC Pools
      - ▼ MAC Pool hv-mgmt-a
        - [00:25:B5:27:A1:01 - 00:25:B5
      - ▼ MAC Pool hv-mgmt-b
        - [00:25:B5:27:B2:01 - 00:25:B5
      - ▼ MAC Pool hv-vmotion-a
        - [00:25:B5:27:A7:01 - 00:25:B5
      - ▼ MAC Pool hv-vmotion-b
        - [00:25:B5:27:B8:01 - 00:25:B5
      - ▼ MAC Pool storage-data-a
        - [00:25:B5:27:A3:01 - 00:25:B5
      - ▼ MAC Pool storage-data-b
        - [00:25:B5:27:B4:01 - 00:25:B5
      - ▼ MAC Pool vm-network-a
        - [00:25:B5:27:A5:01 - 00:25:B5
      - ▼ MAC Pool vm-network-b
        - [00:25:B5:27:B6:01 - 00:25:B5

### Network Control Policies

Cisco UCS Network Control Policies control various aspects of the behavior of vNICs defined in the Cisco UCS Service Profiles. Settings controlled include enablement of Cisco Discovery Protocol (CDP), MAC address registration, MAC address forging, and the action taken on the vNIC status if the Cisco UCS network uplinks are failed. Two policies are configured by the HyperFlex Installer, HyperFlex-infra is applied to the “infrastructure” vNIC interfaces of the HyperFlex system, and HyperFlex-vm, which is only applied to the vNIC interfaces carrying guest VM traffic. This allows for more flexibility, even though the policies are currently configured with the same settings. Table 21 details the Network Control Policies configured for HyperFlex, and their default assignment to the vNIC templates created:

**Table 21 Network Control Policy**

Name	CDP	MAC Register Mode	Action on Up-link Fail	MAC Security	Used by vNIC Template
------	-----	-------------------	------------------------	--------------	-----------------------

Name	CDP	MAC Register Mode	Action on Uplink Fail	MAC Security	Used by vNIC Template
HyperFlex-infra	Enabled	Only Native VLAN	Link-down	Forged: Allow	hv-mgmt-a hv-mgmt-b hv-vmotion-a hv-vmotion-b storage-data-a storage-data-b
HyperFlex-vm	Enabled	Only Native VLAN	Link-down	Forged: Allow	vm-network-a vm-network-b

### 36. Network Control Policy

Properties

---

Name : **HyperFlex-infra**

Description : Network Control policy for infrastructure vNICs Hype

Owner : **Local**

CDP :  Disabled  Enabled

MAC Register Mode :  Only Native Vlan  All Host Vlans

Action on Uplink Fail :  Link Down  Warning

MAC Security

---

Forge :  Allow  Deny

LLDP

---

Transmit :  Disabled  Enabled

Receive :  Disabled  Enabled

## vNIC Templates

Cisco UCS Manager has a feature to configure vNIC templates, which can be used to simplify and speed up configuration efforts. vNIC templates are referenced in service profiles and LAN connectivity policies, versus configuring the same vNICs individually in each service profile, or service profile template. vNIC templates contain all the configuration elements that make up a vNIC, including VLAN assignment, MAC address pool selection, fabric A or B assignment, fabric failover, MTU, QoS policy, Network Control Policy, and more. Templates are created as either initial templates, or updating templates. Updating templates retain a link between the parent template and the child object, therefore when changes are made to the template, the changes are propagated to all remaining linked child objects. An additional feature named “vNIC Redundancy” allows vNICs to be configured in pairs, so that the settings of one vNIC template, designated as a primary template, will automatically be applied to a configured secondary template. For all HyperFlex vNIC templates, the “A” side vNIC template is configured as a primary template, and the related “B” side vNIC template is a secondary. In each case, the only configuration difference between the two templates is which fabric they are configured to connect through. The following tables detail the initial settings in each of the vNIC templates created by the HyperFlex installer:

**Table 22** vNIC Template hv-mgmt-a

<b>vNIC Template Name:</b>	hv-mgmt-a	
<b>Setting</b>	<b>Value</b>	
Fabric ID	A	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	1500	
MAC Pool	hv-mgmt-a	
QoS Policy	silver	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-inband-mgmt>>	Native: No

**Table 23** vNIC Template hv-mgmt-b

<b>vNIC Template Name:</b>	hv-mgmt-b	
<b>Setting</b>	<b>Value</b>	
Fabric ID	B	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	1500	
MAC Pool	hv-mgmt-b	

QoS Policy	silver	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-inband-mgmt>>	Native: No

**Table 24 vNIC Template hv-vmotion-a**

<b>vNIC Template Name:</b>	<b>hv-vmotion-a</b>	
<b>Setting</b>	<b>Value</b>	
Fabric ID	A	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	9000	
MAC Pool	hv-vmotion-a	
QoS Policy	bronze	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-vmotion>>	Native: No

**Table 25 vNIC Template hx-vmotion-b**

<b>vNIC Template Name:</b>	<b>hx-vmotion-b</b>	
<b>Setting</b>	<b>Value</b>	
Fabric ID	B	
Fabric Failover	Disabled	
Target	Adapter	

Type	Updating Template	
MTU	9000	
MAC Pool	hv-vmotion-b	
QoS Policy	bronze	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-vmotion>>	Native: No

**Table 26 vNIC Template storage-data-a**

vNIC Template Name:	storage-data-a	
Setting	Value	
Fabric ID	A	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	9000	
MAC Pool	storage-data-a	
QoS Policy	platinum	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-storage-data>>	Native: No

**Table 27 vNIC Template storage-data-b**

vNIC Template Name:	storage-data-b	
Setting	Value	

<b>Fabric ID</b>	B	
<b>Fabric Failover</b>	Disabled	
<b>Target</b>	Adapter	
<b>Type</b>	Updating Template	
<b>MTU</b>	9000	
<b>MAC Pool</b>	storage-data-b	
<b>QoS Policy</b>	platinum	
<b>Network Control Policy</b>	HyperFlex-infra	
<b>VLANs</b>	<<hx-storage-data>>	Native: No

**Table 28 vNIC Template vm-network-a**

<b>vNIC Template Name:</b>	vm-network-a	
<b>Setting</b>	<b>Value</b>	
<b>Fabric ID</b>	A	
<b>Fabric Failover</b>	Disabled	
<b>Target</b>	Adapter	
<b>Type</b>	Updating Template	
<b>MTU</b>	1500	
<b>MAC Pool</b>	vm-network-a	
<b>QoS Policy</b>	gold	
<b>Network Control Policy</b>	HyperFlex-vm	
<b>VLANs</b>	<<hx-vm-data>>	Native: no

**Table 29 vNIC Template vm-network-b**

<b>vNIC Template Name:</b>	<b>vm-network-b</b>	
<b>Setting</b>	<b>Value</b>	
<b>Fabric ID</b>	B	
<b>Fabric Failover</b>	Disabled	
<b>Target</b>	Adapter	
<b>Type</b>	Updating Template	
<b>MTU</b>	1500	
<b>MAC Pool</b>	vm-network-b	
<b>QoS Policy</b>	gold	
<b>Network Control Policy</b>	HyperFlex-vm	
<b>VLANs</b>	<<hx-vm-data>>	Native: no

**LAN Connectivity Policies**

Cisco UCS Manager has a feature for LAN Connectivity Policies, which aggregates all of the vNICs or vNIC templates desired for a service profile configuration into a single policy definition. This simplifies configuration efforts by defining a collection of vNICs or vNIC templates once, and using that policy in the service profiles or service profile templates. The HyperFlex installer configures a LAN Connectivity Policy named HyperFlex, which contains all of the vNIC templates defined in the previous section, along with an Adapter Policy named HyperFlex, also configured by the HyperFlex installer. Table 30 details the LAN Connectivity Policy configured for HyperFlex:

**Table 30 LAN Connectivity Policy**

<b>Policy Name</b>	<b>Use vNIC Template</b>	<b>vNIC Name</b>	<b>vNIC Template Used</b>	<b>Adapter Policy</b>
<b>HyperFlex</b>	Yes	hv-mgmt-a	hv-mgmt-a	HyperFlex
		hv-mgmt-b	hv-mgmt-b	
		hv-vmotion-a	hv-vmotion-a	

		hv-vmotion-b	hv-vmotion-b	
		storage-data-a	storage-data-a	
		storage-data-b	storage-data-b	
		vm-network-a	vm-network-a	
		vm-network-b	vm-network-b	

### Cisco UCS Servers Policies

#### Adapter Policies

Cisco UCS Adapter Policies are used to configure various settings of the Converged Network Adapter (CNA) installed in the Cisco UCS blade or rack-mount servers. Various advanced hardware features can be enabled or disabled depending on the software or operating system being used. The following figures detail the Adapter Policy configured for HyperFlex:

### 37. Cisco UCS Adapter Policy Resources

Resources

Transmit Queues :	1	[1-1000]
Ring Size :	256	[64-4096]
<hr/>		
Receive Queues :	1	[1-1000]
Ring Size :	512	[64-4096]
<hr/>		
Completion Queues :	2	[1-2000]
Interrupts :	4	[1-1024]

### 38. Cisco UCS Adapter Policy Options

Options

Transmit Checksum Offload	:	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled
Receive Checksum Offload	:	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled
TCP Segmentation Offload	:	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled
TCP Large Receive Offload	:	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled
Receive Side Scaling (RSS)	:	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled
Accelerated Receive Flow Steering	:	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled
Network Virtualization using Generic Routing Encapsulation	:	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled
Virtual Extensible LAN	:	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled
Failback Timeout (Seconds)	:	<input style="width: 50px;" type="text" value="5"/> [0-600]
Interrupt Mode	:	<input checked="" type="radio"/> MSI X <input type="radio"/> MSI <input type="radio"/> IN Tx
Interrupt Coalescing Type	:	<input checked="" type="radio"/> Min <input type="radio"/> Idle
Interrupt Timer (us)	:	<input style="width: 50px;" type="text" value="125"/> [0-65535]
RoCE	:	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled
Advance Filter	:	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled
Interrupt Scaling	:	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled

## BIOS Policies

Cisco HX-Series M4 generation servers have a set of pre-defined BIOS setting defaults defined in Cisco UCS Manager. These settings have been optimized for the Cisco HX-Series servers running HyperFlex. The HyperFlex installer creates a BIOS policy named “HyperFlex” , with all settings set to the defaults, except for enabling the Serial Port A for Serial over LAN (SoL) functionality. This policy allows for future flexibility in case situations arise where the settings need to be modified from the default configuration.

Cisco HX-Series M5 generation servers no longer use pre-defined BIOS setting defaults derived from Cisco UCS Manager, instead the servers have default BIOS tokens set from the factory. The current default token settings can be viewed at the following website:

[https://www.cisco.com/c/en/us/td/docs/unified\\_computing/ucs/ucs-manager/Reference-Docs/Server-BIOS-Tokens/3-2/b\\_UCS\\_BIOS\\_Tokens.html](https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/ucs-manager/Reference-Docs/Server-BIOS-Tokens/3-2/b_UCS_BIOS_Tokens.html)

A second BIOS policy, named “HyperFlex-m5” is created by the HyperFlex installer to modify the setting of M5 generation servers. The settings modified are as follows:

- System altitude is set to “Auto”
- CPU performance is set to “HPC”
- Processor C1E state is set to “Disabled”
- Power Technology is set to “Performance”

- Energy Performance is set to “Performance”
- Serial Port A is enabled
- Console Redirection is set to Serial Port A

### Boot Policies

Cisco UCS Boot Policies define the boot devices used by blade and rack-mount servers, and the order that they are attempted to boot from. Cisco HX-Series M4 generation rack-mount servers have their VMware ESXi hypervisors installed to an internal pair of mirrored Cisco FlexFlash SD cards, therefore they require a boot policy defining that the servers should boot from that location. The HyperFlex installer configures a boot policy named “HyperFlex” specifying boot from the SD cards, which is used by the HyperFlex converged nodes, and should not be modified. The compute-only Cisco UCS blade servers and Cisco UCS Rack-Mount Servers can also boot from SD cards, or they can be configured to boot from local disks, boot from SAN, or via the network using PXE or iSCSI. The HyperFlex installer configures a boot policy named “hx-compute” , which can be modified as needed for the boot method used by the compute-only nodes.

Cisco HX-Series M5 generation rack-mount servers have their VMware ESXi hypervisors installed to an internal M.2 SSD boot drive, therefore they require a unique boot policy defining that the servers should boot from that location. The HyperFlex installer configures a boot policy named “HyperFlex-m5” specifying boot from the M.2 SSDs, referred to as “Embedded Disk” , which is used by the HyperFlex M5 converged nodes, and should not be modified. The HyperFlex installer configures a boot policy named “hx-compute-m5” , which can be modified as needed for the boot method used by the M5 generation compute-only nodes.

The following figures detail the HyperFlex Boot Policies:

#### 39. Cisco UCS M4 Boot Policy

**Actions**

Delete

Show Policy Usage

Use Global

**Properties**

Name : **HyperFlex**

Description : Recommended boot policy for HyperFlex servers

Owner : **Local**

Reboot on Boot Order Change :

Enforce vNIC/vHBA/iSCSI Name :

Boot Mode :  Legacy  Uefi

---

**Warning**

The type (primary/secondary) does not indicate a boot order presence.  
 The effective order of boot devices within the same device class (LAN/Storage/iSCSI) is determined by PCIe bus scan order.  
 If **Enforce vNIC/vHBA/iSCSI Name** is selected and the vNIC/vHBA/iSCSI does not exist, a config error will be reported.  
 If it is not selected, the vNICs/vHBAs are selected if they exist, otherwise the vNIC/vHBA with the lowest PCIe bus scan order is used.

**Boot Order**

+ - Advanced Filter Export Print

Name	Order	vNIC/vHB...	Type	WWN
CD/DVD	1			
SD Card	2			

### 40. Cisco UCS M5 Boot Policy

Actions	Properties
<a href="#">Delete</a> <a href="#">Show Policy Usage</a> <a href="#">Use Global</a>	<b>Name</b> : <b>HyperFlex-m5</b> <b>Description</b> : Recommended boot policy for HyperFlex servers <b>Owner</b> : <b>Local</b> <b>Reboot on Boot Order Change</b> : <input type="checkbox"/> <b>Enforce vNIC/vHBA/iSCSI Name</b> : <input checked="" type="checkbox"/> <b>Boot Mode</b> : <input checked="" type="radio"/> Legacy <input type="radio"/> Uefi

**Warning**

The type (primary/secondary) does not indicate a boot order presence. The effective order of boot devices within the same device class (LAN/Storage/iSCSI) is determined by PCIe bus scan order. If **Enforce vNIC/vHBA/iSCSI Name** is selected and the vNIC/vHBA/iSCSI does not exist, a config error will be reported. If it is not selected, the vNICs/vHBAs are selected if they exist, otherwise the vNIC/vHBA with the lowest PCIe bus scan order is used.

Local Devices	Boot Order															
<a href="#">+ Local Devices</a> <a href="#">+ CIMC Mounted vMedia</a> <a href="#">+ vNICs</a> <a href="#">+ vHBAs</a>	<table border="1"> <thead> <tr> <th>Name</th> <th>Order</th> <th>vNIC/vHB...</th> <th>Type</th> <th>WWN</th> </tr> </thead> <tbody> <tr> <td>CD/DVD</td> <td>1</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Embedded Disk</td> <td>2</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Name	Order	vNIC/vHB...	Type	WWN	CD/DVD	1				Embedded Disk	2			
Name	Order	vNIC/vHB...	Type	WWN												
CD/DVD	1															
Embedded Disk	2															

### Host Firmware Packages

Cisco UCS Host Firmware Packages represent one of the most powerful features of the Cisco UCS platform; the ability to control the firmware revision of all the managed blades and rack-mount servers via a policy specified in the service profile. Host Firmware Packages are defined and referenced in the service profiles. Once a service profile is associated to a server, the firmware of all the components defined in the Host Firmware Package are automatically upgraded or downgraded to match the package. The HyperFlex installer creates two Host Firmware Packages named “HyperFlex” and “HyperFlex-m5” which use the simple package definition method, applying firmware revisions to all components that matches a specific Cisco UCS firmware bundle, versus defining the firmware revisions part by part. The two policies are distinct to allow different generations of HX-Series rack-mount servers to run different firmware packages as needed. The following figures detail the Host Firmware Packages configured by the HyperFlex installer:

### 41. Cisco UCS M4 Host Firmware Package

Actions	Properties
<a href="#">Delete</a> <a href="#">Show Policy Usage</a> <a href="#">Use Global</a> <a href="#">Modify Package Versions</a>	<b>Name</b> : <b>HyperFlex</b> <b>Description</b> : Recommended Host Firmware Packages for HyperFI <b>Owner</b> : <b>Local</b> <b>Blade Package</b> : <b>3.2(1d)B</b> <b>Rack Package</b> : <b>3.2(1d)C</b> <b>Service Pack</b> :

### 42. Cisco UCS M5 Host Firmware Package

Actions	Properties
<a href="#">Delete</a> <a href="#">Show Policy Usage</a> <a href="#">Use Global</a> <a href="#">Modify Package Versions</a>	<b>Name</b> : <b>HyperFlex-m5</b> <b>Description</b> : Recommended Host Firmware Packages for M5 Hyp <b>Owner</b> : <b>Local</b> <b>Blade Package</b> : <b>3.2(1d)B</b> <b>Rack Package</b> : <b>3.2(1d)C</b> <b>Service Pack</b> :

### Local Disk Configuration Policies

Cisco UCS Local Disk Configuration Policies are used to define the configuration of disks installed locally within each blade or rack-mount server, most often to configure Redundant Array of Independent/Inexpensive Disks (RAID levels) when multiple disks are present for data protection. Since HX-Series converged nodes providing storage resources do not require RAID, the HyperFlex installer creates four Local Disk Configuration Policies, named “HyperFlex”, “HyperFlex-m5”, “hx-compute” and “hx-compute-m5”, all of which allows any local disk configuration. The policy named “HyperFlex”

is used by the service profile template named “hx-nodes”, which is for the HyperFlex M4 generation converged servers, and should not be modified. The policy named “HyperFlex-m5” is used by the service profile template named “hx-nodes-m5”, which is for the HyperFlex M5 generation converged servers, and should not be modified. The difference between the two policies is the state of the FlexFlash controller, which is enabled in M4 generation servers to support the SD cards, but is disabled in the M5 generation servers.

Meanwhile, the policies named “hx-compute” and “hx-compute-m5” are used by the service profile templates named “compute-nodes” and “compute-nodes-m5”, which are used by compute-only nodes. The two compute-only node policies can be modified as needed to suit the local disk configuration that will be used in compute-only nodes.

The following figures detail the Local Disk Configuration Policies configured by the HyperFlex installer:

#### 43. Cisco UCS M4 Local Disk Configuration Policy

Actions	Properties
<a href="#">Delete</a> <a href="#">Show Policy Usage</a> <a href="#">Use Global</a>	<p>Name : <b>HyperFlex</b></p> <p>Description : Recommended Local Disk policy for HyperFlex serve</p> <p>Owner : <b>Local</b></p> <p>Mode : Any Configuration</p> <p>Protect Configuration : <input checked="" type="checkbox"/></p> <p>If <b>Protect Configuration</b> is set, the local disk configuration is preserved if the service profile is disassociated with the server. In that case, a configuration error will be raised when a new service profile is associated with that server if the local disk configuration in that profile is different.</p> <hr/> <p><b>FlexFlash</b></p> <p>FlexFlash State : <input type="radio"/> Disable <input checked="" type="radio"/> Enable</p> <p>If <b>FlexFlash State</b> is disabled, SD cards will become unavailable immediately. Please ensure SD cards are not in use before disabling the FlexFlash State.</p> <p>FlexFlash RAID Reporting State : <input type="radio"/> Disable <input checked="" type="radio"/> Enable</p>

#### 44. Cisco UCS M5 Local Disk Configuration Policy

Actions	Properties
<a href="#">Delete</a> <a href="#">Show Policy Usage</a> <a href="#">Use Global</a>	<p>Name : <b>HyperFlex-m5</b></p> <p>Description : Recommended Local Disk policy for M5 HyperFlex si</p> <p>Owner : <b>Local</b></p> <p>Mode : Any Configuration</p> <p>Protect Configuration : <input checked="" type="checkbox"/></p> <p>If <b>Protect Configuration</b> is set, the local disk configuration is preserved if the service profile is disassociated with the server. In that case, a configuration error will be raised when a new service profile is associated with that server if the local disk configuration in that profile is different.</p> <hr/> <p><b>FlexFlash</b></p> <p>FlexFlash State : <input checked="" type="radio"/> Disable <input type="radio"/> Enable</p> <p>If <b>FlexFlash State</b> is disabled, SD cards will become unavailable immediately. Please ensure SD cards are not in use before disabling the FlexFlash State.</p> <p>FlexFlash RAID Reporting State : <input checked="" type="radio"/> Disable <input type="radio"/> Enable</p>

## Maintenance Policies

Cisco UCS Maintenance Policies define the behavior of the attached blades and rack-mount servers when changes are made to the associated service profiles. The default Cisco UCS Maintenance Policy setting is “Immediate” meaning that any change to a service profile that requires a reboot of the physical server will result in an immediate reboot of that server. The Cisco best practice is to use a Maintenance Policy set to “user-ack”, which requires a secondary acknowledgement by a user with the appropriate rights within Cisco UCS Manager, before the server is rebooted to apply the changes. The HyperFlex installer creates a Maintenance Policy named “HyperFlex” with the setting changed to “user-ack”. In addition, the On Next Boot setting is enabled, which will automatically apply changes the next time the server is rebooted, without any secondary acknowledgement.  45. details the Maintenance Policy configured by the HyperFlex installer:

#### 45. Cisco UCS Maintenance Policy

Properties

---

Name : **HyperFlex**

Description : Recommended maintenance policy for HyperFlex se

Owner : **Local**

Soft Shutdown Timer : 150 Secs

Storage Config. Deployment Policy :  Immediate  User Ack

Reboot Policy :  Immediate  User Ack  Timer Automatic

On Next Boot (Apply pending changes at next reboot.)

### Power Control Policies

Cisco UCS Power Control Policies allow administrators to set priority values for power application to servers in environments where power supply may be limited, during times when the servers demand more power than is available. The HyperFlex installer creates a Power Control Policy named “HyperFlex” with all power capping disabled, and fans allowed to run at full speed when necessary.  46. details the Power Control Policy configured by the HyperFlex installer:

#### 46. Cisco UCS Power Control Policy

Properties

---

Name : **HyperFlex**

Description : Recommended Power control policy for HyperFlex se

Owner : **Local**

Fan Speed Policy : Any

Power Capping

If you choose **cap**, the server is allocated a certain amount of power bat highest priority. If you choose **no-cap**, the server is exempt from all pow

No Cap  cap

Cisco UCS Manager only enforces power capping when the servers in a p run at full capacity regardless of their priority.

### Scrub Policies

Cisco UCS Scrub Policies are used to scrub, or erase data from local disks, BIOS settings and FlexFlash SD cards. If the policy settings are enabled, the information is wiped when the service profile using the policy is disassociated from the server. The HyperFlex installer creates a Scrub Policy named “HyperFlex” which has all settings disabled, therefore all data on local disks, SD cards and BIOS settings will be preserved if a service profile is disassociated.  47. details the Scrub Policy configured by the HyperFlex installer:

#### 47. Cisco UCS Scrub Policy

Properties

---

Name : **HyperFlex**

Description : Recommended Scrub policy for HyperFlex servers

Owner : **Local**

Disk Scrub :  No  Yes

BIOS Settings Scrub :  No  Yes

FlexFlash Scrub :  No  Yes

### Serial over LAN Policies

Cisco UCS Serial over LAN (SoL) Policies enable console output which is sent to the serial port of the server, to be accessible via the LAN. For many Linux based operating systems, such as VMware ESXi, the local serial port can be configured as a local console, where users can watch the system boot, and communicate with the system command prompt interactively. Since many blade servers do not have physical serial ports, and often administrators are working remotely, the ability to send and receive that traffic via the LAN is very helpful. Connections to a SoL session can be initiated from Cisco UCS Manager. The HyperFlex installer creates a SoL named “HyperFlex” to enable SoL sessions, and uses this feature to configure the ESXi hosts’ management networking configuration.  48. details the SoL Policy configured by the HyperFlex installer:

## 48. Cisco UCS Serial over LAN Policy

Properties

Name : **HyperFlex**

Description : Recommended Serial over LAN policy for HyperFlex

Owner : **Local**

Serial over LAN State :  Disable  Enable

Speed : 115200

### vMedia Policies

Cisco UCS Virtual Media (vMedia) Policies automate the connection of virtual media files to the remote KVM session of the Cisco UCS blades and rack-mount servers. Using a vMedia policy can speed up installation time by automatically attaching an installation ISO file to the server, without having to manually launch the remote KVM console and connect them one-by-one. The HyperFlex installer creates a vMedia Policy named “HyperFlex” for future use, with no media locations defined.

### Cisco UCS Service Profile Templates

Cisco UCS Manager has a feature to configure service profile templates, which can be used to simplify and speed up configuration efforts when the same configuration needs to be applied to multiple servers. Service profile templates are used to spawn multiple service profile copies to associate with a group of servers, versus configuring the same service profile manually each time it is needed. Service profile templates contain all the configuration elements that make up a service profile, including vNICs, vHBAs, local disk configurations, boot policies, host firmware packages, BIOS policies and more. Templates are created as either initial templates, or updating templates. Updating templates retain a link between the parent template and the child object, therefore when changes are made to the template, the changes are propagated to all remaining linked child objects. The HyperFlex installer creates four service profile templates, named “hx-nodes”, “hx-nodes-m5”, “compute-nodes” and “compute-nodes-m5”, each with nearly the same configuration, except for the BIOS, firmware, local disk configuration and boot policies. This simplifies future efforts if the configuration of the compute only nodes needs to differ from the configuration of the HyperFlex converged storage nodes. The following tables detail the service profile templates configured by the HyperFlex installer:

**Table 31 Cisco UCS Service Profile Template Settings and Values**

<b>Service Profile Template Name:</b>	hx-nodes
<b>Setting</b>	<b>Value</b>
<b>UUID Pool</b>	Hardware Default
<b>Associated Server Pool</b>	None
<b>Maintenance Policy</b>	HyperFlex
<b>Management IP Address Policy</b>	hx-ext-mgmt
<b>Local Disk Configuration Policy</b>	HyperFlex
<b>LAN Connectivity Policy</b>	HyperFlex
<b>Boot Policy</b>	HyperFlex

<b>BIOS Policy</b>	HyperFlex
<b>Firmware Policy</b>	HyperFlex
<b>Power Control Policy</b>	HyperFlex
<b>Scrub Policy</b>	HyperFlex
<b>Serial over LAN Policy</b>	HyperFlex
<b>vMedia Policy</b>	Not defined

<b>Service Profile Template Name:</b>	<b>hx-nodes-m5</b>
<b>Setting</b>	<b>Value</b>
<b>UUID Pool</b>	Hardware Default
<b>Associated Server Pool</b>	None
<b>Maintenance Policy</b>	HyperFlex
<b>Management IP Address Policy</b>	hx-ext-mgmt
<b>Local Disk Configuration Policy</b>	HyperFlex-m5
<b>LAN Connectivity Policy</b>	HyperFlex
<b>Boot Policy</b>	HyperFlex-m5
<b>BIOS Policy</b>	HyperFlex-m5
<b>Firmware Policy</b>	HyperFlex-m5
<b>Power Control Policy</b>	HyperFlex
<b>Scrub Policy</b>	HyperFlex
<b>Serial over LAN Policy</b>	HyperFlex

<b>Service Profile Template Name:</b>	<b>hx-nodes-m5</b>
<b>Setting</b>	<b>Value</b>
vMedia Policy	Not defined

<b>Service Profile Template Name:</b>	<b>compute-nodes</b>
<b>Setting</b>	<b>Value</b>
UUID Pool	Hardware Default
Associated Server Pool	None
Maintenance Policy	HyperFlex
Management IP Address Policy	hx-ext-mgmt
Local Disk Configuration Policy	hx-compute
LAN Connectivity Policy	HyperFlex
Boot Policy	hx-compute
BIOS Policy	HyperFlex
Firmware Policy	HyperFlex
Power Control Policy	HyperFlex
Scrub Policy	HyperFlex
Serial over LAN Policy	HyperFlex
vMedia Policy	Not defined

<b>Service Profile Template Name:</b>	<b>compute-nodes-m5</b>
---------------------------------------	-------------------------

Setting	Value
UUID Pool	Hardware Default
Associated Server Pool	None
Maintenance Policy	HyperFlex
Management IP Address Policy	hx-ext-mgmt
Local Disk Configuration Policy	hx-compute-m5
LAN Connectivity Policy	HyperFlex
Boot Policy	hx-compute-m5
BIOS Policy	HyperFlex-m5
Firmware Policy	HyperFlex-m5
Power Control Policy	HyperFlex
Scrub Policy	HyperFlex
Serial over LAN Policy	HyperFlex
vMedia Policy	Not defined

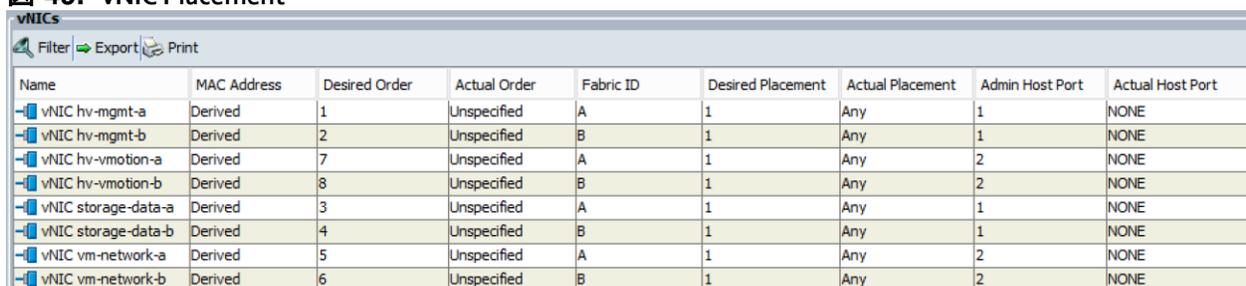
### vNIC/vHBA Placement

In order to control the order of detection of the vNICs and vHBAs defined in service profiles, Cisco UCS allows for the definition of the placement of the vNICs and vHBAs across the cards in a blade or rack-mount server, and the order they are seen. Since HX-series servers are configured with a single Cisco UCS VIC mLOM card, the only valid placement is on card number 1. In certain hardware configurations, the physical mapping of cards and port extenders to their logical order is not linear, therefore each card is referred to as a virtual connection, or vCon. Because of this, the interface where the placement and order is defined does not refer to physical cards, but instead refers to vCons. Therefore, all the vNICs defined in the service profile templates for HX-series servers, places them on vCon 1, then their order is defined.

Through the combination of the vNIC templates created ([vNIC Templates](#)), the LAN Connectivity Policy ([LAN Connectivity Policies](#)), and the vNIC placement, every VMware ESXi server will detect the network interfaces in a known and identical order, and they will always be connected to the same VLANs via the same network fabrics. The following table outlines the vNICs, their placement, their order, the fabric they are connected to, their default VLAN, and how they are enumerated by the ESXi hypervisor:

**Table 32 vNIC Placement**

vNIC	Placement	Order	Fabric	VLAN	ESXi interface enumeration
hv-mgmt-a	1	1	A	<<hx-inband-mgmt>>	vmnic0
hv-mgmt-b	1	2	B	<<hx-inband-mgmt>>	vmnic1
storage-data-a	1	3	A	<<hx-storage-data>>	vmnic2
storage-data-b	1	4	B	<<hx-storage-data>>	vmnic3
vm-network-a	1	5	A	<<hx-vm-data>>	vmnic4
vm-network-b	1	6	B	<<hx-vm-data>>	vmnic5
hv-vmotion-a	1	7	A	<<hx-vmotion>>	vmnic6
hv-vmotion-b	1	8	B	<<hx-vmotion>>	vmnic7

**49. vNIC Placement**


Name	MAC Address	Desired Order	Actual Order	Fabric ID	Desired Placement	Actual Placement	Admin Host Port	Actual Host Port
vNIC hv-mgmt-a	Derived	1	Unspecified	A	1	Any	1	NONE
vNIC hv-mgmt-b	Derived	2	Unspecified	B	1	Any	1	NONE
vNIC hv-vmotion-a	Derived	7	Unspecified	A	1	Any	2	NONE
vNIC hv-vmotion-b	Derived	8	Unspecified	B	1	Any	2	NONE
vNIC storage-data-a	Derived	3	Unspecified	A	1	Any	1	NONE
vNIC storage-data-b	Derived	4	Unspecified	B	1	Any	1	NONE
vNIC vm-network-a	Derived	5	Unspecified	A	1	Any	2	NONE
vNIC vm-network-b	Derived	6	Unspecified	B	1	Any	2	NONE



Note: ESXi VMDirectPath relies on a fixed PCI address for the passthrough devices. If the configuration is changed by adding or removing vNICs or vHBAs, then the order of the devices seen in the PCI tree will change. The ESXi hosts will subsequently need to reboot one additional time in order to repair the configuration, which they will do automatically.

## ESXi Host Design

The following sections detail the design of the elements within the VMware ESXi hypervisors, system requirements, virtual networking and the configuration of ESXi for the Cisco HyperFlex HX Distributed Data Platform.

### Virtual Networking Design

The Cisco HyperFlex system has a pre-defined virtual network design at the ESXi hypervisor level. Four different virtual switches are created by the HyperFlex installer, each using two uplinks, which are each serviced by a vNIC defined in the Cisco UCS service profile. The vSwitches created are:

- **vswitch-hx-inband-mgmt:** This is the default vSwitch which is renamed by the ESXi kickstart file as part of the automated installation. The default VMkernel port, vmko, is configured in the standard Management Network port group. The switch has two uplinks, active on fabric A and standby on fabric B, without jumbo frames. A second port group is created for the Storage Platform Controller VMs to connect to with their individual management interfaces. A third port group is created for cluster to cluster VM snapshot replication traffic. The VLANs are not Native VLANs as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.
- **vswitch-hx-storage-data:** This vSwitch is created as part of the automated installation. A VMkernel port, vmk1, is configured in the Storage Hypervisor Data Network port group, which is the interface used for connectivity to the HX Datastores via NFS. The switch has two uplinks, active on fabric B and standby on fabric A, with jumbo frames highly recommended. A second port group is created for the Storage Platform Controller VMs to connect to with their individual storage interfaces. The VLAN is not a Native VLAN as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.
- **vswitch-hx-vm-network:** This vSwitch is created as part of the automated installation. The switch has two uplinks, active on both fabrics A and B, and without jumbo frames. The VLANs are not Native VLANs as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.
- **vmotion:** This vSwitch is created as part of the automated installation. The switch has two uplinks, active on fabric A and standby on fabric B, with jumbo frames highly recommended. The IP addresses of the VMkernel ports (vmk2) are configured during the post\_install script execution. The VLAN is not a Native VLAN as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.

The following table and figures help give more details into the ESXi virtual networking design as built by the HyperFlex installer by default:

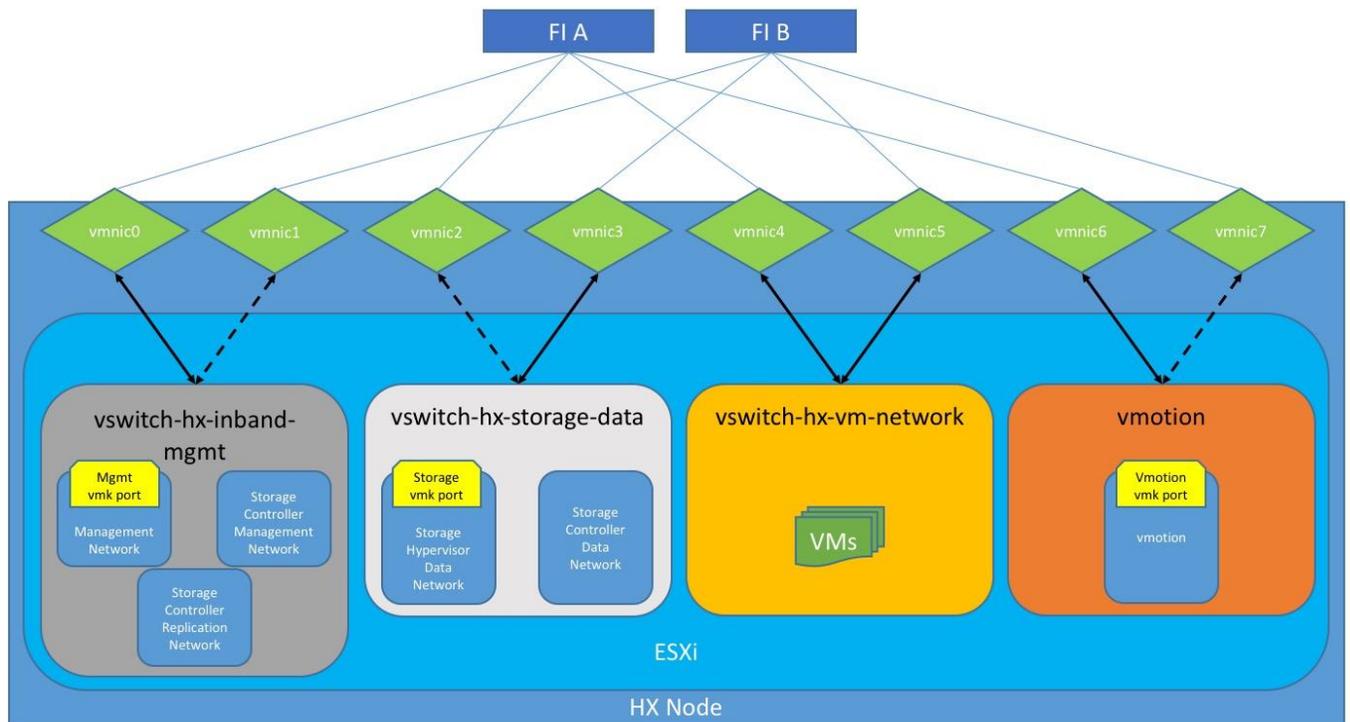
**Table 33 Virtual Switches**

Virtual Switch	Port Groups	Active vmnic(s)	Passive vmnic(s)	VLAN IDs	Jumbo
vswitch-hx-inband-mgmt	Management Network Storage Controller Management Network	vmnico	vmnic1	<<hx-inband-mgmt>>	no
	Storage Controller Replication Network	vmnico	vmnic1	<<hx-inband-repl>>	no
vswitch-hx-storage-data	Storage Controller Data Network Storage Hypervisor Data Network	vmnic3	vmnic2	<<hx-storage-data>>	yes
vswitch-hx-vm-network	vm-network-<<VLAN ID>>	vmnic4 vmnic5		<<vm-network>>	no
vmotion	vmotion-<<VLAN ID>>	vmnic6	vmnic7	<<hx-vmotion>>	yes

❏ 50.



## 51. ESXi Network Design



### VMDirectPath I/O Passthrough

VMDirectPath I/O allows a guest VM to directly access PCI and PCIe devices in an ESXi host as though they were physical devices belonging to the VM itself, also referred to as PCI passthrough. With the appropriate driver for the hardware device, the guest VM sends all I/O requests directly to the physical device, bypassing the hypervisor. In the Cisco HyperFlex system, the Storage Platform Controller VMs use this feature to gain full control of the Cisco 12Gbps SAS HBA cards in the Cisco HX-series rack-mount servers. This gives the controller VMs direct hardware level access to the physical disks installed in the servers, which they consume to construct the Cisco HX Distributed Filesystem. Only the disks connected directly to the Cisco SAS HBA are controlled by the controller VMs. Other disks, connected to different controllers, such as the SD cards, remain under the control of the ESXi hypervisor. The configuration of the VMDirectPath I/O feature is done by the Cisco HyperFlex installer and requires no manual steps.

### Storage Platform Controller VMs

A key component of the Cisco HyperFlex system is the Storage Platform Controller Virtual Machine running on each of the nodes in the HyperFlex cluster. The controller VMs cooperate to form and coordinate the Cisco HX Distributed Filesystem, and service all the guest VM IO requests. The controller VMs are deployed as a vSphere ESXi agent, which is similar in concept to that of a Linux or Windows service. ESXi agents are tied to a specific host, they start and stop along with the ESXi hypervisor, and the system is not considered to be online and ready until both the hypervisor and the agents have started. Each ESXi hypervisor host has a single ESXi agent deployed, which is the controller VM for that node, and it cannot be moved or migrated to another host, nor should its settings be manually modified in any way. The collective ESXi agents are managed via an ESXi agency in the vSphere cluster.

The storage controller VM runs custom software and services that manage and maintain the Cisco HX Distributed Filesystem. The services and processes that run within the controller VMs are not exposed as part of the ESXi agents to the agency, therefore the ESXi hypervisors nor vCenter server have any direct knowledge of the storage services provided by the controller VMs. Management and visibility into the function of the controller VMs, and the Cisco HX Distributed

Filesystem is done via the HyperFlex Connect HTML management webpage, or a plugin installed to the vCenter server or appliance managing the vSphere cluster. The plugin communicates directly with the controller VMs to display the information requested, or make the configuration changes directed, all while operating within the same web-based interface of the vSphere Web Client. The deployment of the controller VMs, agents, agency, and vCenter plugin are all done by the Cisco HyperFlex installer, and requires no manual steps.

### Controller VM Locations

The physical storage location of the controller VMs differs among the Cisco HX-Series rack servers, due to differences with the physical disk location and connections on those server models. The storage controller VM is operationally no different from any other typical virtual machines in an ESXi environment. The VM must have a virtual disk with the bootable root filesystem available in a location separate from the SAS HBA that the VM is controlling via VMDirectPath I/O. The configuration details of the models are as follows:

- **HX220c M5, HXAF220c M5, HX240c M5 and HXAF240c M5:** The server boots the ESXi hypervisor from the internal M.2 form factor SSD. The M.2 SSD is partitioned by the ESXi installer, and the remaining 216 GB of space is used as a VMFS datastore. The controller VM's root filesystem is stored on a 2.5 GB virtual disk, /dev/sda, which is placed on this VMFS datastore. The controller VM has full control of all the front and rear facing hot-swappable disks via PCI passthrough control of the SAS HBA. The controller VM operating system sees the 240 GB SSD, also commonly called the "housekeeping" disk as /dev/sdb, and places HyperFlex binaries and logs on this disk. The remaining disks seen by the controller VM OS are used by the HX Distributed filesystem for caching and capacity layers.
- **HX220c M4 and HXAF220c M4:** The controller VM's root filesystem is stored on a 2.5 GB virtual disk, /dev/sda, which is placed on a 3.5 GB VMFS datastore, and that datastore is provisioned from the internal mirrored SD cards. The controller VM has full control of all the front facing hot-swappable disks via PCI passthrough control of the SAS HBA. The controller VM operating system sees the 120 GB or 240 GB SSD, also commonly called the "housekeeping" disk as /dev/sdb, and places HyperFlex binaries and logs on this disk. The remaining disks seen by the controller VM OS are used by the HX Distributed filesystem for caching and capacity layers.
- **HX240c M4 and HXAF240c M4:** The HX240c-M4SX and HXAF240c-M4SX server has a built-in SATA controller provided by the Intel Wellsburg Platform Controller Hub (PCH) chip, and the 120 GB or 240 GB housekeeping disk is connected to it, placed in an internal drive carrier. Since this model does not connect the housekeeping disk to the SAS HBA, the ESXi hypervisor remains in control of this disk, and a VMFS datastore is provisioned there, using the entire disk. On this VMFS datastore, a 2.2 GB virtual disk is created and used by the controller VM as /dev/sda for the root filesystem, and an 87 GB virtual disk is created and used by the controller VM as /dev/sdb, placing the HyperFlex binaries and logs on this disk. The front-facing hot swappable disks, seen by the controller VM OS via PCI passthrough control of the SAS HBA, are used by the HX Distributed filesystem for caching and capacity layers.

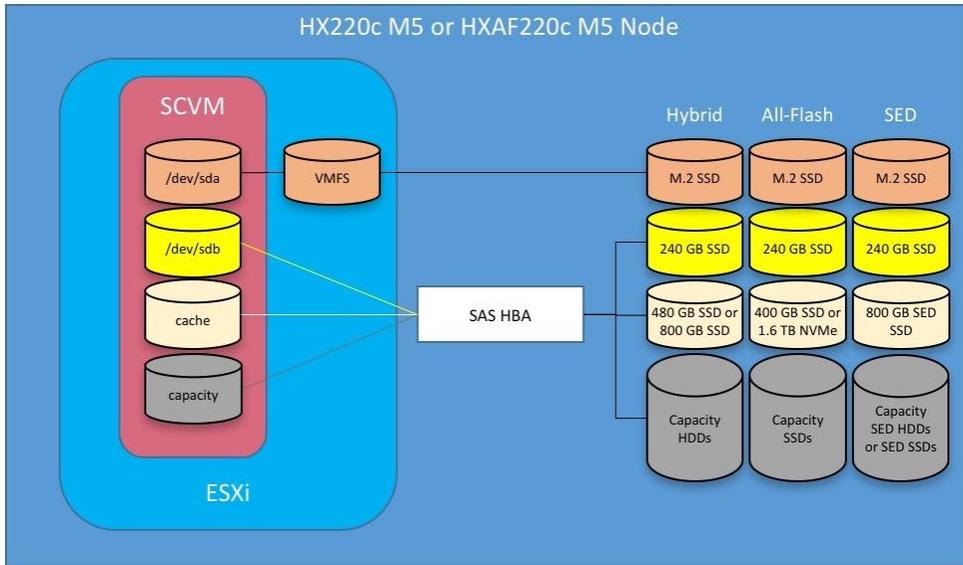


**Note:** On the HX240c M4 and HXAF240c M4 model servers, when configured with SEDs, the housekeeping disk is moved to a front disk slot. Since this disk is physically controlled by the SAS HBA in PCI passthrough mode, the configuration of the SCVM virtual disks changes to be the same as that of the HX220c and HXAF220c servers.

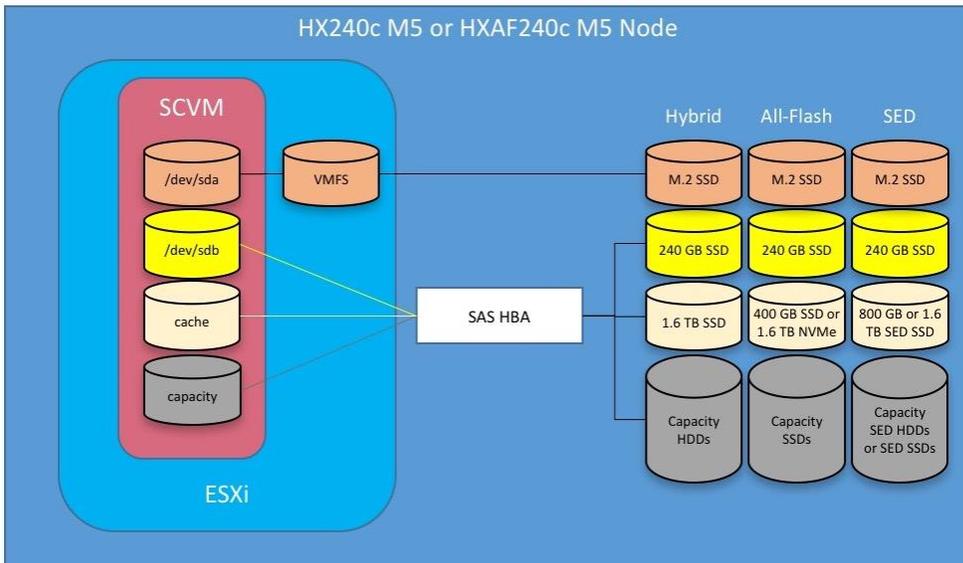
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The following figures detail the Storage Platform Controller VM placement on the ESXi hypervisor hosts:

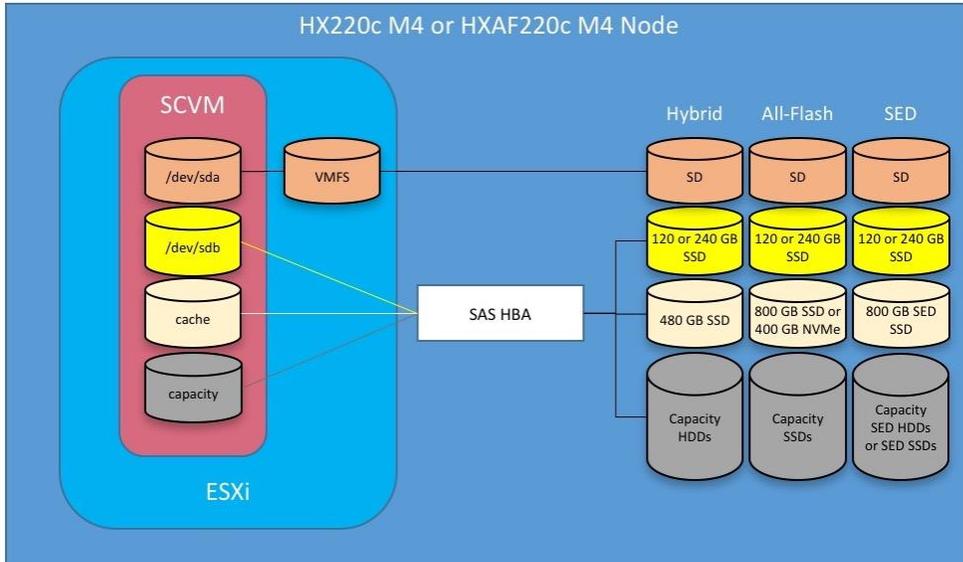
#### ☒ 52. HX220c M5 Controller VM Placement



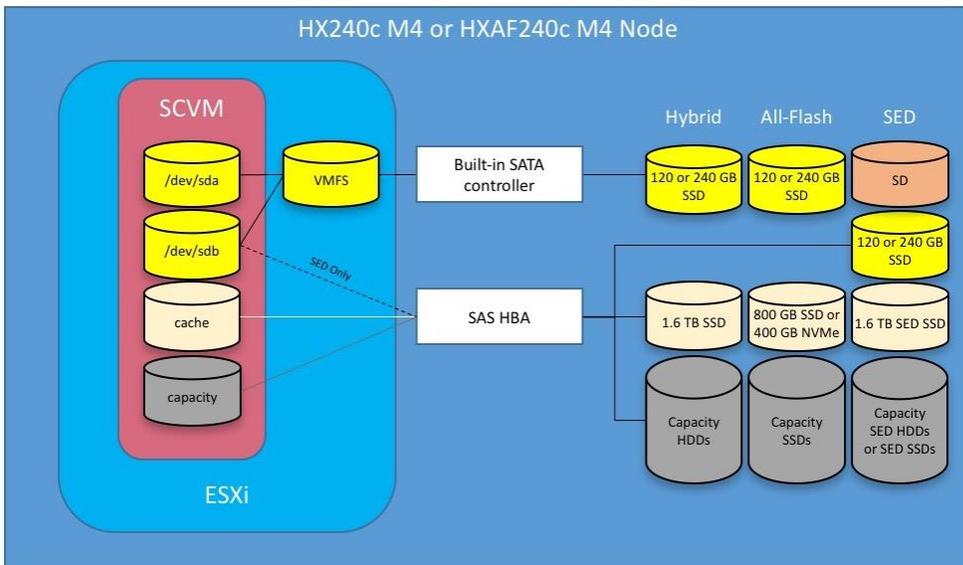
**53. HX240c M5 Controller VM Placement**



**54. HX220c M4 Controller VM Placement**



**55. HX240c M4 Controller VM Placement**

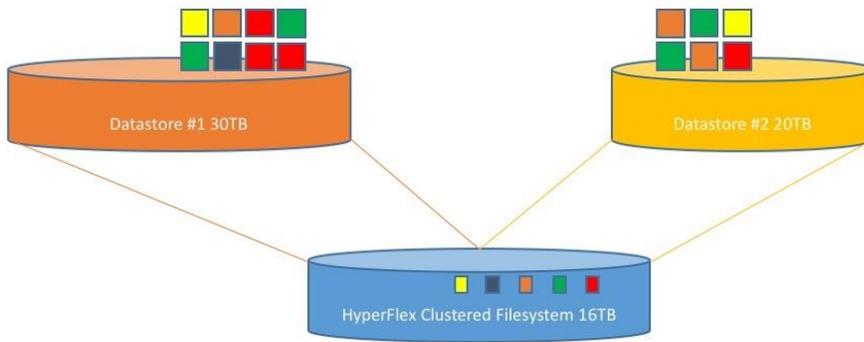


Note: The HyperFlex compute-only Cisco UCS server blades or rack-mount servers also place a lightweight storage controller VM on a 3.5 GB VMFS datastore, which can be provisioned from the SD cards, or placed on a VMFS partition alongside the boot volume if booting from SAN or local disk.

HyperFlex Datastores

The new HyperFlex cluster has no default datastores configured for virtual machine storage, therefore the datastores must be created using the vCenter Web Client plugin or the HyperFlex Connect GUI. It is important to recognize that all HyperFlex datastores are thinly provisioned, meaning that their configured size can far exceed the actual space available in the HyperFlex cluster. Alerts will be raised by the HyperFlex system in HyperFlex Connect or the vCenter plugin when actual space consumption results in low amounts of free space, and alerts will be sent via auto support email alerts. Overall space consumption in the HyperFlex clustered filesystem is optimized by the default deduplication and compression features.

**56. Datastore Example**



### CPU Resource Reservations

Since the storage controller VMs provide critical functionality of the Cisco HX Distributed Data Platform, the HyperFlex installer will configure CPU resource reservations for the controller VMs. This reservation guarantees that the controller VMs will have CPU resources at a minimum level, in situations where the physical CPU resources of the ESXi hypervisor host are being heavily consumed by the guest VMs. This is a soft guarantee, meaning in most situations the SCVMs are not using all of the CPU resources reserved, therefore allowing the guest VMs to use them. The following table details the CPU resource reservation of the storage controller VMs:

**Table 34 Controller VM CPU Reservations**

Number of vCPU	Shares	Reservation	Limit
8	Low	10800 MHz	unlimited

### Memory Resource Reservations

Since the storage controller VMs provide critical functionality of the Cisco HX Distributed Data Platform, the HyperFlex installer will configure memory resource reservations for the controller VMs. This reservation guarantees that the controller VMs will have memory resources at a minimum level, in situations where the physical memory resources of the ESXi hypervisor host are being heavily consumed by the guest VMs. The following table details the memory resource reservation of the storage controller VMs:

**Table 35 Controller VM Memory Reservations**

Server Model	Amount of Guest Memory	Reserve All Guest Memory
HX220c-M5SX HXAF220c-M5SX HX220c-M4S HXAF220c-M4S	48 GB	Yes
HX240c-M5SX HXAF240c-M5SX HX240c-M4SX HXAF240c-M4SX	72 GB	Yes



Note: The compute-only nodes have a lightweight storage controller VM, it is configured with only 1 vCPU of 1024MHz and 512 MB of memory reservation.

---

## Installation

Cisco HyperFlex systems are ordered with a factory pre-installation process having been done prior to the hardware delivery. This factory integration work will deliver the HyperFlex servers with the proper firmware revisions pre-set, a copy of the VMware ESXi hypervisor software pre-installed, and some components of the Cisco HyperFlex software already installed. Once on site, the final steps to be performed are reduced and simplified due to the previous factory work. For the purpose of this document, the setup process is described as though this factory pre-installation work was done, thereby leveraging the tools and processes developed by Cisco to simplify the process and dramatically reduce the deployment time.

Installation of the Cisco HyperFlex system is primarily done via a deployable HyperFlex installer virtual machine, available for download at [cisco.com](http://cisco.com) as an OVA file. The installer VM performs the Cisco UCS configuration work, the configuration of ESXi on the HyperFlex hosts, the installation of the HyperFlex HX Data Platform software and creation of the HyperFlex cluster. Because this simplified installation method has been developed by Cisco, this CVD will not give detailed manual steps for the configuration of all the elements that are handled by the installer. The following sections will guide you through the prerequisites and manual steps needed prior to using the HyperFlex installer, how to utilize the HyperFlex Installer, and finally how to perform the remaining post-installation tasks.

## Prerequisites

Prior to beginning the installation activities, it is important to gather the following information:

## IP Addressing

To install the HX Data Platform, an OVF installer appliance must be deployed on a separate virtualization host, which is not a member of the HyperFlex cluster. The HyperFlex installer requires one IP address on the management network and the HX installer appliance IP address must be able to communicate with Cisco UCS Manager, ESXi management IP addresses on the HX hosts, and the vCenter IP addresses where the HyperFlex cluster will be managed.

Additional IP addresses for the Cisco HyperFlex system need to be allocated from the appropriate subnets and VLANs to be used. IP addresses that are used by the system fall into the following groups:

- **Cisco UCS Manager:** These addresses are used and assigned by Cisco UCS manager. Three IP addresses are used by Cisco UCS Manager; one address is assigned to each Cisco UCS Fabric Interconnect, and the third IP address is a roaming address for management of the Cisco UCS cluster. In addition, at least one IP address per Cisco UCS blade or HX-series rack-mount server is required for the `hx-ext-mgmt` IP address pool, which are assigned to the CIMC interface of the physical servers. Since these management addresses are assigned from a pool, they need to be provided in a contiguous block of addresses. These addresses must all be in the same subnet.
- **HyperFlex and ESXi Management:** These addresses are used to manage the ESXi hypervisor hosts, and the HyperFlex Storage Platform Controller VMs. Two IP addresses per node in the HyperFlex cluster are required from the same subnet, and a single additional IP address is needed as the roaming HyperFlex cluster management interface. These addresses can be assigned from the same subnet as the Cisco UCS Manager addresses, or they may be separate.
- **HyperFlex Replication:** These addresses are used by the HyperFlex Storage Platform Controller VMs for clusters that are configured to replicate VMs to one another. One IP address per HX node is required, plus one additional IP address as a roaming clustered replication interface. These addresses are assigned to a pool as part of a post-installation activity described later in this document, and are not needed to complete the initial installation of a HyperFlex cluster. These addresses can be from the same subnet as the HyperFlex and ESXi management addresses, but it is recommended that the VLAN ID and subnet be unique.

- HyperFlex Storage:** These addresses are used by the HyperFlex Storage Platform Controller VMs, and as VMkernel interfaces on the ESXi hypervisor hosts, for sending and receiving data to/from the HX Distributed Data Platform Filesystem. Two IP addresses per node in the HyperFlex cluster are required from the same subnet, and a single additional IP address is needed as the roaming HyperFlex cluster storage interface. It is recommended to provision a subnet that is not used in the network for other purposes, and it is also possible to use non-routable IP address ranges for these interfaces. Finally, if the Cisco UCS domain is going to contain multiple HyperFlex clusters, it is recommended to use a different subnet and VLAN ID for the HyperFlex storage traffic for each cluster. This is a safer method, guaranteeing that storage traffic from multiple clusters cannot intermix.
- VMotion:** These IP addresses are used by the ESXi hypervisor hosts as VMkernel interfaces to enable vMotion capabilities. One or more IP addresses per node in the HyperFlex cluster are required from the same subnet. Multiple addresses and VMkernel interfaces can be used if you wish to enable multi-nic vMotion, although this configuration would require additional manual steps.

The following tables will assist with gathering the required IP addresses for the installation of an 8 node standard HyperFlex cluster, or a 4+4 extended cluster, by listing the addresses required, and an example configuration:



**Note:** Table cells shaded in black do not require an IP address.

**Table 36** HyperFlex Cluster IP Addressing

Address Group:	UCS Management	HyperFlex and ESXi Management			HyperFlex Storage		VMotion
VLAN ID:							
Subnet:							
Subnet Mask:							
Gateway:							
Device	UCS Management Addresses	ESXi Management Interface	Storage Controller Management Interface	Storage Controller Replication Network	ESXi Hypervisor Storage VMkernel Interface	Storage Controller Storage Interface	VMotion VMkernel Interface
Fabric Interconnect A							
Fabric Interconnect B							
UCS Manager							
HyperFlex Cluster							
HyperFlex Node #1							
HyperFlex Node #2							
HyperFlex Node #3							
HyperFlex Node #4							
HyperFlex Node #5							
HyperFlex Node #6							
HyperFlex Node #7							
HyperFlex Node #8							

**Table 37 HyperFlex Extended Cluster IP Addressing**

Address Group:	UCS Management	HyperFlex and ESXi Management			HyperFlex Storage		VMotion
VLAN ID:							
Subnet:							
Subnet Mask:							
Gateway:							
Device	UCS Management Addresses	ESXi Management Interface	Storage Controller Management Interface	Storage Controller Replication Network	ESXi Hypervisor Storage VMkernel Interface	Storage Controller Storage Interface	VMotion VMkernel Interface
Fabric Interconnect A							
Fabric Interconnect B							
UCS Manager							
HyperFlex Cluster							
HyperFlex Node #1							
HyperFlex Node #2							
HyperFlex Node #3							
HyperFlex Node #4							
Compute Node #1							
Compute Node #2							
Compute Node #3							
Compute Node #4							

**Table 38 HyperFlex Cluster Example IP Addressing**

Address Group:	UCS Management	HyperFlex and ESXi Management			HyperFlex Storage		VMotion
VLAN ID:	133	133	150		51		200
Subnet:	10.29.133.0	10.29.133.0	192.168.150.0		192.168.51.0		192.168.200.0
Subnet Mask:	255.255.255.0	255.255.255.0	255.255.255.0		255.255.255.0		255.255.255.0
Gateway:	10.29.133.1	10.29.133.1	192.168.150.1				
Device	UCS Management Addresses	ESXi Management Interface	Storage Controller Management Interface	Storage Controller Replication Network	ESXi Hypervisor Storage VMkernel Interface	Storage Controller Storage Interface	VMotion VMkernel Interface
Fabric Interconnect A	10.29.133.104						
Fabric Interconnect B	10.29.133.105						
UCS Manager	10.29.133.106						
HyperFlex Cluster			10.29.133.151	192.168.150.10		192.168.51.20	
HyperFlex Node #1	10.29.133.133	10.29.133.143	10.29.133.152	192.168.150.11	192.168.51.11	192.168.51.21	192.168.200.11
HyperFlex Node #2	10.29.133.134	10.29.133.144	10.29.133.153	192.168.150.12	192.168.51.12	192.168.51.22	192.168.200.12
HyperFlex Node #3	10.29.133.135	10.29.133.145	10.29.133.154	192.168.150.13	192.168.51.13	192.168.51.23	192.168.200.13
HyperFlex Node #4	10.29.133.136	10.29.133.146	10.29.133.155	192.168.150.14	192.168.51.14	192.168.51.24	192.168.200.14
HyperFlex Node #5	10.29.133.137	10.29.133.147	10.29.133.156	192.168.150.15	192.168.51.15	192.168.51.25	192.168.200.15
HyperFlex Node #6	10.29.133.138	10.29.133.148	10.29.133.157	192.168.150.16	192.168.51.16	192.168.51.26	192.168.200.16
HyperFlex Node #7	10.29.133.139	10.29.133.149	10.29.133.158	192.168.150.17	192.168.51.17	192.168.51.27	192.168.200.17
HyperFlex Node #8	10.29.133.140	10.29.133.150	10.29.133.159	192.168.150.18	192.168.51.18	192.168.51.28	192.168.200.18



**Note:** The Cisco UCS Management and HyperFlex and ESXi Management IP addresses can come from the same subnet, or be separate, as long as the HyperFlex installer can reach them both.

### DHCP versus Static IP

By default, the HX installation will assign a static IP address to the management interface of the ESXi servers. Using Dynamic Host Configuration Protocol (DHCP) for automatic IP address assignment is not recommended.

### DNS

DNS servers are highly recommended to be configured for querying Fully Qualified Domain Names (FQDN) in the HyperFlex and ESXi Management group. DNS records need to be created prior to beginning the installation. At a minimum, it is highly recommended to create A records and reverse PTR records for the ESXi hypervisor hosts' management interfaces. Additional A records can be created for the Storage Controller Management interfaces, ESXi Hypervisor Storage interfaces, and the Storage Controller Storage interfaces if desired.

The following tables will assist with gathering the required DNS information for the installation, by listing the information required, and an example configuration:

**Table 39 DNS Server Information**

Item	Value
DNS Server #1	
DNS Server #2	
DNS Domain	
vCenter Server Name	
SMTP Server Name	
UCS Domain Name	
HX Server #1 Name	
HX Server #2 Name	
HX Server #3 Name	
HX Server #4 Name	
HX Server #5 Name	
HX Server #6 Name	
HX Server #7 Name	
HX Server #8 Name	

**Table 40 DNS Server Example Information**

Item	Value
DNS Server #1	10.29.133.110
DNS Server #2	
DNS Domain	hx.lab.cisco.com

Item	Value
vCenter Server Name	vcenter.hx.lab.cisco.com
SMTP Server Name	outbound.cisco.com
UCS Domain Name	HX1-FI
HX Server #1 Name	hx220-01.hx.lab.cisco.com
HX Server #2 Name	hx220-02.hx.lab.cisco.com
HX Server #3 Name	hx220-03.hx.lab.cisco.com
HX Server #4 Name	hx220-04.hx.lab.cisco.com
HX Server #5 Name	hx220-05.hx.lab.cisco.com
HX Server #6 Name	hx220-06.hx.lab.cisco.com
HX Server #7 Name	hx220-07.hx.lab.cisco.com
HX Server #8 Name	hx220-08.hx.lab.cisco.com

## NTP

Consistent time clock synchronization is required across the components of the HyperFlex system, provided by reliable NTP servers, accessible for querying in the Cisco UCS Management network group, and the HyperFlex and ESXi Management group. NTP is used by Cisco UCS Manager, vCenter, the ESXi hypervisor hosts, and the HyperFlex Storage Platform Controller VMs. The use of public NTP servers is highly discouraged, instead a reliable internal NTP server should be used.

The following tables will assist with gathering the required NTP information for the installation by listing the information required, and an example configuration:

**Table 41 NTP Server Information**

Item	Value
NTP Server #1	
NTP Server #2	
Timezone	

**Table 42 NTP Server Example Information**

Item	Value
NTP Server #1	171.68.38.65
NTP Server #2	171.68.38.66
Timezone	(UTC-8:00) Pacific Time

## VLANS

Prior to the installation, the required VLAN IDs need to be documented, and created in the upstream network if necessary. At a minimum, there are 4 VLANs that need to be trunked to the Cisco UCS Fabric Interconnects that comprise the HyperFlex system; a VLAN for the HyperFlex and ESXi Management group, a VLAN for the HyperFlex Storage group, a VLAN for the VMotion group, and at least one VLAN for the guest VM traffic. If HyperFlex Replication is to be used, another VLAN must be created and trunked for the replication traffic. The VLAN IDs must be supplied during the HyperFlex Cisco UCS configuration step, and the VLAN names can optionally be customized.

The following tables will assist with gathering the required VLAN information for the installation by listing the information required, and an example configuration:

**Table 43 VLAN Information**

Name	ID
<<hx-inband-mgmt>>	
<<hx-inband-repl>>	
<<hx-storage-data>>	
<<hx-vm-data>>	
<<hx-vmotion>>	

**Table 44 VLAN Example Information**

Name	ID
hx-inband-mgmt	133
hx-inband-repl	150
hx-storage-data	51

Name	ID
vm-network	100
hx-vmotion	200

## Network Uplinks

The Cisco UCS uplink connectivity design needs to be finalized prior to beginning the installation. One of the early manual tasks to be completed is to configure the Cisco UCS network uplinks and verify their operation, prior to beginning the HyperFlex installation steps. Refer to the network uplink design possibilities in the [Network Design](#) section.

The following tables will assist with gathering the required network uplink information for the installation by listing the information required, and an example configuration:

**Table 45 Network Uplink Configuration**

Fabric Interconnect Port		Port Channel	Port Channel Type	Port Channel ID	Port Channel Name
A		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> LACP		
		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> vPC		
		<input type="checkbox"/> Yes <input type="checkbox"/> No			
		<input type="checkbox"/> Yes <input type="checkbox"/> No			
B		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> LACP		
		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> vPC		
		<input type="checkbox"/> Yes <input type="checkbox"/> No			
		<input type="checkbox"/> Yes <input type="checkbox"/> No			

**Table 46 Network Uplink Example Configuration**

Fabric Interconnect Port		Port Channel	Port Channel Type	Port Channel ID	Port Channel Name
A	1/25	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> LACP	10	vpc-10
	1/26	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> vPC		

Fabric Interconnect Port		Port Channel	Port Channel Type	Port Channel ID	Port Channel Name
		<input type="checkbox"/> Yes <input type="checkbox"/> No			
		<input type="checkbox"/> Yes <input type="checkbox"/> No			
B	1/25	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> LACP <input checked="" type="checkbox"/> vPC	20	vpc-20
	1/26	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
		<input type="checkbox"/> Yes <input type="checkbox"/> No			
		<input type="checkbox"/> Yes <input type="checkbox"/> No			

### Username and Passwords

Several usernames and passwords need to be defined or known as part of the HyperFlex installation process. The following tables will assist with gathering the required username and password information by listing the information required and an example configuration:

**Table 47** Usernames and Passwords

Account	Username	Password
HX Installer Administrator	root	<<hx_install_root_pw>>
UCS Administrator	admin	<<ucs_admin_pw>>
ESXi Administrator	root	<<esxi_root_pw>>
HyperFlex Administrator	root	<<hx_admin_pw>>
vCenter Administrator	<<vcenter_administrator>>	<<vcenter_admin_pw>>

**Table 48** Example Usernames and Passwords

Account	Username	Password
HX Installer Administrator	root	Cisco123
UCS Administrator	admin	Cisco123

Account	Username	Password
ESXi Administrator	root	Cisco123
HyperFlex Administrator	root	Cisco123!!
vCenter Administrator	administrator@vsphere.local	!QAZ2wsx

## Physical Installation

Install the Fabric Interconnects, the HX-Series rack-mount servers, standard C-series rack-mount servers, the Cisco UCS 5108 chassis, the Cisco UCS Fabric Extenders, and the Cisco UCS blades according to their corresponding hardware installation guides:

Cisco UCS 6200 Series Fabric Interconnect:

[http://www.cisco.com/c/en/us/td/docs/unified\\_computing/ucs/hw/6200-install-guide/6200\\_HIG.pdf](http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/hw/6200-install-guide/6200_HIG.pdf)

Cisco UCS 6300 Series Fabric Interconnect:

[https://www.cisco.com/c/en/us/td/docs/unified\\_computing/ucs/hw/6300-install-guide/6300\\_Series\\_HIG.html](https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/hw/6300-install-guide/6300_Series_HIG.html)

HX220c M5 Server:

[https://www.cisco.com/c/en/us/td/docs/hyperconverged\\_systems/HX\\_series/HX220c\\_M5/HX220c\\_M5.html](https://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HX_series/HX220c_M5/HX220c_M5.html)

HX240c M5 Server:

[https://www.cisco.com/c/en/us/td/docs/hyperconverged\\_systems/HX\\_series/HX240c\\_M5/HX240c\\_M5.html](https://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HX_series/HX240c_M5/HX240c_M5.html)

HX220c M4 Server:

[http://www.cisco.com/c/en/us/td/docs/hyperconverged\\_systems/HX\\_series/HX220c\\_M4/HX220c/overview.html](http://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HX_series/HX220c_M4/HX220c/overview.html)

HX240c M4 Server:

[http://www.cisco.com/c/en/us/td/docs/hyperconverged\\_systems/HX\\_series/HX240c\\_M4/HX240c/overview.html](http://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HX_series/HX240c_M4/HX240c/overview.html)

Cisco UCS 5108 Chassis, Servers and Fabric Extenders:

[http://www.cisco.com/c/en/us/td/docs/unified\\_computing/ucs/hw/chassis-install-guide/ucs5108\\_install.pdf](http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/hw/chassis-install-guide/ucs5108_install.pdf)

## Cabling

The physical layout of the HyperFlex system was previously described in section [Physical Topology](#). The Fabric Interconnects, HX-series rack-mount servers, Cisco UCS chassis and blades need to be cabled properly before beginning the installation activities.

Table 49 provides an example cabling map for installation of a Cisco HyperFlex system, with eight HyperFlex converged servers, and one Cisco UCS 5108 chassis.

**Table 49 Example Cabling Map**

Device	Port	Connected To	Port	Type	Length	Note
UCS6248-A	L1	UCS6248-B	L1	CAT5	1FT	
UCS6248-A	L2	UCS6248-B	L2	CAT5	1FT	
UCS6248-A	mgmto	Customer LAN				
UCS6248-A	1/1	HX Server #1	mLOM port 1	Twinax	3M	Server 1
UCS6248-A	1/2	HX Server #2	mLOM port 1	Twinax	3M	Server 2
UCS6248-A	1/3	HX Server #3	mLOM port 1	Twinax	3M	Server 3
UCS6248-A	1/4	HX Server #4	mLOM port 1	Twinax	3M	Server 4
UCS6248-A	1/5	HX Server #5	mLOM port 1	Twinax	3M	Server 5
UCS6248-A	1/6	HX Server #6	mLOM port 1	Twinax	3M	Server 6
UCS6248-A	1/7	HX Server #7	mLOM port 1	Twinax	3M	Server 7
UCS6248-A	1/8	HX Server #8	mLOM port 1	Twinax	3M	Server 8
UCS6248-A	1/9	2204XP #1	IOM1 port 1	Twinax	3M	Chassis 1
UCS6248-A	1/10	2204XP #1	IOM1 port 2	Twinax	3M	Chassis 1
UCS6248-A	1/11	2204XP #1	IOM1 port 3	Twinax	3M	Chassis 1
UCS6248-A	1/12	2204XP #1	IOM1 port 4	Twinax	3M	Chassis 1
UCS6248-A	1/13					

Device	Port	Connected To	Port	Type	Length	Note
UCS6248-A	1/14					
UCS6248-A	1/15					
UCS6248-A	1/16					
UCS6248-A	1/17					
UCS6248-A	1/18					
UCS6248-A	1/19					
UCS6248-A	1/20					
UCS6248-A	1/21					
UCS6248-A	1/22					
UCS6248-A	1/23					
UCS6248-A	1/24					
UCS6248-A	1/25	Customer LAN				uplink
UCS6248-A	1/26	Customer LAN				uplink
UCS6248-A	1/27					
UCS6248-A	1/28					
UCS6248-A	1/29					
UCS6248-A	1/30					
UCS6248-A	1/31					
UCS6248-A	1/32					

UCS6248-B	L1	UCS6248-A	L1	CAT5	1FT	
UCS6248-B	L2	UCS6248-A	L2	CAT5	1FT	
UCS6248-B	mgmt0	Customer LAN				
UCS6248-B	1/1	HX Server #1	mLOM port 2	Twinax	3M	Server 1
UCS6248-B	1/2	HX Server #2	mLOM port 2	Twinax	3M	Server 2
UCS6248-B	1/3	HX Server #3	mLOM port 2	Twinax	3M	Server 3
UCS6248-B	1/4	HX Server #4	mLOM port 2	Twinax	3M	Server 4
UCS6248-B	1/5	HX Server #5	mLOM port 2	Twinax	3M	Server 5
UCS6248-B	1/6	HX Server #6	mLOM port 2	Twinax	3M	Server 6
UCS6248-B	1/7	HX Server #7	mLOM port 2	Twinax	3M	Server 7

Device	Port	Connected To	Port	Type	Length	Note
UCS6248-B	1/8	HX Server #8	mLOM port 2	Twinax	3M	Server 8
UCS6248-B	1/9	2204XP #1	IOM2 port 1	Twinax	3M	Chassis 1
UCS6248-B	1/10	2204XP #1	IOM2 port 2	Twinax	3M	Chassis 1
UCS6248-B	1/11	2204XP #1	IOM2 port 3	Twinax	3M	Chassis 1
UCS6248-B	1/12	2204XP #1	IOM2 port 4	Twinax	3M	Chassis 1
UCS6248-B	1/13					
UCS6248-B	1/14					
UCS6248-B	1/15					
UCS6248-B	1/16					
UCS6248-B	1/17					
UCS6248-B	1/18					
UCS6248-B	1/19					
UCS6248-B	1/20					
UCS6248-B	1/21					
UCS6248-B	1/22					
UCS6248-B	1/23					
UCS6248-B	1/24					
UCS6248-B	1/25	Customer LAN				uplink
UCS6248-B	1/26	Customer LAN				uplink
UCS6248-B	1/27					
UCS6248-B	1/28					
UCS6248-B	1/29					
UCS6248-B	1/30					
UCS6248-B	1/31					
UCS6248-B	1/32					

## Cisco UCS Installation

This section describes the steps to initialize and configure the Cisco UCS Fabric Interconnects, to prepare them for the HyperFlex installation.

### Cisco UCS Fabric Interconnect A

To configure Fabric Interconnect A, complete the following steps:

1. Make sure the Fabric Interconnect cabling is properly connected, including the L1 and L2 cluster links, and power the Fabric Interconnects on by inserting the power cords.
2. Connect to the console port on the first Fabric Interconnect, which will be designated as the A fabric device. Use the supplied Cisco console cable (CAB-CONSOLE-RJ45=), and connect it to a built-in DB9 serial port, or use a USB to DB9 serial port adapter.
3. Start your terminal emulator software.
4. Create a connection to the COM port of the computer's DB9 port, or the USB to serial adapter. Set the terminal emulation to VT100, and the settings to 9600 baud, 8 data bits, no parity, and 1 stop bit.
5. Open the connection just created. You may have to press ENTER to see the first prompt.
6. Configure the first Fabric Interconnect, using the following example as a guideline:

```
---- Basic System Configuration Dialog ----
```

```
This setup utility will guide you through the basic configuration of
the system. Only minimal configuration including IP connectivity to
the Fabric interconnect and its clustering mode is performed through these steps.
```

```
Type Ctrl-C at any time to abort configuration and reboot system.
To back track or make modifications to already entered values,
complete input till end of section and answer no when prompted
to apply configuration.
```

```
Enter the configuration method. (console/gui) ? console
```

```
Enter the setup mode; setup newly or restore from backup. (setup/restore) ? setup
```

```
You have chosen to setup a new Fabric interconnect. Continue? (y/n): y
```

```
Enforce strong password? (y/n) [y]: y
```

```
Enter the password for "admin":
Confirm the password for "admin":
```

```
Is this Fabric interconnect part of a cluster(select 'no' for standalone)? (yes/no) [n]: yes
```

```
Enter the switch fabric (A/B) []: A
```

```
Enter the system name: HX1-FI
```

```
Physical Switch Mgmt0 IP address : 10.29.133.104
```

```
Physical Switch Mgmt0 IPv4 netmask : 255.255.255.0
```

```
IPv4 address of the default gateway : 10.29.133.1
```

```
Cluster IPv4 address : 10.29.133.106
```

```
Configure the DNS Server IP address? (yes/no) [n]: yes
```

```
DNS IP address : 10.29.133.110
```

```
Configure the default domain name? (yes/no) [n]: yes
```

```
Default domain name : hx.lab.cisco.com
```

Join centralized management environment (UCS Central)? (yes/no) [n]: no

Following configurations will be applied:

```
Switch Fabric=A
System Name=HX1-FI
Enforced Strong Password=no
Physical Switch Mgmt0 IP Address=10.29.133.104
Physical Switch Mgmt0 IP Netmask=255.255.255.0
Default Gateway=10.29.133.1
Ipv6 value=0
DNS Server=10.29.133.110
Domain Name=hx.lab.cisco.com
```

```
Cluster Enabled=yes
Cluster IP Address=10.29.133.106
NOTE: Cluster IP will be configured only after both Fabric Interconnects are initialized
```

Apply and save the configuration (select 'no' if you want to re-enter)? (yes/no): yes  
Applying configuration. Please wait.

Configuration file - Ok

## Cisco UCS Fabric Interconnect B

To configure Fabric Interconnect B, complete the following steps:

1. Connect to the console port on the first Fabric Interconnect, which will be designated as the B fabric device. Use the supplied Cisco console cable (CAB-CONSOLE-RJ45=), and connect it to a built-in DB9 serial port, or use a USB to DB9 serial port adapter.
2. Start your terminal emulator software.
3. Create a connection to the COM port of the computer's DB9 port, or the USB to serial adapter. Set the terminal emulation to VT100, and the settings to 9600 baud, 8 data bits, no parity, and 1 stop bit.
4. Open the connection just created. You may have to press ENTER to see the first prompt.
5. Configure the second Fabric Interconnect, using the following example as a guideline:

```
---- Basic System Configuration Dialog ----
```

This setup utility will guide you through the basic configuration of the system. Only minimal configuration including IP connectivity to the Fabric interconnect and its clustering mode is performed through these steps.

Type Ctrl-C at any time to abort configuration and reboot system.  
To back track or make modifications to already entered values, complete input till end of section and answer no when prompted to apply configuration.

Enter the configuration method. (console/gui) ? console

Installer has detected the presence of a peer Fabric interconnect. This Fabric interconnect will be added to the cluster. Continue (y/n) ? y

```
Enter the admin password of the peer Fabric interconnect:
Connecting to peer Fabric interconnect... done
Retrieving config from peer Fabric interconnect... done
Peer Fabric interconnect Mgmt0 IPv4 Address: 10.29.133.104
```

```
Peer Fabric interconnect Mgmt0 IPv4 Netmask: 255.255.255.0  
Cluster IPv4 address : 10.29.133.106
```

```
Peer FI is IPv4 Cluster enabled. Please Provide Local Fabric Interconnect Mgmt0 IPv4 Address  
Physical Switch Mgmt0 IP address : 10.29.133.105
```

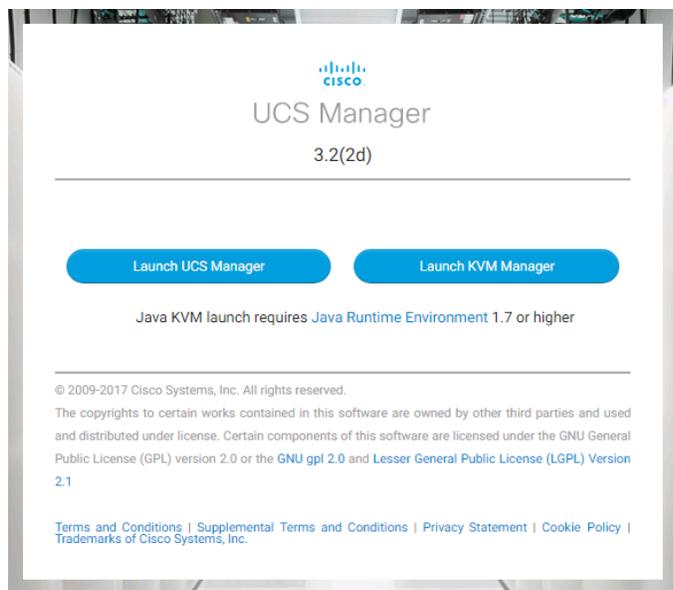
```
Apply and save the configuration (select 'no' if you want to re-enter)? (yes/no): yes  
Applying configuration. Please wait.
```

Configuration file - Ok

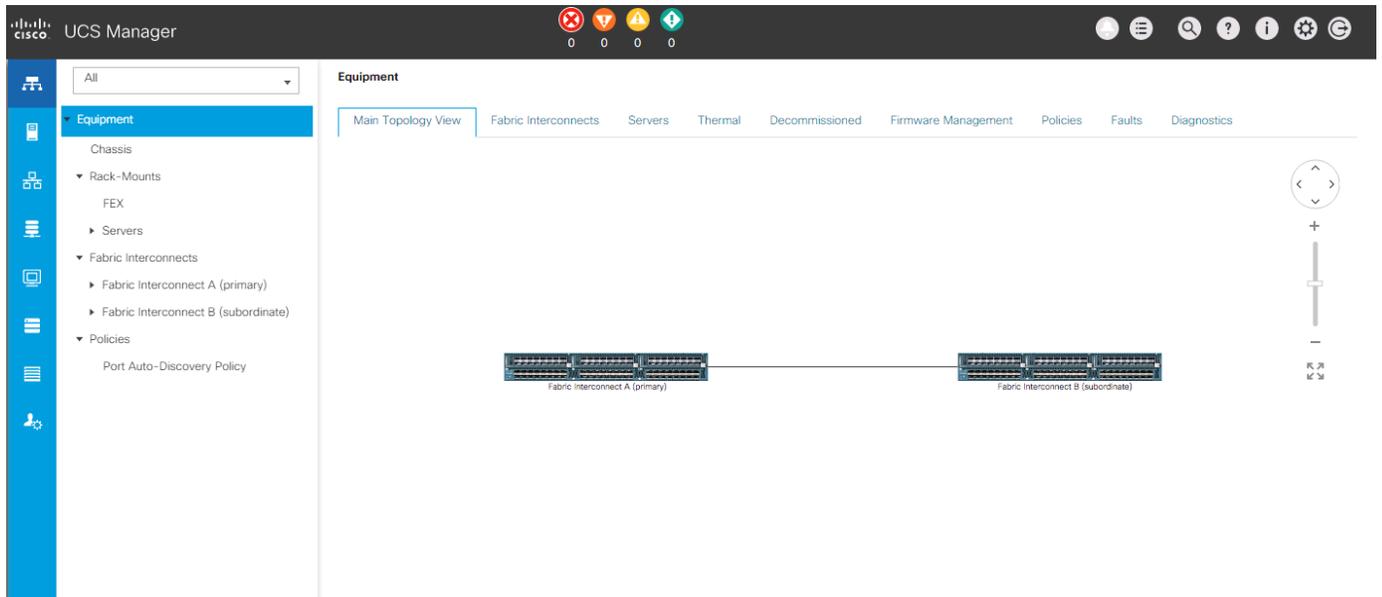
## Cisco UCS Manager

Log in to the Cisco UCS Manager environment by completing the following steps:

1. Open a web browser and navigate to the Cisco UCS Manager Cluster IP address, for example <https://10.29.133.106>



2. Click the “Launch UCS Manager” HTML link to open the Cisco UCS Manager web client.
3. At the login prompt, enter “admin” as the username, and enter the administrative password that was set during the initial console configuration.
4. Click No when prompted to enable Cisco Smart Call Home, this feature can be enabled at a later time.



## Cisco UCS Configuration

Configure the following ports, settings, and policies in the Cisco UCS Manager interface prior to beginning the HyperFlex installation.

### Cisco UCS Firmware

Your Cisco UCS firmware version should be correct as shipped from the factory, as documented in the [Software Components](#) section. This document is based on Cisco UCS infrastructure, B-series bundle, and C-Series bundle software versions 3.2(2d). If the firmware version of the Fabric Interconnects is older than this version, the firmware must be upgraded to match the requirements prior to completing any further steps. To upgrade the Cisco UCS Manager version, the Fabric Interconnect firmware, and the server bundles, refer to these instructions:

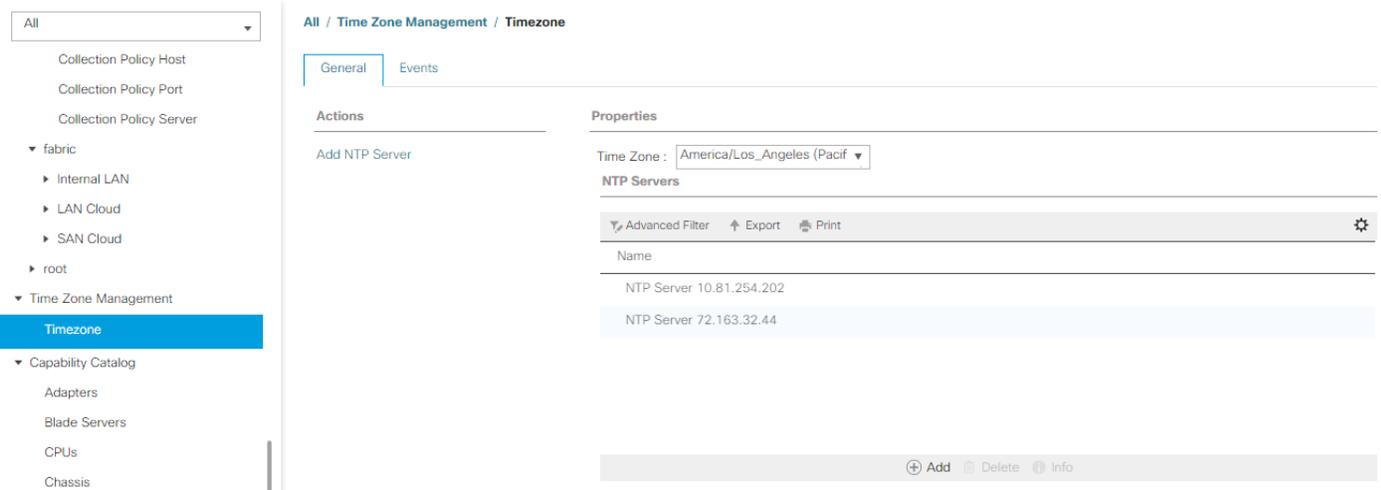
[https://www.cisco.com/c/en/us/td/docs/unified\\_computing/ucs/ucs-manager/GUI-User-Guides/Firmware-Mgmt/3-2/b\\_UCS\\_M\\_GUI\\_Firmware\\_Management\\_Guide\\_3\\_2.html](https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/ucs-manager/GUI-User-Guides/Firmware-Mgmt/3-2/b_UCS_M_GUI_Firmware_Management_Guide_3_2.html)

### NTP

To synchronize the Cisco UCS environment time to the NTP server, complete the following steps:

1. In Cisco UCS Manager, click the Admin button on the left-hand side.
2. In the navigation pane, select All > Time Zone Management, and click the carat next to Time Zone Management to expand it.
3. Click Timezone.
4. In the Properties pane, select the appropriate time zone in the Time Zone menu.
5. Click Add NTP Server.
6. Enter the NTP server IP address and click OK.
7. Click OK.

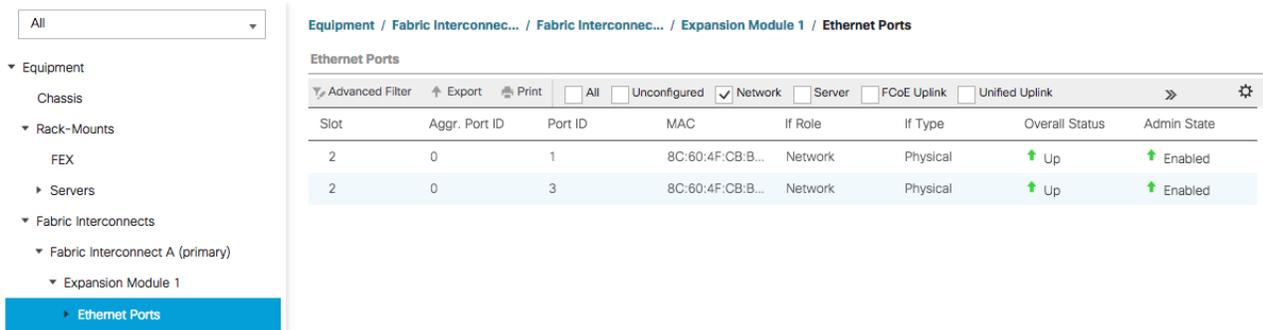
8. Click Save Changes and then click OK.



## Uplink Ports

The Ethernet ports of a Cisco UCS Fabric Interconnect are all capable of performing several functions, such as network uplinks or server ports, and more. By default, all ports are unconfigured, and their function must be defined by the administrator. To define the specified ports to be used as network uplinks to the upstream network, complete the following steps:

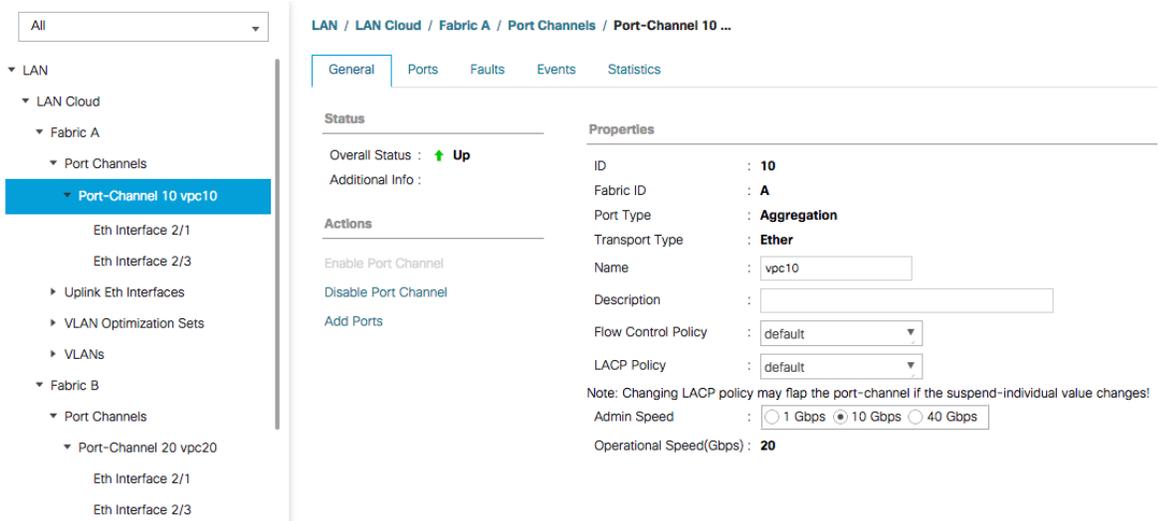
1. In Cisco UCS Manager, click the Equipment button on the left-hand side.
2. Select Fabric Interconnects > Fabric Interconnect A > Fixed Module or Expansion Module as appropriate > Ethernet Ports.
3. Select the ports that are to be uplink ports, right click them, and click Configure as Uplink Port.
4. Click Yes to confirm the configuration, and click OK.
5. Select Fabric Interconnects > Fabric Interconnect B > Fixed Module or Expansion Module as appropriate > Ethernet Ports.
6. Select the ports that are to be uplink ports, right-click them, and click Configure as Uplink Port.
7. Click Yes to confirm the configuration and click OK.
8. Verify all the necessary ports are now configured as uplink ports, where their role is listed as “Network” .



## Uplink Port Channels

If the Cisco UCS uplinks from one Fabric Interconnect are to be combined into a port channel or vPC, you must separately configure the port channels, which will use the previously configured uplink ports. To configure the necessary port channels in the Cisco UCS environment, complete the following steps:

1. In Cisco UCS Manager, click the LAN button on the left-hand side.
2. Under LAN > LAN Cloud, click the carat to expand the Fabric A tree.
3. Right-click Port Channels underneath Fabric A, then click Create Port Channel.
4. Enter the port channel ID number as the unique ID of the port channel (this does not have to match the port-channel ID on the upstream switch).
5. Enter the name of the port channel.
6. Click Next.
7. Click each port from Fabric Interconnect A that will participate in the port channel, and click the >> button to add them to the port channel.
8. Click Finish.
9. Click OK.
10. Under LAN > LAN Cloud, click the carat to expand the Fabric B tree.
11. Right-click Port Channels underneath Fabric B, then click Create Port Channel.
12. Enter the port channel ID number as the unique ID of the port channel (this does not have to match the port-channel ID on the upstream switch).
13. Enter the name of the port channel.
14. Click Next.
15. Click each port from Fabric Interconnect B that will participate in the port channel, and click the >> button to add them to the port channel.
16. Click Finish.
17. Click OK.
18. Verify the necessary port channels have been created. It can take a few minutes for the newly formed port channels to converge and come online.

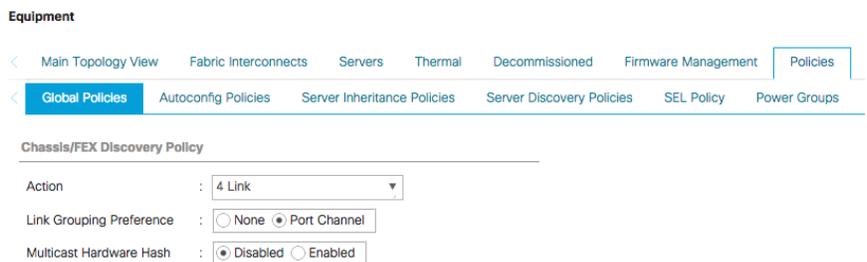


## Chassis Discovery Policy

If the Cisco HyperFlex system will use blades as compute-only nodes in an extended cluster design, additional settings must be configured for connecting the Cisco UCS 5108 blade chassis. The Chassis Discovery policy defines the number of links between the Fabric Interconnect and the Cisco UCS Fabric Extenders which must be connected and active, before the chassis will be discovered. This also effectively defines how many of those connected links will be used for communication. The Link Grouping Preference setting specifies if the links will operate independently, or if Cisco UCS Manager will automatically combine them into port-channels. Cisco best practices recommends using link grouping, and the number of links per side is dependent on the hardware used in Cisco UCS 5108 chassis, and the model of Fabric Interconnects. For 10 GbE connections Cisco recommends 4 links per side, and for 40 GbE connections Cisco recommends 2 links per side.

To configure the necessary policy and setting, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side, and click Equipment in the top of the navigation tree on the left.
2. In the properties pane, click the Policies tab.
3. Under the Global Policies sub-tab, set the Chassis/FEX Discovery Policy to match the number of uplink ports that are cabled per side, between the chassis and the Fabric Interconnects.
4. Set the Link Grouping Preference option to Port Channel.
5. Click Save Changes.
6. Click OK.



## Server Ports

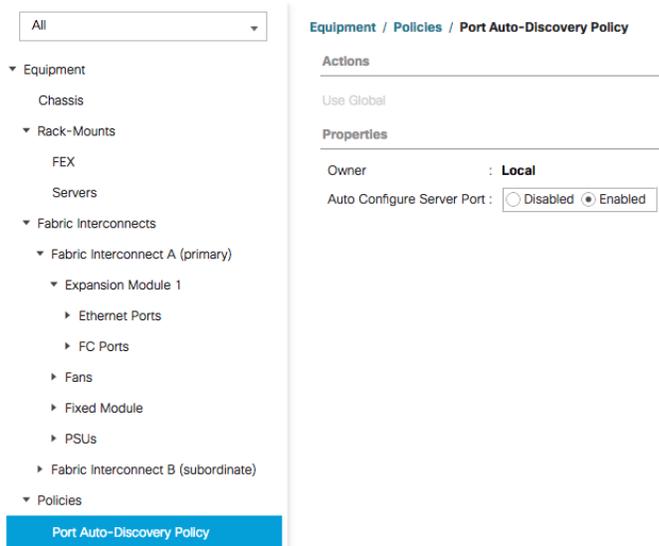
The Ethernet ports of a Cisco UCS Fabric Interconnect connected to the rack-mount servers, or to the blade chassis must be defined as server ports. When a server port is activated, the connected server or chassis will begin the discovery process shortly afterwards. Rack-mount servers and blade chassis are automatically numbered in Cisco UCS Manager in the order which they are first discovered. For this reason, it is important to configure the server ports sequentially in the order you wish the physical servers and/or chassis to appear within Cisco UCS Manager. For example, if you installed your servers in a cabinet or rack with server #1 on the bottom, counting up as you go higher in the cabinet or rack, then you need to enable the server ports to the bottom-most server first, and enable them one-by-one as you move upward. You must wait until the server appears in the Equipment tab of Cisco UCS Manager before configuring the ports for the next server. The same numbering procedure applies to blade server chassis, although chassis and rack-mount server numbers are separate from each other.

## Auto Configuration

A new feature in Cisco UCS Manager 3.1(3a) and later is Server Port Auto-Discovery, which automates the configuration of ports on the Fabric Interconnects as server ports when a Cisco UCS rack-mount server or blade chassis is connected to them. The firmware on the rack-mount servers or blade chassis Fabric Extenders must already be at version 3.1(3a) or later in order for this feature to function properly. Enabling this policy eliminates the manual steps of configuring each server port, however it does configure the servers in a somewhat random order. For example, the rack-mount server at the bottom of the stack, which you may refer to as server #1, and you may have plugged into port 1 of both Fabric Interconnects, could be discovered as server 2, or server 5, etc. In order to have fine control of the rack-mount server or chassis numbering and order, the manual configuration steps listed in the next section must be followed.

To configure automatic server port definition and discovery, complete the following steps:

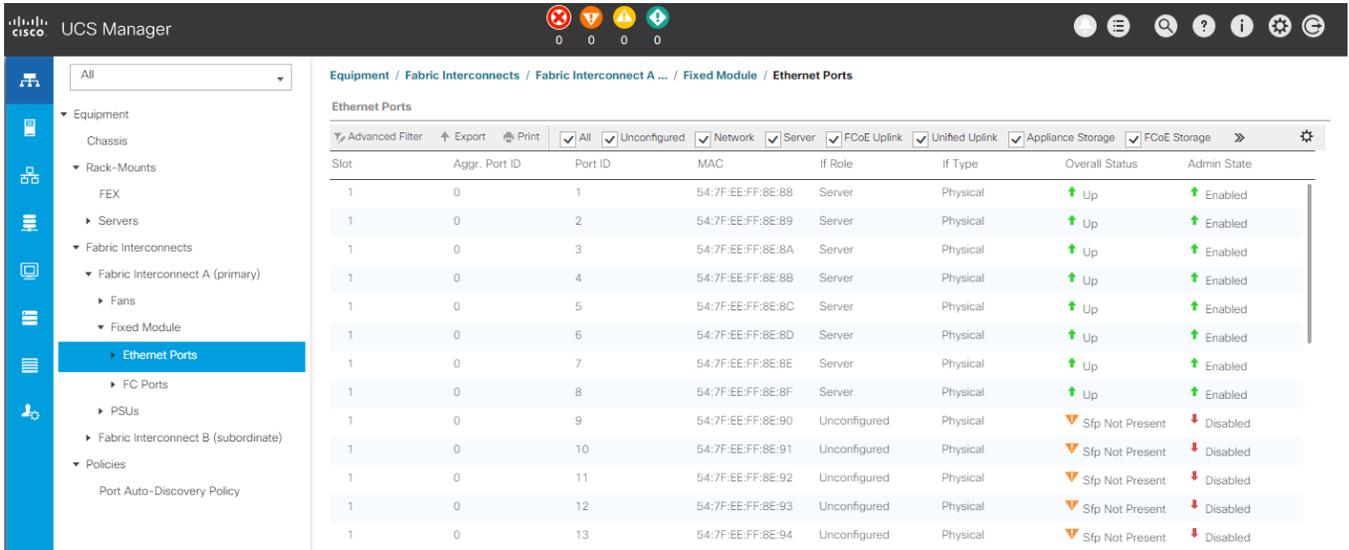
1. In Cisco UCS Manager, click the Equipment button on the left-hand side.
2. In the navigation tree, under Policies, click Port Auto-Discovery Policy
3. In the properties pane, set Auto Configure Server Port option to Enabled.
4. Click Save Changes.
5. Click OK.
6. Wait for a brief period, until the rack-mount servers appear in the Equipment tab underneath Equipment > Rack Mounts > Servers, or the chassis appears underneath Equipment > Chassis.



## Manual Configuration

To manually define the specified ports to be used as server ports, and have control over the numbering of the servers, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side.
2. Select Fabric Interconnects > Fabric Interconnect A > Fixed Module or Expansion Module as appropriate > Ethernet Ports.
3. Select the first port that is to be a server port, right-click it, and click Configure as Server Port.
4. Click Yes to confirm the configuration and click OK.
5. Select Fabric Interconnects > Fabric Interconnect B > Fixed Module or Expansion Module as appropriate > Ethernet Ports.
6. Select the matching port as chosen for Fabric Interconnect A that is to be a server port, right-click it, and click Configure as Server Port.
7. Click Yes to confirm the configuration and click OK.
8. Wait for a brief period, until the rack-mount server appears in the Equipment tab underneath Equipment > Rack Mounts > Servers, or the chassis appears underneath Equipment > Chassis.
9. Repeat Steps 1-8 for each server port, until all rack-mount servers and chassis appear in the order desired in the Equipment tab.

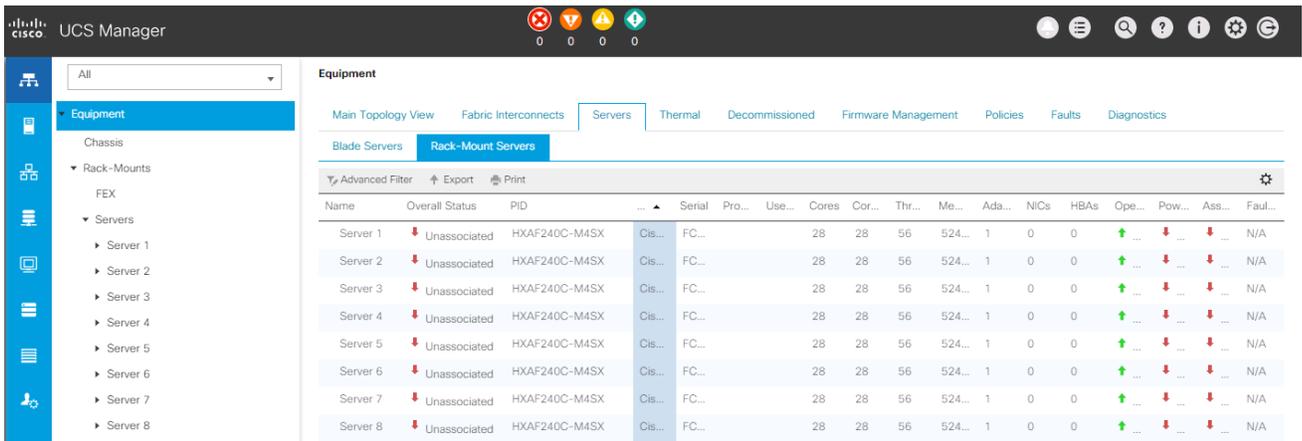


## Server Discovery

As previously described, when the server ports of the Fabric Interconnects are configured and active, the servers connected to those ports will begin a discovery process. During discovery, the servers’ internal hardware inventories are collected, along with their current firmware revisions. Before continuing with the HyperFlex installation processes, which will create the service profiles and associate them with the servers, wait for all of the servers to finish their discovery process and to show as unassociated servers that are powered off, with no errors.

To view the servers’ discovery status, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side, and click Equipment in the top of the navigation tree on the left.
2. In the properties pane, click the Servers tab.
3. Click the Blade Servers or Rack-Mount Servers sub-tab as appropriate, and view the servers’ status in the Overall Status column.



## HyperFlex Installer Deployment

The Cisco HyperFlex software is distributed as a deployable virtual machine, contained in an Open Virtual Appliance (OVA) file format. The HyperFlex OVA file is available for download at [cisco.com](https://software.cisco.com/download/release.html?mdfid=286305544&flowid=79522&softwareid=286305994&release=2.6(1b)):

[https://software.cisco.com/download/release.html?mdfid=286305544&flowid=79522&softwareid=286305994&release=2.6\(1b\)](https://software.cisco.com/download/release.html?mdfid=286305544&flowid=79522&softwareid=286305994&release=2.6(1b))

This document is based on the Cisco HyperFlex 2.6(1b) release filename:

***Cisco-HX-Data-Platform-Installer-v2.6.1b-26700.ova***

The HyperFlex installer OVA file can be deployed as a virtual machine in an existing VMware vSphere environment, VMware Workstation, VMware Fusion, or other virtualization environment which supports the import of OVA format files. For the purpose of this document, the process described uses an existing ESXi server managed by vCenter to run the HyperFlex installer OVA, and deploying it via the VMware vSphere Web Client.

### Installer Connectivity

The Cisco HyperFlex Installer VM must be deployed in a location that has connectivity to the following network locations and services:

- Connectivity to the vCenter Server which will manage the HyperFlex cluster(s) to be installed.
- Connectivity to the management interfaces of the Fabric Interconnects that contain the HyperFlex cluster(s) to be installed.
- Connectivity to the management interface of the ESXi hypervisor hosts which will host the HyperFlex cluster(s) to be installed.
- Connectivity to the DNS server(s) which will resolve host names used by the HyperFlex cluster(s) to be installed.
- Connectivity to the NTP server(s) which will synchronize time for the HyperFlex cluster(s) to be installed.
- Connectivity from the staff operating the installer to the webpage hosted by the installer, and to log in to the installer via SSH.

If the network where the HyperFlex installer VM is deployed has DHCP services available to assign the proper IP address, subnet mask, default gateway, and DNS servers, the HyperFlex installer can be deployed using DHCP. If a static address must be defined, use Table 50 to document the settings to be used for the HyperFlex installer VM:

**Table 50 HyperFlex Installer Settings**

Setting	Value
IP Address	
Subnet Mask	
Default Gateway	
DNS Server #1	
NTP Servers	

## Deploy Installer OVA

To deploy the HyperFlex installer OVA, complete the following steps:

1. Open the vSphere Web Client webpage of a vCenter server where the installer OVA will be deployed, and log in with admin privileges.
2. In the vSphere Web Client, from the Home view, click Hosts and Clusters.
3. From the Actions menu, click Deploy OVF Template.
4. Click the Local file option, then click Browse and locate the cisco-HX-Data-Platform-Installer-v2.6.1b-26700.ova file, click the file and click Open.
5. Click Next.
6. Modify the name of the virtual machine to be created if desired, and click a folder location to place the virtual machine, then click Next.
7. Click a specific host or cluster to locate the virtual machine and click Next.
8. After the file validation, review the details and click Next.
9. Select a Thin provision virtual disk format, and the datastore to store the new virtual machine, then click Next.
10. Modify the network port group selection from the drop-down list in the Destination Networks column, choosing the network the installer VM will communicate on, and click Next.
11. If DHCP is to be used for the installer VM, leave the fields blank, except for the NTP server value and click Next. If static address settings are to be used, fill in the fields for the DNS server, Default Gateway, NTP Servers, IP address, and subnet mask, then click Next.

Deploy OVF Template

1 Select template  
2 Select name and location  
3 Select a resource  
4 Review details  
5 Select storage  
6 Select networks  
7 **Customize template**  
8 Ready to complete

**Customize template**  
Customize the deployment properties of this software solution.

All properties have valid values [Show next...](#) [Collapse all...](#)

Property	Value
Networking Properties	5 settings
DNS	The domain name servers for this VM (comma separated). Leave blank if DHCP is desired. 10.29.133.110
Default Gateway	The default gateway address for this VM. Leave blank if DHCP is desired. 10.29.133.1
NTP	NTP servers for this VM (comma separated) to sync time. 72.163.32.44,10.81.254.202
Network 1 IP Address	The IP address for this interface. Leave blank if DHCP is desired. 10.29.133.115
Network 1 Netmask	The netmask or prefix for this interface. Leave blank if DHCP is desired. 255.255.255.0

Back Next Finish Cancel

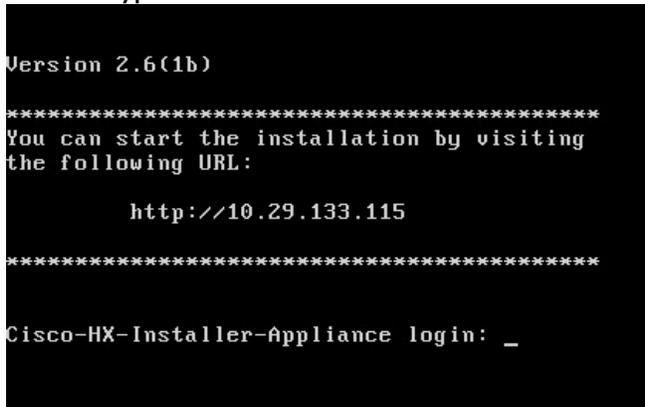
12. Review the final configuration and click Finish.

13. The installer VM will take a few minutes to deploy, once it has deployed, power on the new VM and proceed to the next step.

### HyperFlex Installer Web Page

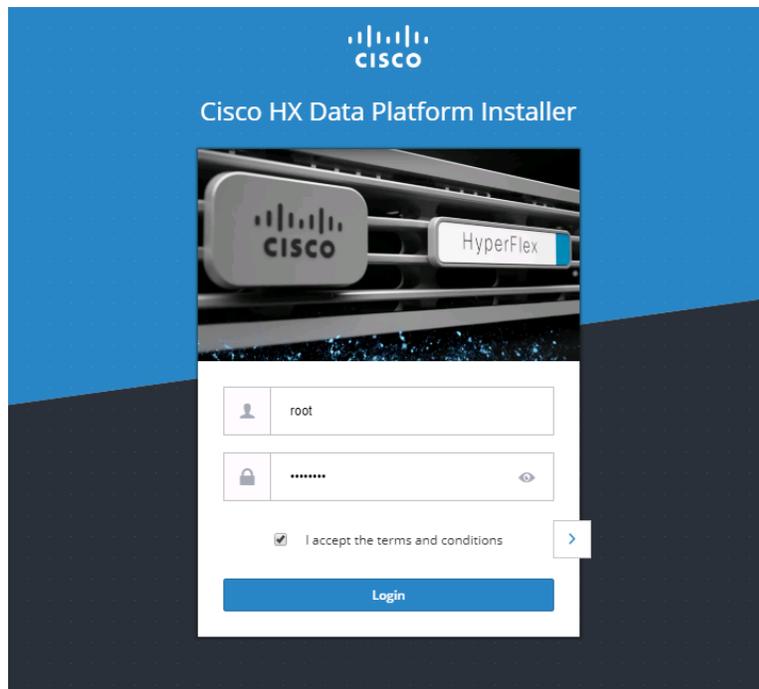
The HyperFlex installer is accessed via a webpage using your local computer and a web browser. If the HyperFlex installer was deployed with a static IP address, then the IP address of the website is already known. If DHCP was used, open the local console of the installer VM. In the console, you will see an interface similar to the example below, showing the IP address that was leased:

**57. HyperFlex Installer VM IP Address**



To access the HyperFlex installer webpage, complete the following steps:

1. Open a web browser on the local computer and navigate to the IP address of the installer VM. For example, open <http://10.29.133.115>
2. Click accept or continue to bypass any SSL certificate errors.
3. At the login screen, enter the username: root
4. At the login screen, enter the default password: Cisco123
5. Verify the version of the installer in the lower right-hand corner of the Welcome page is the correct version.
6. Check the box for “I accept the terms and conditions” and click Login.



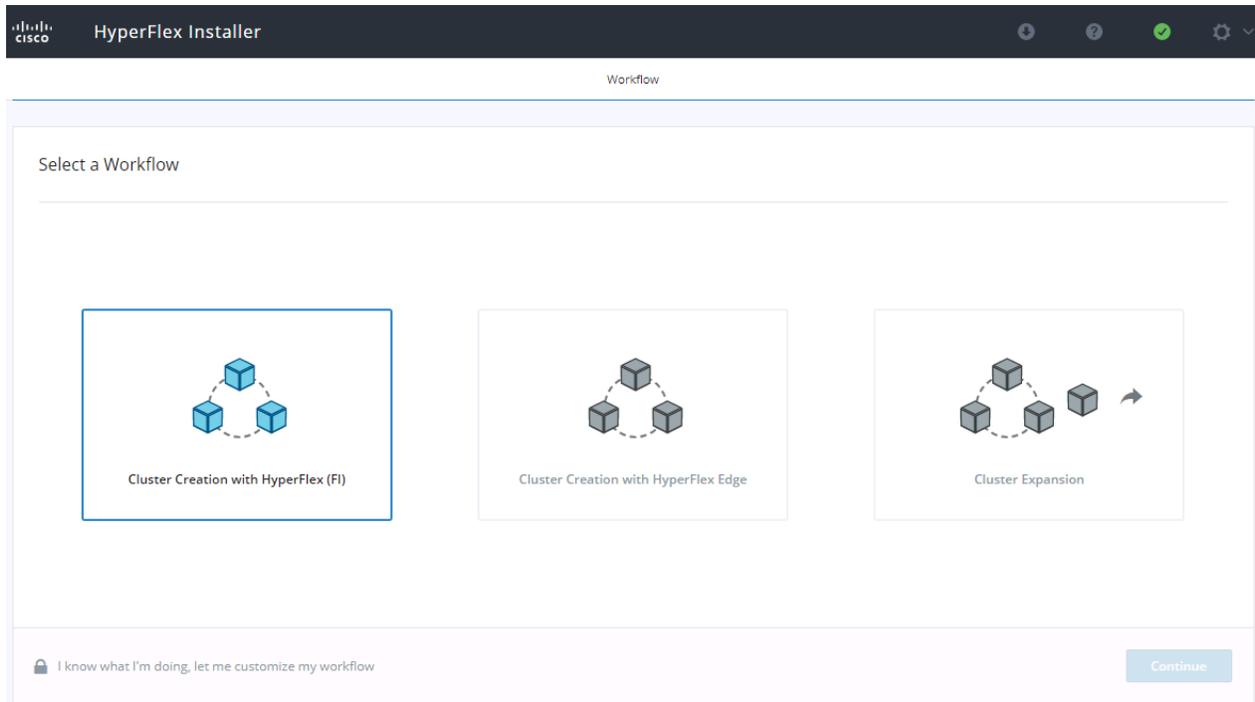
## HyperFlex Installation

### HyperFlex Cluster Creation

The HX installer will guide you through the process of setting up your cluster. It will configure Cisco UCS policies, templates, service profiles, and settings, as well as assigning IP addresses to the HX servers that come from the factory with ESXi hypervisor software preinstalled. The installer will load the HyperFlex controller VMs and software on the nodes, add the nodes to the vCenter cluster, then finally create the HyperFlex cluster and distributed filesystem. All of these processes can be completed via a single workflow from the HyperFlex Installer webpage.

To install and configure a HyperFlex cluster, complete the following steps:

1. On the HyperFlex installer webpage select the workflow named “Cluster Creation with HyperFlex (FI)” .



2. Enter the Cisco UCS Manager and vCenter DNS hostname or IP address, the admin usernames, and the passwords. The default Hypervisor credential which comes installed from the factory is username: root with a password of “Cisco123” and these values are already entered in the installer. You can select the option to see the passwords in clear text. Optionally, you can import a JSON file that has the configuration information, except for the appropriate passwords.

The screenshot shows the HyperFlex Installer interface. At the top, there is a navigation bar with the following tabs: Credentials (selected), Server Selection, UCSM Configuration, Hypervisor Configuration, IP Addresses, and Cluster Configuration. The main content area is divided into two panels. The left panel, titled 'Credentials', contains three sections:
 

- UCS Manager Credentials:** Fields for UCS Manager Host Name (10.29.133.165), User Name (admin), and Password (masked).
- vCenter Credentials:** Fields for vCenter Server (vcenter2.hx.lab.cisco.com), User Name (administrator@vsphere.local), and Admin Password (masked).
- Hypervisor Credentials:** Fields for Admin User Name (root) and Admin Password (masked).

 The right panel, titled 'Configuration', contains a dashed box with the text 'Drag and drop configuration files here or' and a 'Select a File' button. At the bottom of the right panel, there are 'Back' and 'Continue' buttons.

3. Click Continue.
4. Select the Unassociated HX server models that are to be used in the new HX cluster and click Continue. If the Fabric Interconnect server ports were not enabled in the earlier step, you have the option to enable them here to begin the discovery process by clicking the Configure Server Ports link.



**Note:** Using the option to enable the server ports within the HX Installer will not allow you to finely control the server number order, as would be possible when performing this step manually before installing the HyperFlex cluster. To have control of the server number order, perform the steps outlined earlier for manually configuring the server ports.



**Note:** The server discovery can take several minutes to complete, and it will be necessary to periodically click the Refresh button to see the unassociated servers appear once discovery is completed.

The screenshot shows the HyperFlex Installer interface. The main window is titled "HyperFlex Installer" and has a navigation bar with tabs: Credentials, Server Selection, UCSM Configuration, Hypervisor Configuration, IP Addresses, and Cluster Configuration. The "Server Selection" tab is active, showing a table of four unassociated servers. The table has columns for Server Name, Status, Model, Serial, Assoc State, and Actions. The servers are Server 1, Server 2, Server 3, and Server 4, all with status "unassociated" and model "HXAF240C-M4SX". The "Configuration" panel on the right shows fields for UCS Manager Host Name (10.29.133.165), User Name (admin), vCenter Server (vcenter2.hx.lab.cisco.com), User Name (administrator@vsphere.local), and Admin User Name (root). There are "Back" and "Continue" buttons at the bottom of the Configuration panel.

5. Enter the VLAN names and VLAN IDs that are to be created in Cisco UCS, as well as the MAC Pool prefix, (Only enter the 4<sup>th</sup> byte value, for example: 00:25:B5:ED). Multiple comma-separated VLAN IDs for different guest VM networks are allowed here.
6. Enter the IP address range to be used by the CIMC interfaces of the servers in this HX cluster.
7. If multiple firmware packages exist on the Fabric Interconnect, choose the version to be installed on the servers that will comprise this cluster. Note that for M5 generation servers, the minimum version is 3.2(2d).
8. Enter a unique Org name for the HyperFlex Cluster.



**Important:** When deploying a second or any additional clusters, you must put them into a different sub-org, use a different MAC Pool prefix, and you should also create new VLAN names for the additional clusters. Even if reusing the same VLAN ID, it is prudent to create a new VLAN name to avoid conflicts. For example, for a second cluster change the VLAN names, MAC Pool prefix, Cluster Name and Org Name so as to not overwrite the original cluster information.



**Important:** (Optional) If you need to add extra iSCSI vNICs and/or FC vHBAs to connect the HX nodes to an external iSCSI or FC array, enable iSCSI Storage and/or FC Storage here using the procedure described in the following section: [Process for adding additional vHBAs or iSCSI vNICs prior to cluster creation.](#)

9. Click Continue.
10. Enter the subnet mask, gateway, DNS, and IP addresses and hostnames for the Hypervisors. The IP addresses will be assigned via Serial over Lan (SoL) through Cisco UCS Manager to the ESXi host systems as their management IP addresses.
11. Click Continue.

The screenshot shows the HyperFlex Installer web interface. The main navigation bar includes: Credentials, Server Selection, UCSM Configuration, **Hypervisor Configuration**, IP Addresses, and Cluster Configuration. The main content area is divided into two panels:

- Configure common Hypervisor Settings:**
  - Subnet Mask: 255.255.255.0
  - Gateway: 10.29.133.1
  - DNS Server(s): 10.29.133.110
- Hypervisor Settings:**
  - Make IP Addresses and Hostnames Sequential
  - Table with columns: #, Name, Serial, Static IP Address, Hostname.

#	Name	Serial	Static IP Address	Hostname
1	Server 1	FCH1944V0G0	10.29.133.176	hx240-01
2	Server 2	FCH1944V08Q	10.29.133.177	hx240-02
3	Server 3	FCH1944V07F	10.29.133.178	hx240-03
4	Server 4	FCH1944V07N	10.29.133.179	hx240-04

The right-hand **Configuration** panel contains:

- Credentials:**
  - UCS Manager Host Name: 10.29.133.165
  - User Name: admin
  - vCenter Server: vcenter2.hx.lab.cisco.com
  - User Name: administrator@vsphere.local
  - Admin User Name: root
- Server Selection:**
  - Server 2: FCH1944V08Q / HXAF240C-M45X
  - Server 3: FCH1944V07F / HXAF240C-M45X
  - Server 1: FCH1944V0G0 / HXAF240C-M45X
  - Server 4: FCH1944V07N / HXAF240C-M45X
- UCSM Configuration:**
  - VLAN Name: hx-inband-mgmt
  - VLAN ID: 133
  - VLAN Name: hx-storage-data
  - VLAN ID: 52

At the bottom of the Configuration panel are **Back** and **Continue** buttons.

- Assign the additional IP addresses for the Management and Data networks as well as the cluster IP addresses, then click Continue.



**Note:** A default gateway is not required for the data network, as those interfaces normally will not communicate with any other hosts or networks, and the subnet can be non-routable.

The screenshot shows the HyperFlex Installer interface. The main window is titled 'IP Addresses' and contains a table with columns for Server, Hypervisor, and Storage Controller. Below the table are fields for Management and Data network settings, including Cluster IP Address, Subnet Mask, and Gateway. The right sidebar is titled 'Configuration' and contains sections for Credentials, Server Selection, and UCSM Configuration.

Server	Hypervisor	Storage Controller	Hypervisor	Storage Controller
FCH1944V0G0	10.29.133.176	10.29.133.185	192.168.52.11	192.168.52.21
FCH1944V08Q	10.29.133.177	10.29.133.186	192.168.52.12	192.168.52.22
FCH1944V07F	10.29.133.178	10.29.133.187	192.168.52.13	192.168.52.23
FCH1944V07N	10.29.133.179	10.29.133.188	192.168.52.14	192.168.52.24

Management - VLAN 133

Data - VLAN 52

Cluster IP Address: Management: 10.29.133.184, Data: 192.168.52.20

Subnet Mask: Management: 255.255.255.0, Data: 255.255.255.0

Gateway: Management: 10.29.133.1

Configuration sidebar:

- Credentials: UCS Manager Host Name: 10.29.133.165, User Name: admin, vCenter Server: vcenter2.hx.lab.cisco.com, User Name: administrator@vsphere.local, Admin User Name: root
- Server Selection: Server 2: FCH1944V08Q / HXAF240C-M45X, Server 3: FCH1944V07F / HXAF240C-M45X, Server 1: FCH1944V0G0 / HXAF240C-M45X, Server 4: FCH1944V07N / HXAF240C-M45X
- UCSM Configuration: VLAN Name: hx-inband-mgmt, VLAN ID: 133, VLAN Name: hx-storage-data, VLAN ID: 52

13. Enter the HX Cluster Name and Replication Factor setting.
14. Enter the Password that will be assigned to the Controller VMs.
15. Enter the Datacenter Name from vCenter, and vCenter Cluster Name.
16. Enter the System Services information for DNS, NTP, and Time Zone.
17. Enable Connected Services in order to enable management via Cisco Intersight, and enter the email address to receive service ticket alerts, then scroll down.
18. Leave the defaults for Advanced Networking.
19. Under Advanced Settings, validate that VDI is not checked (hybrid nodes only). Jumbo Frames should be enabled. It is not necessary to select Clean up disk partitions for a new cluster installation, but an installation using previously used converged nodes should have the option checked.
20. Click Start.
21. Validation of the configuration will now start. If there are warnings, you can review them and click "Skip Validation" if the warnings are acceptable. If there are no warnings, the installer will automatically continue on to the configuration process.



**Note:** The initial validation will always fail when using new Cisco UCS 6332 or 6332-16UP model Fabric Interconnects. This is due to the fact that changes to the QoS system classes require these models to reboot. If the

validation is skipped, the HyperFlex installer will continue the installation and automatically reboot both Fabric Interconnects sequentially. If this is an initial setup of these Fabric Interconnects, and no other systems are running on them yet, then it is safe to proceed. However, if these Fabric Interconnects are already in use for other workloads, then caution must be taken to ensure that the sequential reboots of both Fabric Interconnects will not interrupt those workloads, and that the QoS changes will not cause traffic drops. Contact Cisco TAC for assistance if this situation applies.

The screenshot displays the HyperFlex Installer web interface during the Cluster Configuration phase. The main configuration area includes the following sections:

- Cisco HX Cluster:** Cluster Name (AFCluster), Replication Factor (3).
- Controller VM:** Create Admin Password and Confirm Admin Password fields.
- vCenter Configuration:** vCenter Datacenter Name (Datacenter), vCenter Cluster Name (AFCluster).
- System Services:** DNS Server(s) (10.29.133.110), NTP Server(s) (1.ntp.esl.cisco.com, 2.ntp.esl.cisco.co), Time Zone ((UTC-08:00) Pacific Time).
- Connected Services:** Enable Connected Services (Recommended) checkbox is checked. Send service ticket notifications to field is empty.
- Advanced Networking:** Management vSwitch (vswitch-hx-inband-mgmt), Data vSwitch (vswitch-hx-storage-data).
- Advanced Configuration:** Enable Jumbo Frames on Data Network checkbox is checked. Clean up disk partitions checkbox is unchecked. vCenter Single-Sign-On Server field contains: ex: https://<address>:7444/sts/STSService/.

The right-hand sidebar provides a summary of the configuration:

- Credentials:** UCS Manager Host Name (10.29.133.165), User Name (admin), vCenter Server (vcenter2.hx.lab.cisco.com), User Name (administrator@vsphere.local), Admin User Name (root).
- Server Selection:** Server 2 (FCH1944V08Q / HXAF240C-M4SX), Server 3 (FCH1944V07F / HXAF240C-M4SX), Server 1 (FCH1944V0G0 / HXAF240C-M4SX), Server 4 (FCH1944V07N / HXAF240C-M4SX).
- UCSM Configuration:** VLAN Name (hx-inband-mgmt), VLAN ID (133), VLAN Name (hx-storage-data), VLAN ID (52).

At the bottom of the sidebar are navigation buttons: < Back and Start.

The screenshot displays the HyperFlex Installer's progress interface. At the top, a progress bar indicates the current step is 'Validations'. Below this, a list of validation checks is shown, all of which are successful, indicated by green checkmarks. A warning message at the bottom states 'Warnings found during Validations' and provides options to 'Retry Validations' or 'Skip Validations'. The right-hand side of the screen contains a configuration panel with the following details:

Credentials	
UCS Manager Host Name	10.29.133.165
User Name	admin
vCenter Server	vcenter2.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Server Selection	
Server 2	FCH1944V08Q / HXAF240C-M45X
Server 3	FCH1944V07F / HXAF240C-M45X
Server 1	FCH1944V0G0 / HXAF240C-M45X
Server 4	FCH1944V07N / HXAF240C-M45X

UCSM Configuration	
VLAN Name	hx-inband-mgmt
VLAN ID	133
VLAN Name	hx-storage-data
VLAN ID	52
VLAN Name	hx-vmotion

- The HX installer will now proceed to complete the deployment and perform all the steps listed at the top of the screen along with their status. The process can also be monitored in Cisco UCS Manager and vCenter while the profiles and cluster are created.

**HyperFlex Installer**

Progress

Start | Validations | **UCSM Configuration** | Hypervisor Configuration | Deploy Validation | Deploy | Create Validation | Cluster Creation

UCSM Configuration in Progress

UCSM Configuration - Overall **In Progress**

- ✓ Login to UCS API
- ✓ Inventory physical servers
- ✓ Validate UCS firmware version
- ✓ Setting flags for firmware validation
- ✓ Get inventory of firmware bundles
- ✓ Download firmware bundle
- ✓ Configure UCS Fabric Interconnect
- ✓ Configure FI Server Ports

**Configuration**

**Credentials**

UCS Manager Host Name: 10.29.133.165  
 User Name: admin  
 vCenter Server: vcenter2.hx.lab.cisco.com  
 User Name: administrator@vsphere.local  
 Admin User Name: root

**Server Selection**

Server 2: FCH1944V08Q / HXAF240C-M4SX  
 Server 3: FCH1944V07F / HXAF240C-M4SX  
 Server 1: FCH1944V0G0 / HXAF240C-M4SX  
 Server 4: FCH1944V07N / HXAF240C-M4SX

**UCSM Configuration**

VLAN Name: hx-inband-mgmt  
 VLAN ID: 133  
 VLAN Name: hx-storage-data

**UCS Manager**

Equipment

Chassis

Rack-Mounts

FEX

Servers

- Server 1
- Server 2
- Server 3
- Server 4

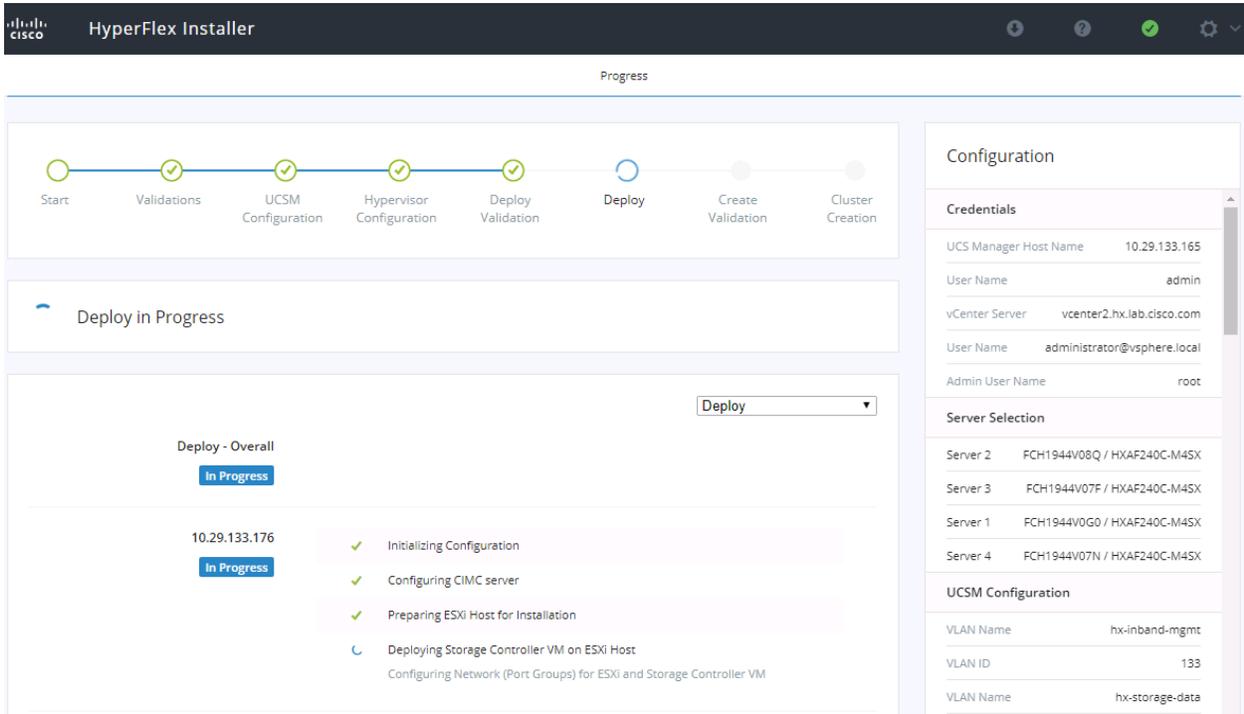
**Equipment**

Main Topology View | Fabric Interconnects | **Servers** | TI

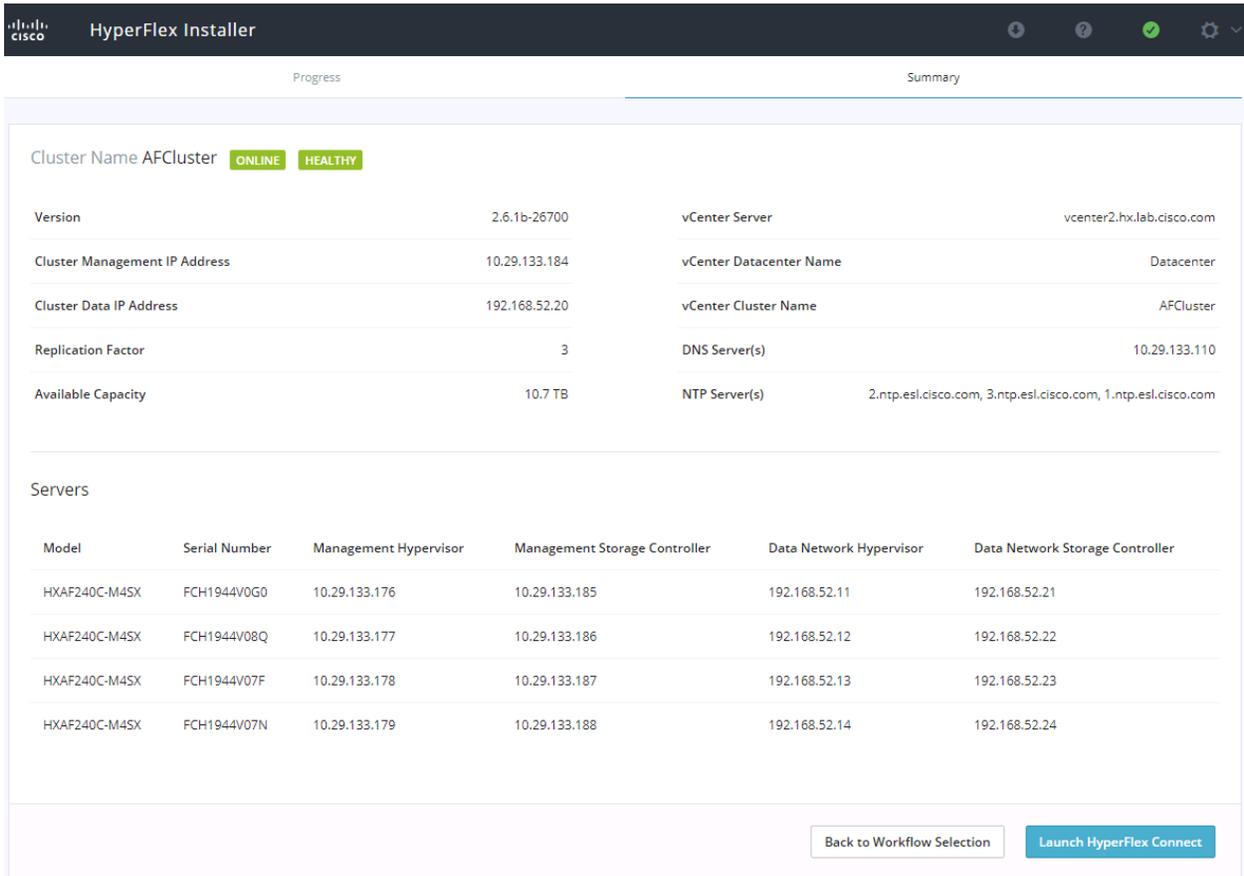
Blade Servers | **Rack-Mount Servers**

Advanced Filter | Export | Print

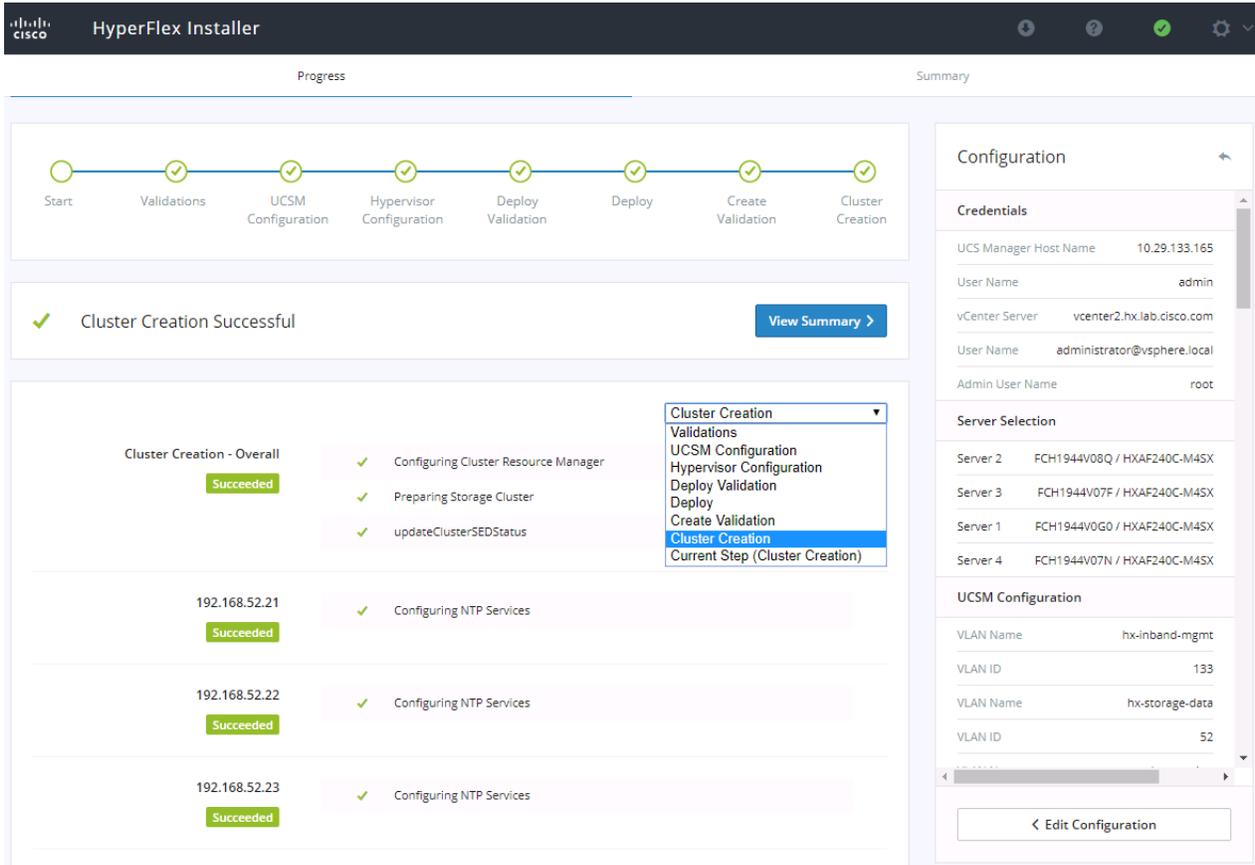
Name	Overall Status	PID
Server 1	Config	HXAF240C-M4SX
Server 2	Config	HXAF240C-M4SX
Server 3	Config	HXAF240C-M4SX
Server 4	Config	HXAF240C-M4SX



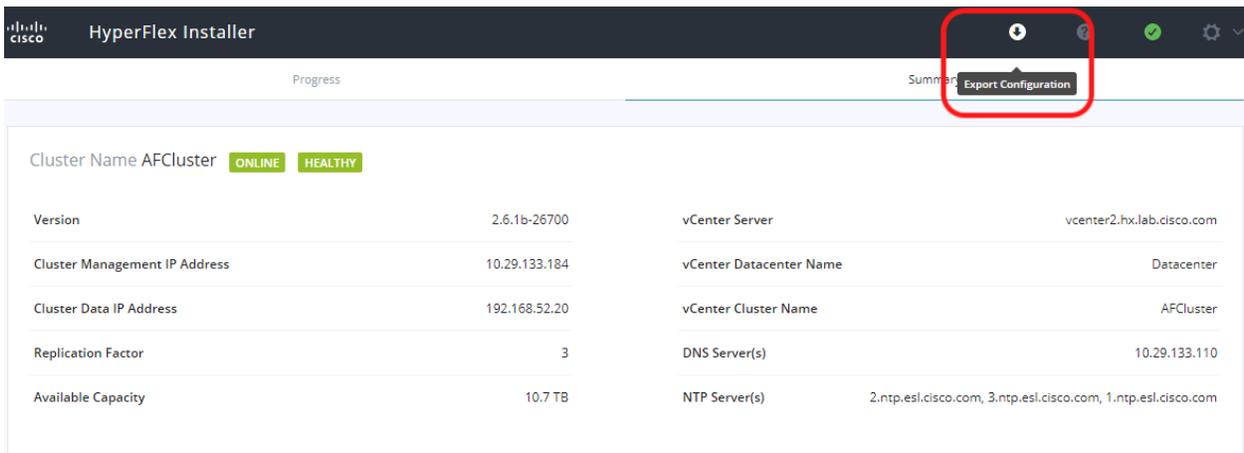
23. Review the Summary screen after the install completes by selecting Summary on the top right of the window.



24. You can also review the details of the installation process after the install completes by selecting Progress on the top left of the window.



25. After the install completes, you may export the cluster configuration by clicking on the downward arrow icon in the top right of the screen. Click OK to save the configuration to a JSON file. This file can be imported to save time if you need to rebuild the same cluster in the future, and be kept as a record of the configuration options and settings used during the installation.



26. After the installation completes, you can click the Launch HyperFlex Connect button to immediately log in to the new HTML5 GUI.

## Post Installation Script to Complete Your HX Configuration

To automate the post installation procedures and verify the HyperFlex Installer has properly configured Cisco UCS Manager, a script has been provided on the HyperFlex Installer OVA. These steps can also be performed manually in vCenter if preferred. The following procedure will use the script. To run this script, complete the following steps:

1. SSH to the installer OVA IP as root with password Cisco123,

```
# ssh root@10.29.133.115
```

2. From the CLI of the installer VM, run the script named post\_install.
3. The installer will already have the information from the just completed HX installation and it will be used by the script. Enter the HX Storage Controller VM root password for the HX cluster (use the one entered during the HX Cluster installation), as well as the vCenter user name and password. You can also enter the vSphere license or complete this task later.

```
root@Cisco-HX-Installer-Appliance:~# post_install
Script succesfully updated
Logging in to controller 10.29.133.151
HX CVM root Password for:
Getting ESX hosts from HX cluster...
vCenter URL: 10.29.133.120
Enter vCenter username (user@domain): administrator@vsphere.local
vCenter Password:
Found datacenter Datacenter
Found cluster HybridCluster

Enter vSphere license key or switch licenses to Evaluation Mode? (y/n) n
```

4. Enter “y” to enable HA/DRS.

```
Enable HA/DRS on cluster? (y/n) y
```

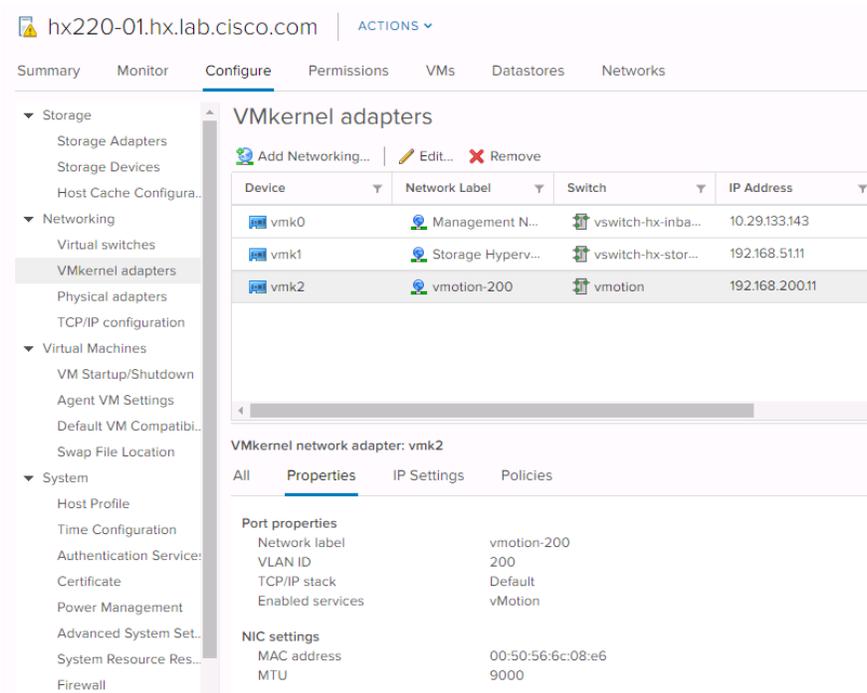
5. Enter “y” to disable the ESXi hosts’ SSH warning.

```
Disable SSH warning? (y/n) y
```

6. Add the vMotion VMkernel interfaces to each node by entering “y”. Input the netmask, the vMotion VLAN ID, and the vMotion IP addresses for each of the hosts as prompted.

```
Add vmotion interfaces? (y/n) y
Netmask for vMotion: 255.255.255.0
VLAN ID: (0-4096) 200
vMotion IP for hx220-01.hx.lab.cisco.com: 192.168.200.11
Adding vmotion-200 to hx220-01.hx.lab.cisco.com
Adding vmkernel to hx220-01.hx.lab.cisco.com
vMotion IP for hx220-02.hx.lab.cisco.com: 192.168.200.12
Adding vmotion-200 to hx220-02.hx.lab.cisco.com
Adding vmkernel to hx220-02.hx.lab.cisco.com
vMotion IP for hx220-03.hx.lab.cisco.com: 192.168.200.13
Adding vmotion-200 to hx220-03.hx.lab.cisco.com
Adding vmkernel to hx220-03.hx.lab.cisco.com
vMotion IP for hx220-04.hx.lab.cisco.com: 192.168.200.14
Adding vmotion-200 to hx220-04.hx.lab.cisco.com
Adding vmkernel to hx220-04.hx.lab.cisco.com
```

A vMotion VMkernel Port is created for each host in vCenter:



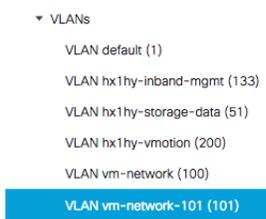
- The main installer will have already created at least one vm-network port group and assigned the default VM network VLAN input from the cluster installation. Enter “n” to skip this step and use the group(s) that were created. If desired, additional VM network port groups can be created and the additional VLANs will be added to the vm-networks vSwitch. This option will also create the corresponding VLANs in Cisco UCS Manager, and assign the VLAN to the vm-network vNIC-Template. This script can be rerun at later time as well to create additional VM networks and Cisco UCS VLANs.

```
Add VM network VLANs? (y/n) n
```

Example: Using this option in the script to show how to add more VM networks:

```
Add VM network VLANs? (y/n) y
Attempting to find UCSM IP
Found UCSM 10.29.133.106, logging with username admin. Org is hx1hybrid
UCSM Password:
Port Group Name to add (VLAN ID will be appended to the name): vm-network
VLAN ID: (0-4096) 101
Adding VLAN 101 to FI
Adding VLAN 101 to vm-network-a VNIC template
Adding vm-network-101 to hx220-01.hx.lab.cisco.com
Adding vm-network-101 to hx220-02.hx.lab.cisco.com
Adding vm-network-101 to hx220-03.hx.lab.cisco.com
Adding vm-network-101 to hx220-04.hx.lab.cisco.com
Add additional VM network VLANs? (y/n) n
```

VLANs are created in Cisco UCS:



VLANs are assigned to vNICs:

VLAN	Native VLAN
vm-network	<input type="radio"/>
vm-network-101	<input type="radio"/>

Port groups are created:

Virtual switches

Switch	Discovered Issues
vswitch-hx-inband-mgmt	--
vswitch-hx-vm-network	--
vmotion	--
vswitch-hx-storage-data	--

Standard switch: vswitch-hx-vm-network

Port Groups Properties Policies

Port Group	VLAN ID	Active Ports	Uplinks
vm-network-100	100	0	vmnic4, vmnic5
vm-network-101	101	0	vmnic4, vmnic5

- Enter “n” to skip testing the auto support email function, because the email configuration has not been completed yet.
- The post install script will now check the networking configuration and jumbo frames.

```

Checking MTU settings
Pinging 192.168.51.22 from vmk1
Pinging 192.168.51.24 from vmk1
Pinging 192.168.51.23 from vmk1
Pinging 192.168.51.21 from vmk1
Setting vmnic2 to active and vmnic3 to standby
Pinging 192.168.51.22 from vmk1
Pinging 192.168.51.22 with mtu 8972 from vmk1
Pinging 192.168.51.24 from vmk1
Pinging 192.168.51.24 with mtu 8972 from vmk1
Pinging 192.168.51.23 from vmk1
Pinging 192.168.51.23 with mtu 8972 from vmk1
Pinging 192.168.51.21 from vmk1
Pinging 192.168.51.21 with mtu 8972 from vmk1
Setting vmnic3 to active and vmnic2 to standby
Pinging 10.29.133.144 from vmk0
Pinging 10.29.133.146 from vmk0
Pinging 10.29.133.145 from vmk0
Pinging 10.29.133.143 from vmk0
Setting vmnic1 to active and vmnic0 to standby
Pinging 10.29.133.144 from vmk0
Pinging 10.29.133.146 from vmk0
Pinging 10.29.133.145 from vmk0
Pinging 10.29.133.143 from vmk0
Setting vmnic0 to active and vmnic1 to standby
    
```

- The script will complete and provide a summary screen. Validate there are no errors and the cluster is healthy.

## Syslog

It is recommended to enable a syslog destination for permanent storage of the ESXi host logs. It is possible to use the vCenter server as the log destination in this case.

To configure syslog, complete the following steps:

1. Log on to the ESXi host via SSH as the root user.
2. Enter the following commands, replacing the IP address in the first command with the IP address of the vCenter server that will receive the syslog logs:

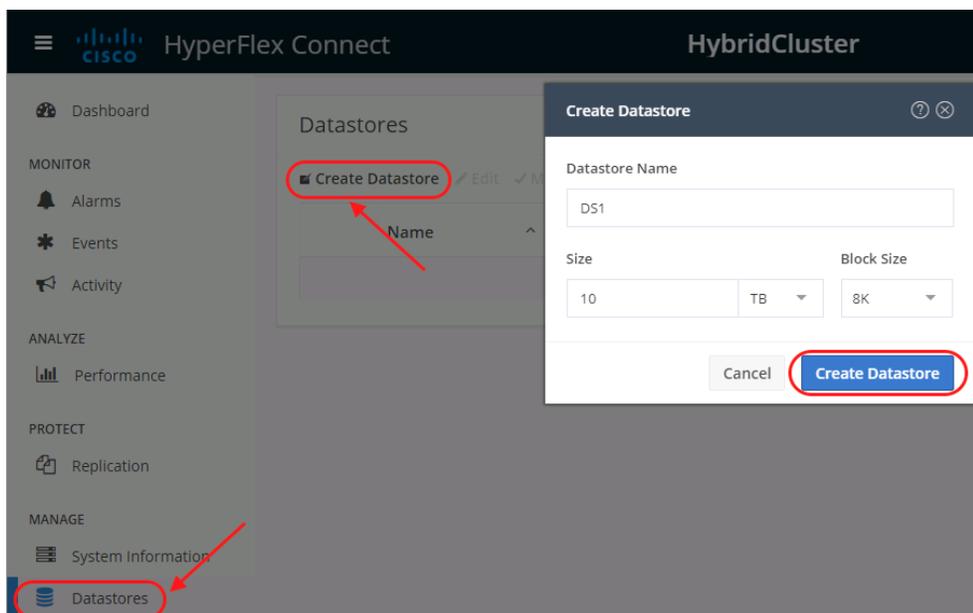
```
[root@hx220-01:~] esxcli system syslog config set --loghost='udp://10.29.133.120'
[root@hx220-01:~] esxcli system syslog reload
[root@hx220-01:~] esxcli network firewall ruleset set -r syslog -e true
[root@hx220-01:~] esxcli network firewall refresh
```

3. Repeat for each ESXi host.

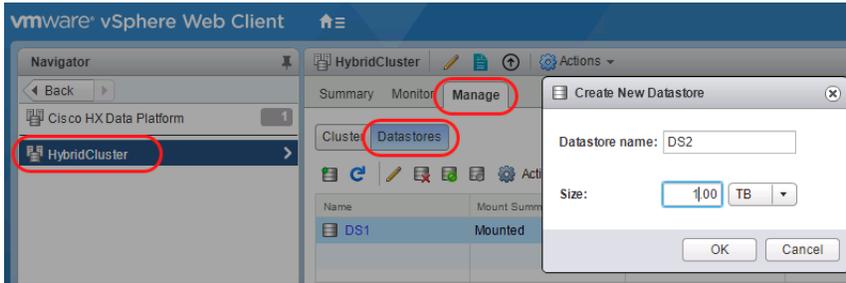
## Datstores

Create a datastore for storing the virtual machines. This task can be completed by using the vSphere Web Client HX plugin, or by using the HyperFlex Connect HTML management webpage. To configure a new datastore, complete the following steps:

1. Use a web browser to open the HX cluster IP management URL.
2. Enter a local credential, or a vCenter RBAC credential for the username, and the corresponding password.
3. Click Login.
4. Click Datstores in the left pane and click Create Datastore.
5. In the popup, enter the Datastore Name and size. For most applications, leave the Block Size at the default of 8K.
6. Click Create Datastore.



- Alternatively, to create the datastore using the vSphere web client, select vCenter Inventory Lists, and select the Cisco HyperFlex System, Cisco HX Data Platform, cluster-name, manage tab and the plus (+) icon to create a datastore.

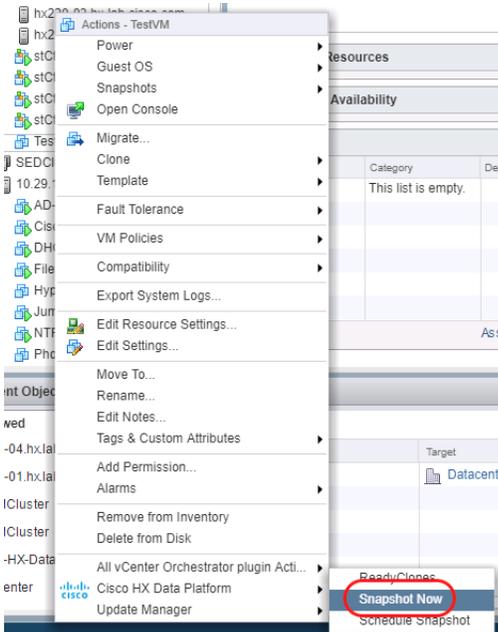


## Testing

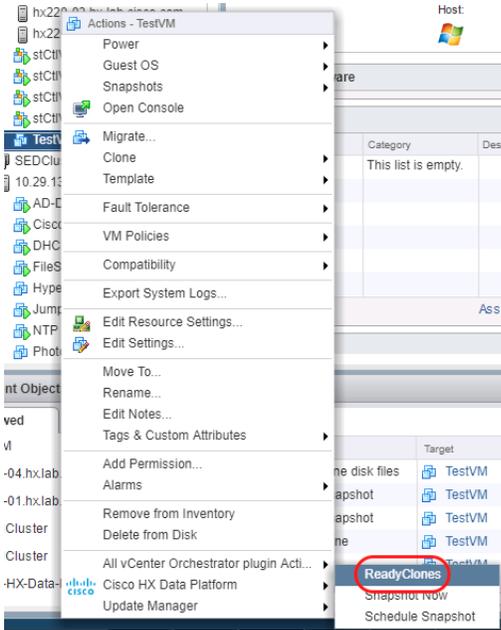
- Create a test virtual machine stored on your new HX datastore in order to take a snapshot and perform a cloning operation.



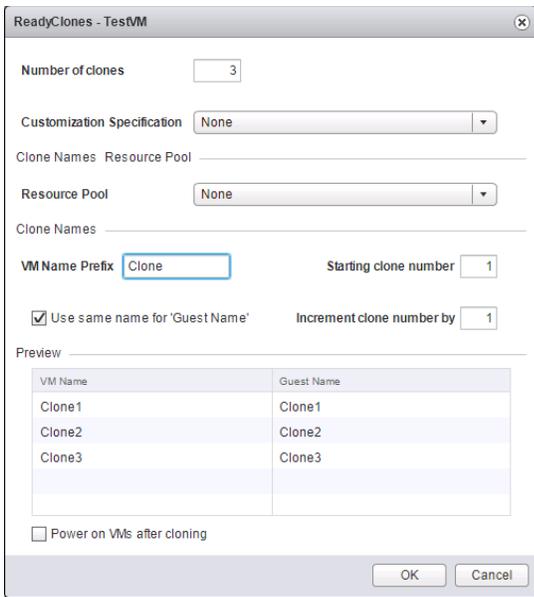
- Take a snapshot of the new virtual machine via the vSphere Web Client prior to powering it on. This can be scheduled as well. In the vSphere web client, right-click the VM, select Cisco HX Data Platform, then select Snapshot Now.



- Input the snapshot name and click OK.
- Create a few clones of our virtual machine. Right-click the VM, and select Cisco HX Data Platform, then ReadyClones.



5. Input the Number of clones and Prefix, then click OK to start the operation. The clones will be created in seconds.



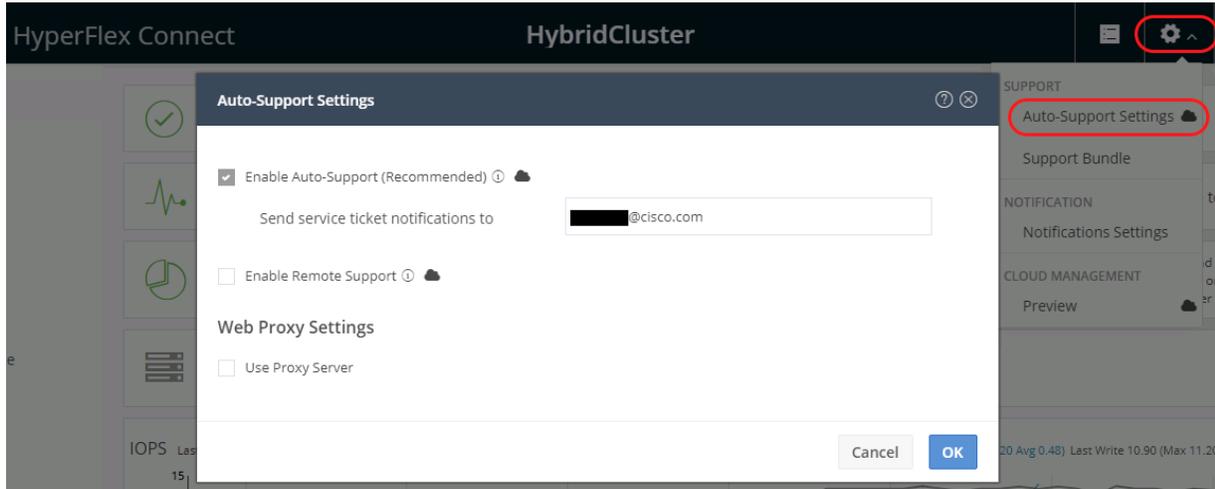
## Auto-Support and Notifications

Auto-Support should be enabled for all clusters during the initial HyperFlex installation. Auto-Support enables Call Home to automatically send support information to Cisco TAC, and notifications of tickets to the email address specified. If the settings need to be modified, they can be changed in the HyperFlex Connect HTML management webpage.

To change Auto-Support settings, complete the following steps:

1. From the HyperFlex Connect webpage, click the gear shaped icon in the upper right-hand corner, and click Auto-Support Settings.
2. Enable or disable Auto-Support as needed.

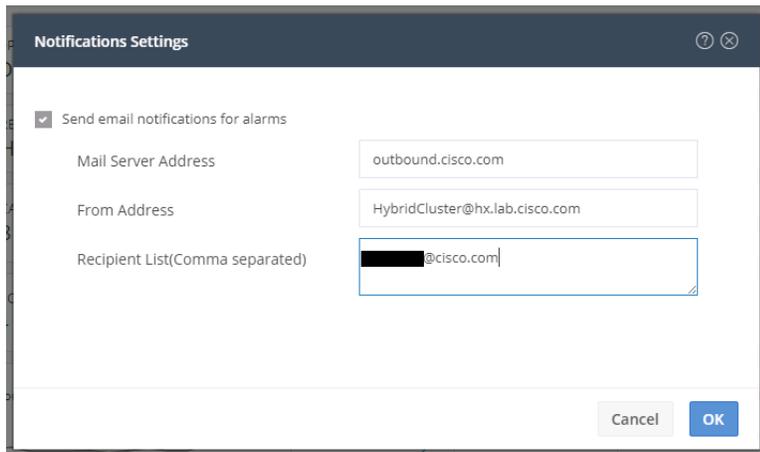
3. Enter the email address to receive alerts when Auto-Support events are generated.
4. Enable or disable Remote Support as needed. Remote support allows Cisco TAC to connect to the HX cluster and accelerate troubleshooting efforts.
5. Enter in the information for a web proxy if needed.
6. Click OK.



Email notifications that come directly from the HyperFlex cluster can also be enabled.

To enable direct email notifications, complete the following steps:

1. From the HyperFlex Connect webpage, click the gear shaped icon in the upper right-hand corner, and click Notifications Settings.
2. Enter the DNS name or IP address of the outgoing email server or relay, the email address the notifications will come from, and the recipients.
3. Click OK.



## Security

It is recommended that the default ESXi root passwords be changed for enhanced security. To change the root password of the ESXi host, complete the following steps:

1. Log into the ESXi host via SSH.
2. If the logon account used was not root, gain root privileges via su (you must know the root account password):

```
su -
```

3. Change the root password:

```
passwd root
```

4. Enter the new password and press Enter.
5. Enter the new password again to confirm, and press Enter.
6. Repeat steps 1-5 for each ESXi host.
7. Optionally, you can change the HX controller password via the “stcli security password set” command.

```
root@SpringpathControllerYIB7YF1IYT:~#
root@SpringpathControllerYIB7YF1IYT:~# stcli security password set
Enter new password for user root: █
```

## Smart Licensing

HyperFlex 2.5 and later utilizes Cisco Smart Licensing, which communicates with a Cisco Smart Account to validate and check out HyperFlex licenses to the nodes, from the pool of available licenses in the account. At the beginning, Smart Licensing is enabled but the HX storage cluster is unregistered and in a 90-day evaluation period or EVAL MODE. For the HX storage cluster to start reporting license consumption, it must be registered with the Cisco Smart Software Manager (SSM) through a valid Cisco Smart Account. Before beginning, verify that you have a Cisco Smart account, and valid HyperFlex licenses are available to be checked out by your HX cluster.

To create a Smart Account, see [Cisco Software Central > Request a Smart Account](#)

<https://webapps.cisco.com/software/company/smartaccounts/home?route=module/accountcreation> .

To activate and configure smart licensing, complete the following steps:

1. Log into a controller VM. Confirm that your HX storage cluster is in Smart Licensing mode.

```
# stcli license show status
```

```
Smart Licensing is ENABLED
```

```
Registration:
```

```
Status: UNREGISTERED
```

```
Export-Controlled Functionality: Not Allowed
```

```
License Authorization:
```

```
Status: EVAL MODE
```

```
Evaluation Period Remaining: 79 days, 8 hr, 52 min, 57 sec
```

```
Last Communication Attempt: NONE
```

Feedback will show Smart Licensing is ENABLED, Status: UNREGISTERED, and the amount of time left during the 90-day evaluation period (in days, hours, minutes, and seconds).

2. Navigate to Cisco Software Central (<https://software.cisco.com/>) and log in to your Smart Account.
3. From Cisco Smart Software Manager, generate a registration token.
4. In the License pane, click Smart Software Licensing to open Cisco Smart Software Manager.
5. Click Inventory.
6. From the virtual account where you want to register your HX storage cluster, click General, and then click New Token.
7. In the Create Registration Token dialog box, add a short Description for the token, enter the number of days you want the token to be active and available to use on other products, and check Allow export-controlled functionality on the products registered with this token.
8. Click Create Token.
9. From the New ID Token row, click the Actions drop-down list, and click Copy.
10. Log into a controller VM.
11. Register your HX storage cluster, where *idtoken-string* is the New ID Token from Cisco Smart Software Manager.

```
# stcli license register --idtoken idtoken-string
```

12. Confirm that your HX storage cluster is registered.

```
# stcli license show summary
```

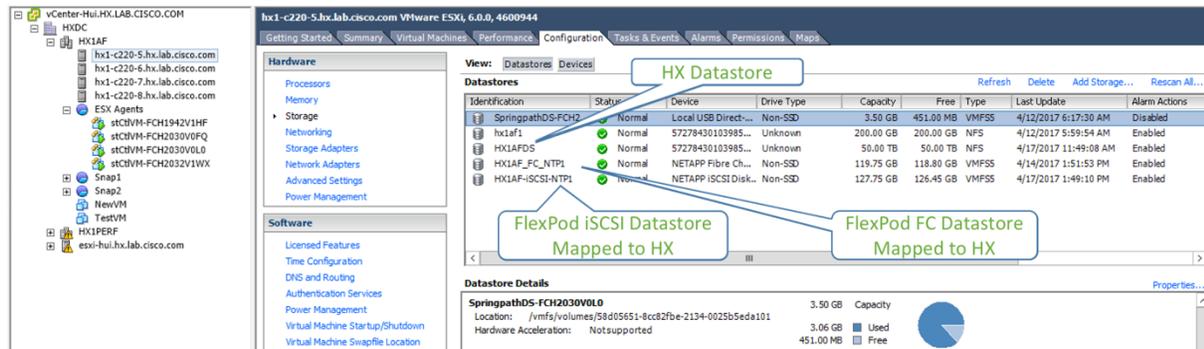
The cluster is now ready. You may run any other preproduction tests that you wish to run at this point.

## Additional vHBAs or vNICs

### Overview

From HXDP version 1.8 onward, customers have the flexibility to leverage third-party storage infrastructure by connecting external storage arrays to HX systems. As an example, one can map and connect Fibre Channel LUNs from an IBM VersaStack or NFS volumes from a NetApp FlexPod system, and then easily perform a Storage vMotion of virtual machines into the HyperFlex system.

### 58. External Storage in HX



In order to connect to other storage systems such as FlexPod via iSCSI or NFS, or an FC SAN, it is recommended that the additional vHBAs or vNICs be added during the creation of the HX cluster. If these are added post cluster creation, the PCI

enumeration can change causing PCI passthrough device configuration errors. With HXDP 2.5 and onward, the system can repair these changes automatically via an additional reboot of the ESXi hosts. It is recommended that you do not make such hardware changes after the HX cluster is created. A better option is to add vHBAs or vNICs as necessary while the cluster is created. Both of these processes are documented below.

In this section only the addition of FC vHBAs or iSCSI vNICs to HX hosts is documented. A more detailed procedure about connecting other iSCSI or NFS storage to HX cluster is in the [Appendix](#).



**Note:** Although in this CVD we use iSCSI as example to connect HX to external IP storage devices, the vNICs created by this procedure could be used for connecting to NFS storage devices.

### Adding vHBAs or iSCSI vNICs During HX Cluster Creation

From HXDP 2.0 onward, the HX installer supports adding supplemental vHBAs or vNICs as a part of the cluster creation. An overview of this procedure is as follows:

1. Open the HyperFlex Installer from a web browser, login as root user.
2. On the HyperFlex Installer webpage select a Workflow of Cluster Creation to start a fresh cluster installation.
3. Continue with appropriate inputs until you get to the page for Cisco UCS Manager configuration.

**VLAN Configuration**

VLAN for Hypervisor and HyperFlex management

VLAN Name	VLAN ID
hx1af-inband-mgmt	3041

VLAN for HyperFlex storage traffic

VLAN Name	VLAN ID
hx1af-storage-data	3042

VLAN for VM vMotion

VLAN Name	VLAN ID
hx1af-vmotion	3043

VLAN for VM Network

VLAN Name	VLAN ID(s)
vm-network-hx1af	3044

**MAC Pool**

MAC Pool Prefix

00:25:85:ED

**'ext-mgmt' IP Pool for Out-of-band CIMC**

IP Blocks	Subnet Mask	Gateway
10.29.133.24-31	255.255.255.0	10.29.133.1

> iSCSI Storage

> FC Storage

**Advanced**

UCS Firmware Version	HyperFlex Cluster Name	Org Name
3.1(2f)	HX1AF	HX1AF

**Configuration**

**Credentials**

UCS Manager Host Name	10.29.133.55
User Name	admin
vCenter Server	10.29.133.62
User Name	huich@hx
Admin User Name	root

**Server Selection**

Server 6	FCH2030V0FQ / HXAF220C-M4S
Server 7	FCH2032V1WX / HXAF220C-M4S
Server 5	FCH2030V0L0 / HXAF220C-M4S

< Back Continue

4. Click the > carat to expand iSCSI Storage configuration. Check the box Enable iSCSI Storage if you want to create additional vNICs to connect to the external iSCSI storage systems. Enter a VLAN name and ID for Fabric A and B dual connections.

---

▼ iSCSI Storage

iSCSI Storage	VLAN A Name	VLAN A ID
<input checked="" type="checkbox"/> Enable iSCSI Storage	<input type="text" value="hx1af-ext-storage-iscsi-a"/>	<input type="text" value="3045"/>
VLAN B Name	VLAN B ID	
<input type="text" value="hx1af-ext-storage-iscsi-b"/>	<input type="text" value="3046"/>	

---

- Click the > carat to expand FC Storage configuration. Check the box Enable FC Storage if you want to create Fibre Channel vHBAs to connect to the external FC or FCoE storage systems. Enter WWxN Pool prefix (For example: 20:00:00:25:B5:ED, only enter the last byte value), VSAN names and IDs for Fabric A and B dual connections.

---

▼ FC Storage

FC Storage	WWxN Pool	VSAN A Name
<input checked="" type="checkbox"/> Enable FC Storage	<input type="text" value="20:00:00:25:B5:ED"/>	<input type="text" value="hx-ext-storage-fc-a"/>
VSAN A ID	VSAN B Name	VSAN B ID
<input type="text" value="3049"/>	<input type="text" value="hx-ext-storage-fc-b"/>	<input type="text" value="3048"/>

---

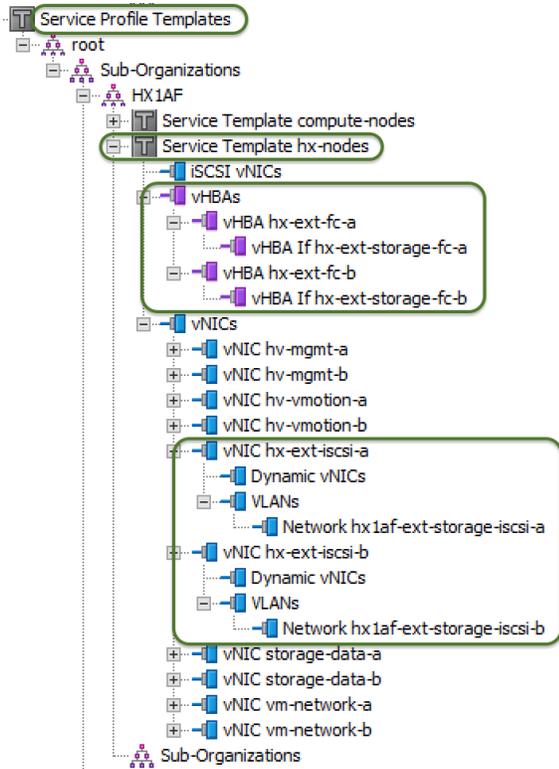
- Continue and complete the inputs for all the remaining cluster configuration tasks, start the cluster creation and wait for the completion.



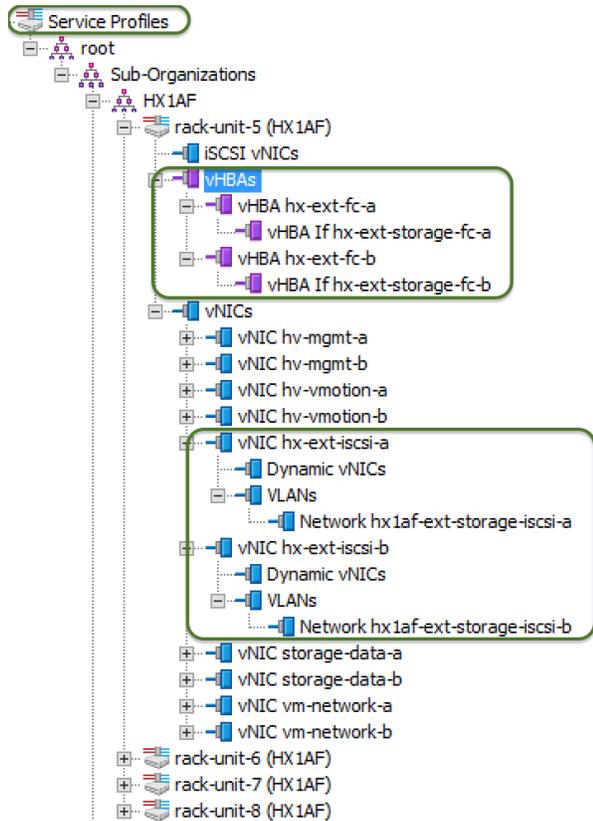
Note: You can choose to enable either only iSCSI, only FC, or both according to your needs.

---

- After the install is completed, the additional dual vHBAs and/or dual vNICs are created for the Service Profile Templates named “hx-nodes” and “compute-nodes” .



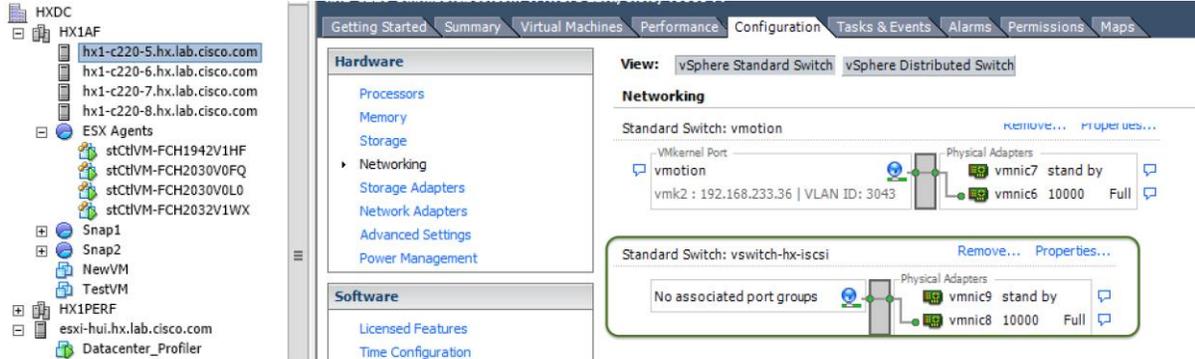
8. For each HX node, dual vHBAs and/or dual iSCSI vNICs are created as well.





**Note:** In Cisco UCS Manager, the additional vNICs are configured as standard vNICs, not as iSCSI vNICs, as iSCSI vNICs are specifically used for iSCSI boot adapters.

- In vCenter, a standard vSwitch vswitch-hx-iscsi is created on each HX ESXi host. Further configuration to create iSCSI VMkernel ports needs to be done manually for storage connections (see [Appendix D](#)).

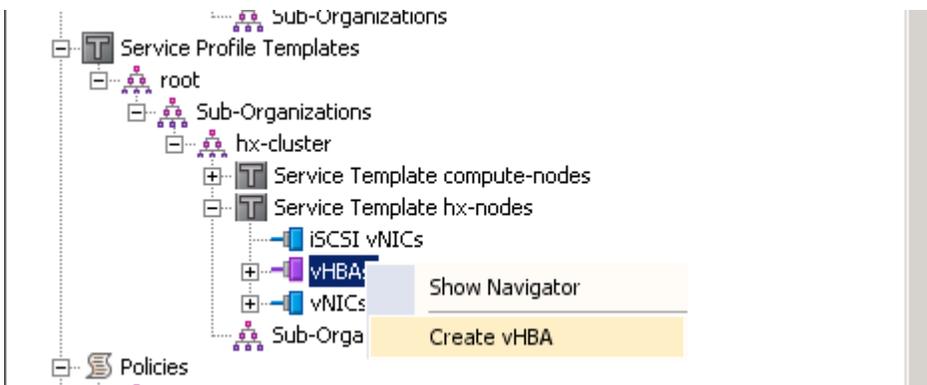


### Adding vHBAs or iSCSI vNICs to an Existing HX Cluster

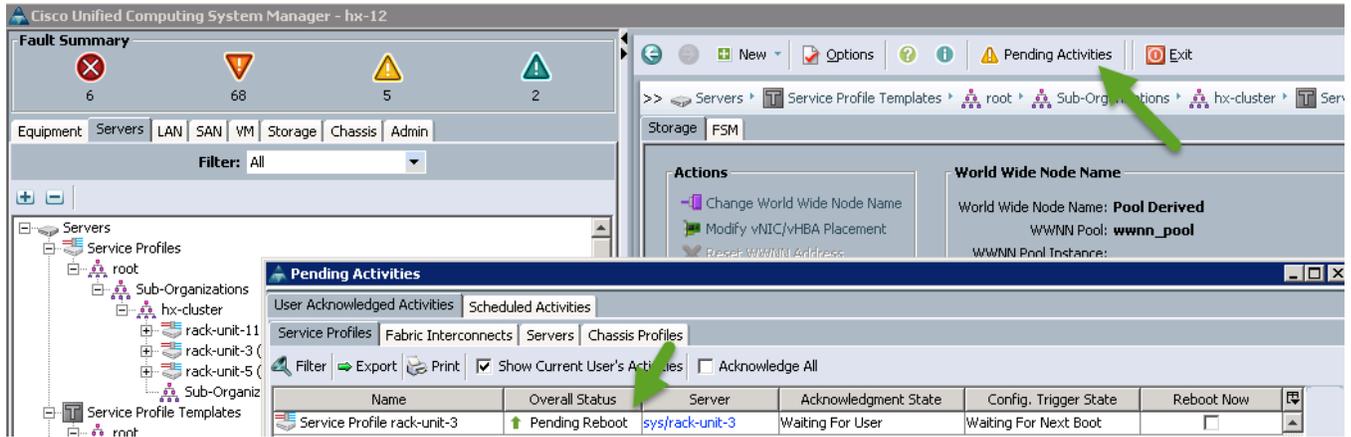
Should you decide to add additional storage such as a FlexPod after you have already installed your cluster, the following procedure can be used for adding vHBAs or vNICs that could cause PCI re-enumeration upon an ESXi host reboot. Beginning with HXDP 2.5, the DirectPath I/O configuration will repair itself automatically via an additional reboot of the node. Therefore, it is recommended you do not reboot multiple nodes at once after making these hardware changes, as it could lead to a cluster failure. Validate the health state of each host, and the HX cluster before rebooting or performing the procedure on subsequent nodes. In this example, we will be adding vHBAs after an HX cluster is created via the Cisco UCS service profile template. We will reboot one ESXi node at a time in a rolling upgrade fashion so there will be no outage.

To add vHBAs or iSCSI vNICs, complete the following steps:

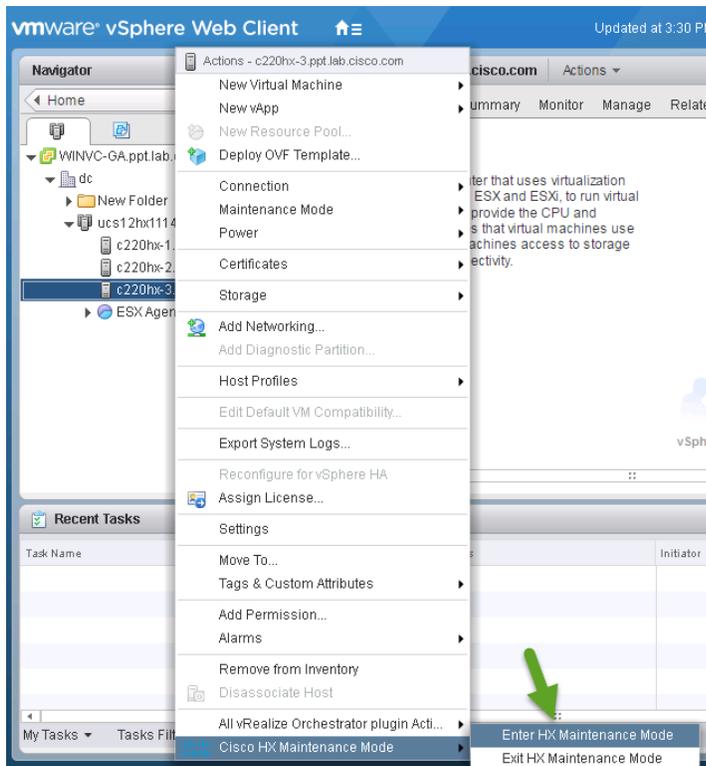
- Example of hardware change: Add vHBAs to the Service Profile Templates for HX (refer to Cisco UCS documentation for your storage device such as a FlexPod CVD for configuring the vHBAs).



- After adding the vHBAs to the templates, the servers will be in a Pending Reboot state and require a reboot to add the new interface. **Do NOT reboot the HX servers at this time.**



- Using HyperFlex Connect, or the vSphere Web Client, place one of the HX ESXi hosts in HX-Maintenance Mode.



- After the host has entered Maintenance Mode, reboot the associated node to complete the addition of the new hardware.
- After the node has rebooted, the HXDP software will detect that the DirectPath I/O configuration has changed, and must be reconfigured. This will result in one additional automatic reboot of the node.
- After the second reboot, exit the ESXi host from maintenance mode, the SCVM should start automatically without errors.
- Check the health status of the cluster, validating that the cluster is healthy before proceeding to reboot the next node. The cluster health status can be viewed from HyperFlex Connect, or via the CLI. Example: Run these command to the cluster IP for the HX Controllers “stcli cluster refresh” then “stcli cluster info | grep -i health”

```

root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster refresh
HyperFlex StorageController 1.8(1c)
root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster info | grep -i health
HyperFlex StorageController 1.8(1c)
  healthState: unhealthy
  Storage cluster is unhealthy.
root@ubuntu3:/scripts/8nodec220# █

```

8. Continue checking or refreshing until the HX cluster is healthy.

```

root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster refresh
HyperFlex StorageController 1.8(1c)
root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster info | grep -i health
HyperFlex StorageController 1.8(1c)
  healthState: healthy
  state: healthy
  Storage cluster is healthy.
root@ubuntu3:/scripts/8nodec220# █

```

9. Repeat the process for each node in the cluster as necessary.

## ESXi Hypervisor Installation

HX nodes come from the factory with a copy of the ESXi hypervisor pre-installed, however there are scenarios where it may be necessary to redeploy or reinstall ESXi on an HX node. In addition, this process can be used to deploy ESXi on rack mount or blade servers that will function as HX compute-only nodes. The HyperFlex system requires a Cisco custom ESXi ISO file to be used, which has Cisco hardware specific drivers pre-installed, and customized settings configured to ease the installation process. The Cisco custom ESXi ISO file is available to download at [cisco.com](https://www.cisco.com).

### ESXi Kickstart ISO

The HX custom ISO is based on the Cisco custom ESXi 6.5 Update 1 ISO release with the filename: ***HX-Vmware-ESXi-6.5U1-5969303-Cisco-Custom-6.5.1.1.iso*** and is available on the Cisco web site:

[https://software.cisco.com/download/release.html?mdfid=286305544&flowid=79522&softwareid=286305994&release=2.6\(1b\)](https://software.cisco.com/download/release.html?mdfid=286305544&flowid=79522&softwareid=286305994&release=2.6(1b))

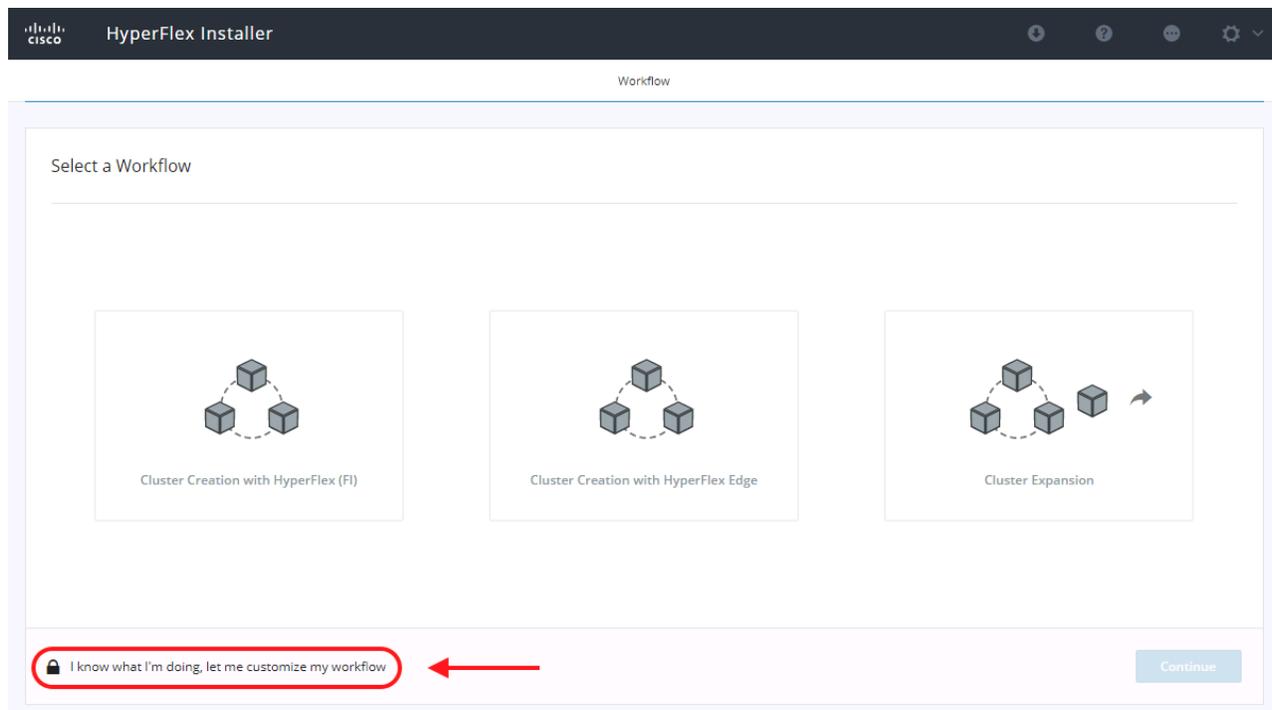
The custom Cisco HyperFlex ESXi ISO will automatically perform the following tasks with no user interaction required:

- Accept the End User License Agreement
- Configure the root password to: Cisco123
- Install ESXi to the internal mirrored Cisco FlexFlash SD cards
- Set the default management network to use vmnic0, and obtain an IP address via DHCP
- Enable SSH access to the ESXi host
- Enable the ESXi shell
- Enable serial port com1 console access to facilitate Serial over LAN access to the host
- Configure the ESXi configuration to always use the current hardware MAC address of the network interfaces, even if they change
- Rename the default vSwitch to vswitch-hx-inband-mgmt

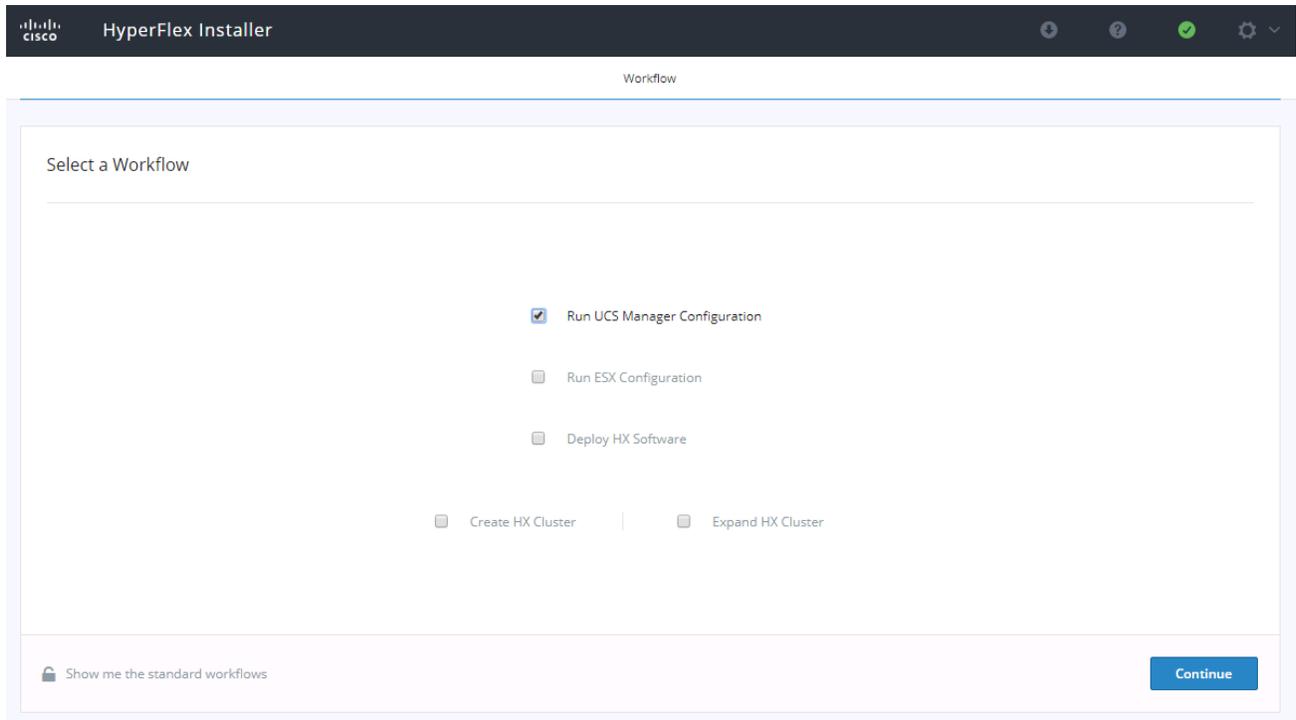
### Reinstall HX Cluster

A high-level example of a HX rebuild procedure would be:

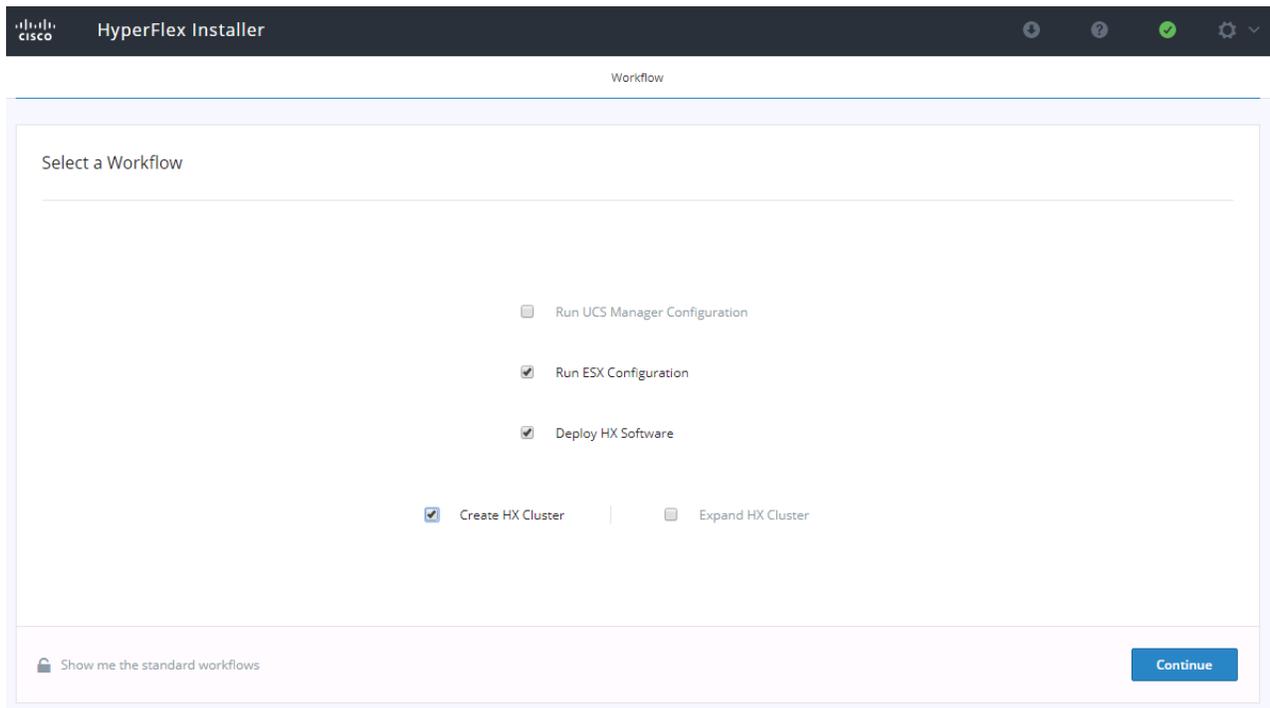
1. Clean up the existing environment by:
  - Deleting existing HX virtual machines and HX datastores.
  - Removing the HX cluster in vCenter.
  - Removing vCenter MOB entries for the HX extension.
  - Deleting HX sub-organization and HX VLANs in Cisco UCS Manager.
2. Run HX installer, use the customized version of the installation workflow by selecting the “I know what I am doing” link.



3. Use customized workflow and only choose the “Run UCS Manager Configuration” option, click Continue.



4. When the Cisco UCS Manager configuration is complete, HX hosts are associated with HX service profiles and powered on. Now perform a fresh ESXi installation using the custom ISO image and following the steps in section [Cisco UCS vMedia and Boot Policies](#).
5. When the ESXi fresh installations are all finished, use the customized workflow and select the remaining 3 options; ESXi Configuration, Deploy HX Software, and Create HX Cluster, to continue and complete the HyperFlex cluster installation.



More information on the various installation methods can be found in the [Getting Started Guide](#).

## Cisco UCS vMedia and Boot Policies

By using a Cisco UCS vMedia policy, the custom Cisco HyperFlex ESXi installation ISO file can be mounted to all of the HX servers automatically. The existing vMedia policy, named “HyperFlex” must be modified to mount this file, and the boot policy must be modified temporarily to boot from the remotely mounted vMedia file. Once these two tasks are completed, the servers can be rebooted, and they will automatically boot from the remotely mounted vMedia file, installing and configuring ESXi on the servers.

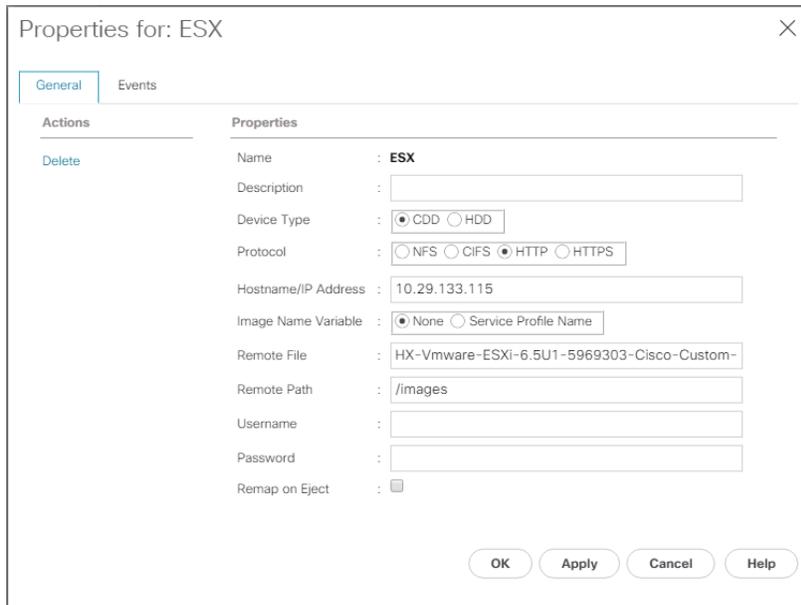


**WARNING!** While vMedia policies are very efficient for installing multiple servers, using vMedia policies as described could lead to an accidental reinstall of ESXi on any existing server that is rebooted with this policy. Please be certain that the servers being rebooted while the policy is in effect are the servers you wish to reinstall. Even though the custom ISO will not continue without a secondary confirmation, extreme caution is recommended. This procedure needs to be carefully monitored and the boot policy should be changed back to original settings immediately after the intended servers are rebooted, and the ESXi installation begins. Using this policy is only recommended for new installs or rebuilds. Alternatively, you can manually select the boot device using the KVM console during boot, and pressing F6, instead of making the vMedia device the default boot selection.

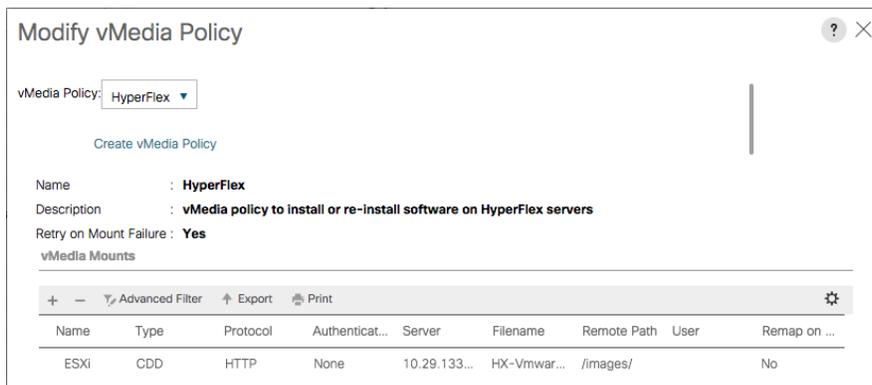
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To configure the Cisco UCS vMedia and Boot Policies, complete the following steps:

1. Copy the *HX-Vmware-ESXi-6.5U1-5969303-Cisco-Custom-6.5.1.1.iso* file to the HX Installer VM via SCP or SFTP, placing it in the folder `/var/www/localhost/images/`.
2. In Cisco UCS Manager, click the Servers button on the left-hand side of the screen.
3. Expand Servers > Policies > root > Sub-Organizations > <<HX\_ORG>> > vMedia Policies, and click vMedia Policy HyperFlex.
4. In the configuration pane, click Create vMedia Mount.
5. Enter a name for the mount, for example: ESXi.
6. Select the CDD option.
7. Select HTTP as the protocol.
8. Enter the IP address of the HyperFlex installer VM, for example: 10.29.133.115
9. Select None as the Image Variable Name.
10. Enter *HX-Vmware-ESXi-6.5U1-5969303-Cisco-Custom-6.5.1.1.iso* as the Remote File.
11. Enter `/images/` as the Remote Path.

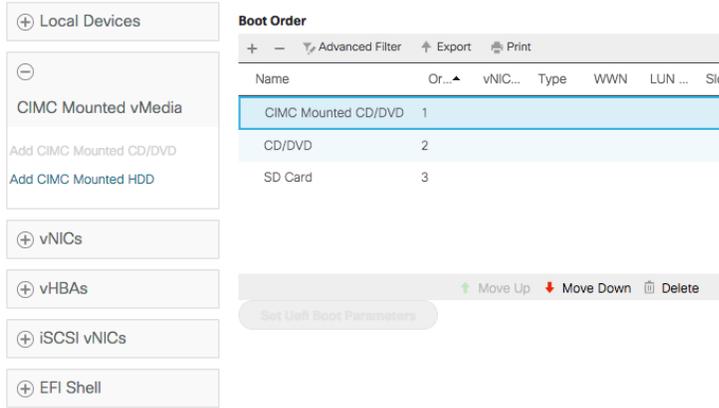


12. Click OK.
13. Select Servers > Service Profile Templates > root > Sub-Organizations > <<HX\_ORG>> > Service Template hx-nodes.
14. In the configuration pane, click the vMedia Policy tab.
15. Click Modify vMedia Policy.
16. Chose the HyperFlex vMedia Policy from the drop-down selection and click OK twice.



17. For Compute-Only nodes (if necessary), select Servers > Service Profile Templates > root > Sub-Organizations > <<HX\_ORG>> > Service Template compute-nodes.
18. In the configuration pane, click the vMedia Policy tab.
19. Click Modify vMedia Policy.
20. Chose the HyperFlex vMedia Policy from the drop-down selection and click OK twice.
21. Select Servers > Policies > root > Sub-Organizations > <<HX\_ORG>> > Boot Policy HyperFlex.
22. In the navigation pane, expand the section titled CIMC Mounted vMedia.

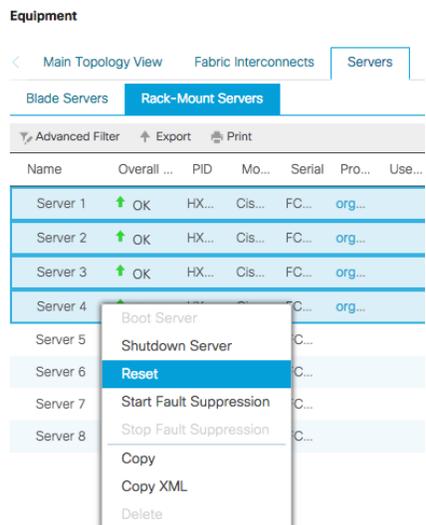
23. Click the entry labeled Add CIMC Mounted CD/DVD.
24. Select the CIMC Mounted CD/DVD entry in the Boot Order list, and click the Move Up button until the CIMC Mounted CD/DVD entry is listed first.
25. Click Save Changes and click OK.



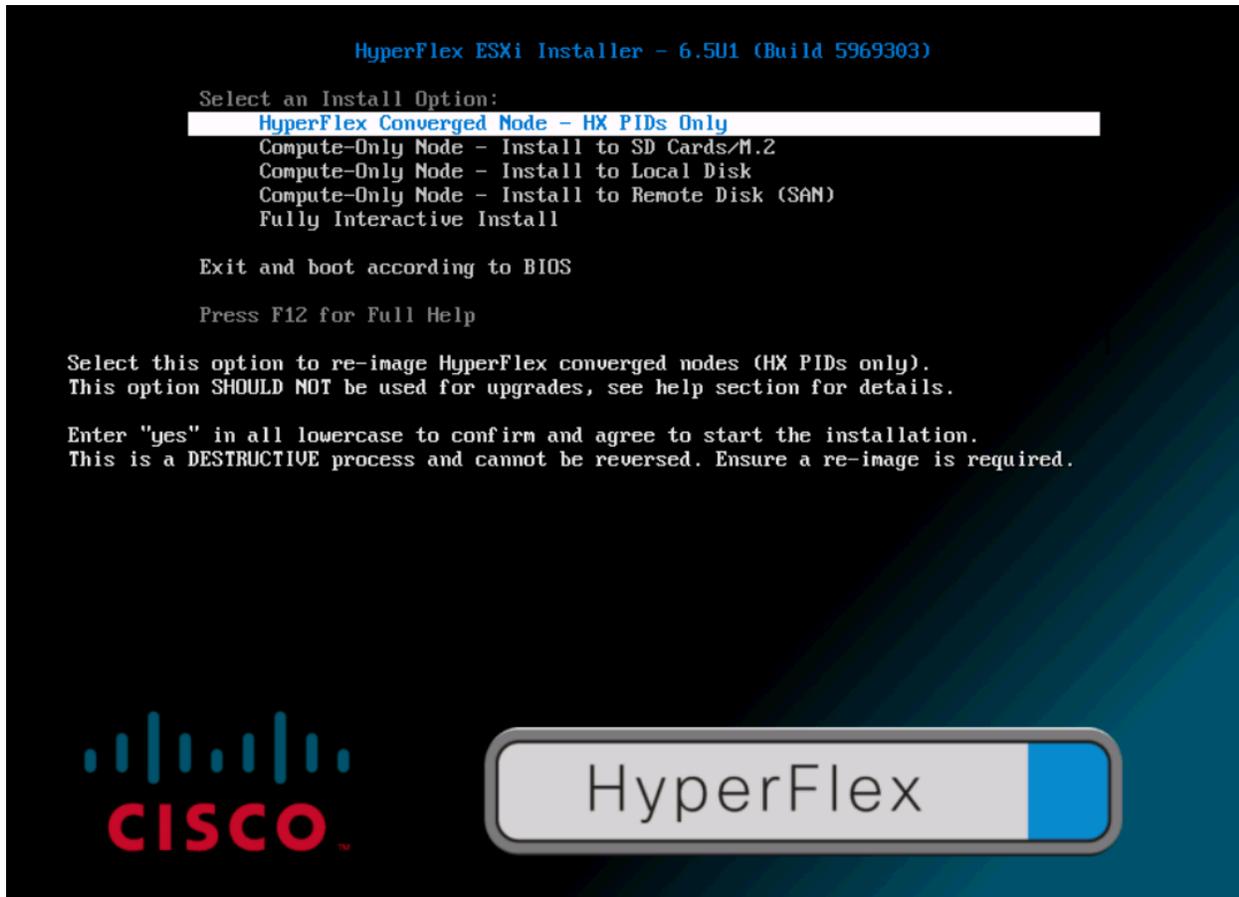
## Install ESXi

To begin the installation after modifying the vMedia policy, Boot policy and service profile template, the servers need to be rebooted. To complete the reinstallation, it is necessary to open a remote KVM console session to each server being worked on. To open the KVM console and reboot the servers, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side.
2. Expand Equipment > Rack mounts > Servers > Server 1.
3. In the configuration pane, click KVM Console.
4. The remote KVM Console window will open in a new browser tab. Click Continue to any security alerts that appear, and click the hyperlink to start the remote KVM session.
5. Repeat Steps 2-4 for all additional servers whose console you need to monitor during the installation.
6. In Cisco UCS Manager, click the Equipment button on the left-hand side.
7. Expand Equipment > Rack-Mount Servers > Servers.
8. In the configuration pane, click the first server to be rebooted, then shift+click the last server to be rebooted, selecting all of the servers.
9. Right-click the mouse and click Reset.



10. Click OK.
11. Select Power Cycle and click OK.
12. Click OK. The servers you are monitoring in the KVM console windows will now immediately reboot, and boot from the remote vMedia mount. Alternatively, the individual KVM consoles can be used to perform a power cycle one-by-one.
13. When the server boots from the installation ISO file, you will see a customized Cisco boot menu. In the Cisco customized installation boot menu, select “HyperFlex Converged Node - HX PIDs Only” and press enter.



14. Enter “yes” in all lowercase letters, and press Enter to confirm and install ESXi.

```
Enter yes (all lowercase) and hit ENTER to confirm. This will factory erase the node.
```

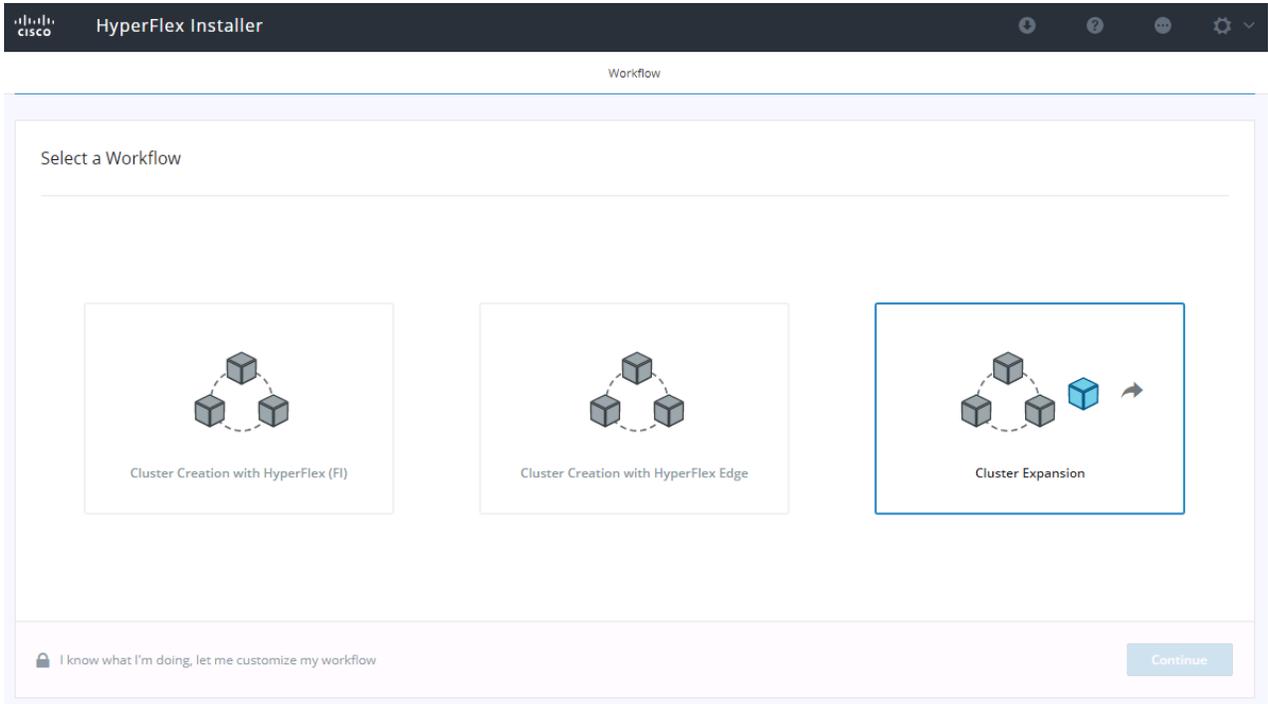
15. (Optional) When installing Compute-Only nodes, the appropriate Compute-Only Node option for the boot location to be used should be selected. The “Fully Interactive Install” option should only be used for debugging purposes.
16. The ESXi installer will continue the installation process automatically, there may be error messages seen on screen, but they can be safely ignored. When the process is complete, the standard ESXi console screen will be seen as below:



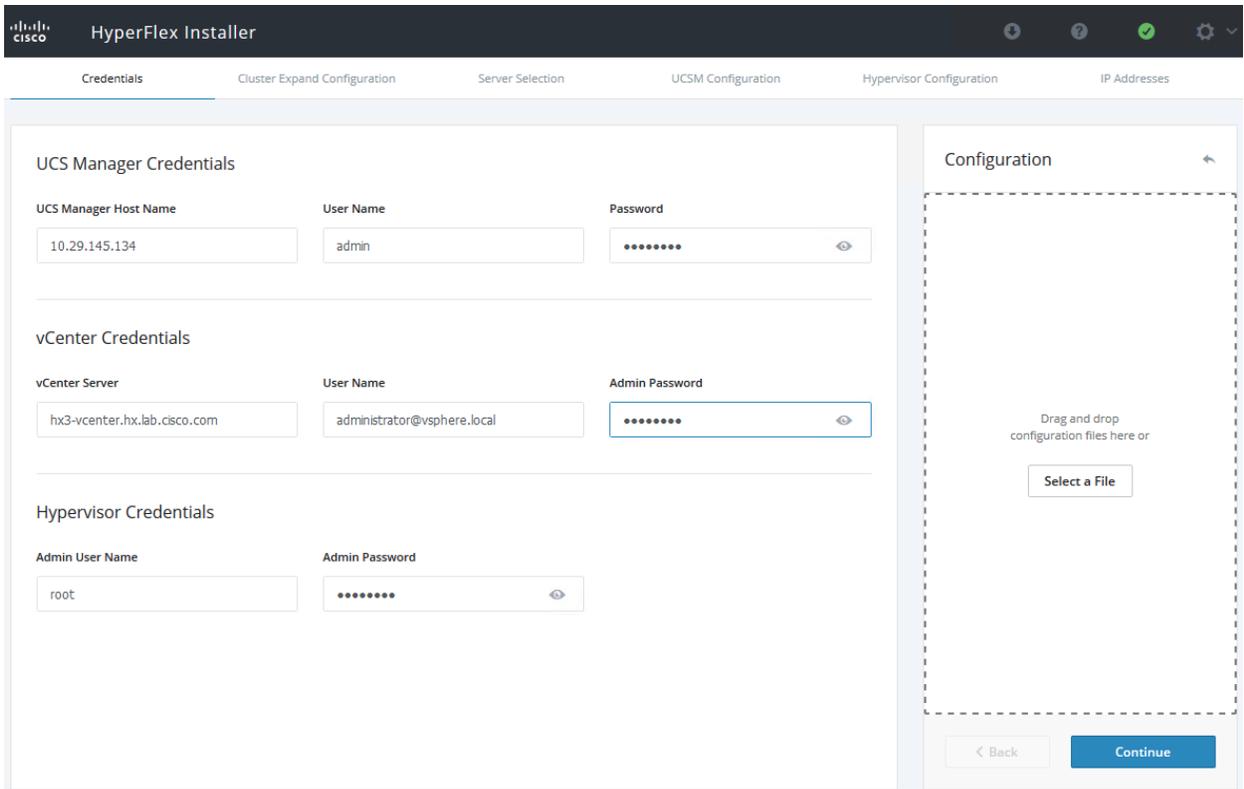
- The number of compute-only nodes cannot exceed the number of HyperFlex converged nodes within a single HyperFlex cluster.
- The Cisco UCS infrastructure firmware revision, which provides the firmware for Cisco UCS Manager and the Fabric Interconnects, must be maintained at the minimum version required for the HyperFlex converged nodes, or higher, at all times.
- The version of VMware ESXi installed on the compute-only nodes must be compatible with the Cisco HyperFlex version in use, and it must match the version installed on the HyperFlex converged nodes.
- While the CPU models and memory capacities between the compute-only nodes and the HyperFlex converged nodes do not have to match, configuring the nodes to have similar capacities is recommended.
- Care must be taken that the addition of the compute-only nodes will not significantly impact the HyperFlex cluster by creating additional load, or by consuming too much space. Pay close attention to the space consumption and performance requirements of any net-new VMs that will run on the additional compute-only nodes, and note the current cluster performance and space utilization. If no new VMs will be created, then the current cluster performance will not be impacted.
- Mixing different models of compute-only nodes is allowed within the same cluster. Example: using Cisco UCS C220 M3 and C240 M4 servers as compute-only nodes is allowed.
- Connectivity between compute-only nodes and the HyperFlex cluster must be within the same Cisco UCS domain, and must be 10 GbE or 40 GbE. Connecting compute-only nodes from a different Cisco UCS domain is not allowed, and connecting standalone rack-mount servers from outside of the Cisco UCS domain is not allowed.
- Blade servers installed in the Cisco UCS 5108 Blade Chassis can connect through 10 GbE or 40 GbE chassis links, using the Cisco UCS 2204XP, 2208XP, or 2304 model Fabric Extenders. The Fabric Extenders, also called I/O Modules (IOMs), are typically installed in pairs, and connect the 5108 chassis to the Fabric Interconnects, which provide all the networking and management for the blades. Care must be taken not to oversubscribe and saturate the chassis links.
- Mixing CPU generations will require configuring VMware Enhanced vMotion Compatibility (EVC) in order to allow vMotion to work between the compute-only nodes and the converged nodes. Enabling EVC typically requires all VMs to be powered off. If it is known ahead of time that EVC will be needed, then it is easier to enable EVC on the vCenter cluster prior to installing HyperFlex.
- Compute-only nodes can be configured to boot from SAN, local disks, or internal SD cards. No other internal storage should be present in a compute-only node. Manual configuration of the boot policy will be necessary if booting from any device other than SD cards.
- Compute-only nodes can be configured with additional vNICs or vHBAs in order to connect to supported external storage arrays via NFS, iSCSI or Fibre Channel, in the same way as HyperFlex converged nodes are allowed to do.

The HX installer has a wizard for Cluster Expansion with converged nodes and compute-only nodes, however the compute-only node process requires some additional manual steps to install the ESXi hypervisor on the nodes. To expand an existing HyperFlex cluster with compute-only nodes, creating an extended HyperFlex cluster, complete the following steps:

1. On the HyperFlex installer webpage select a Workflow of “Cluster Expansion” .

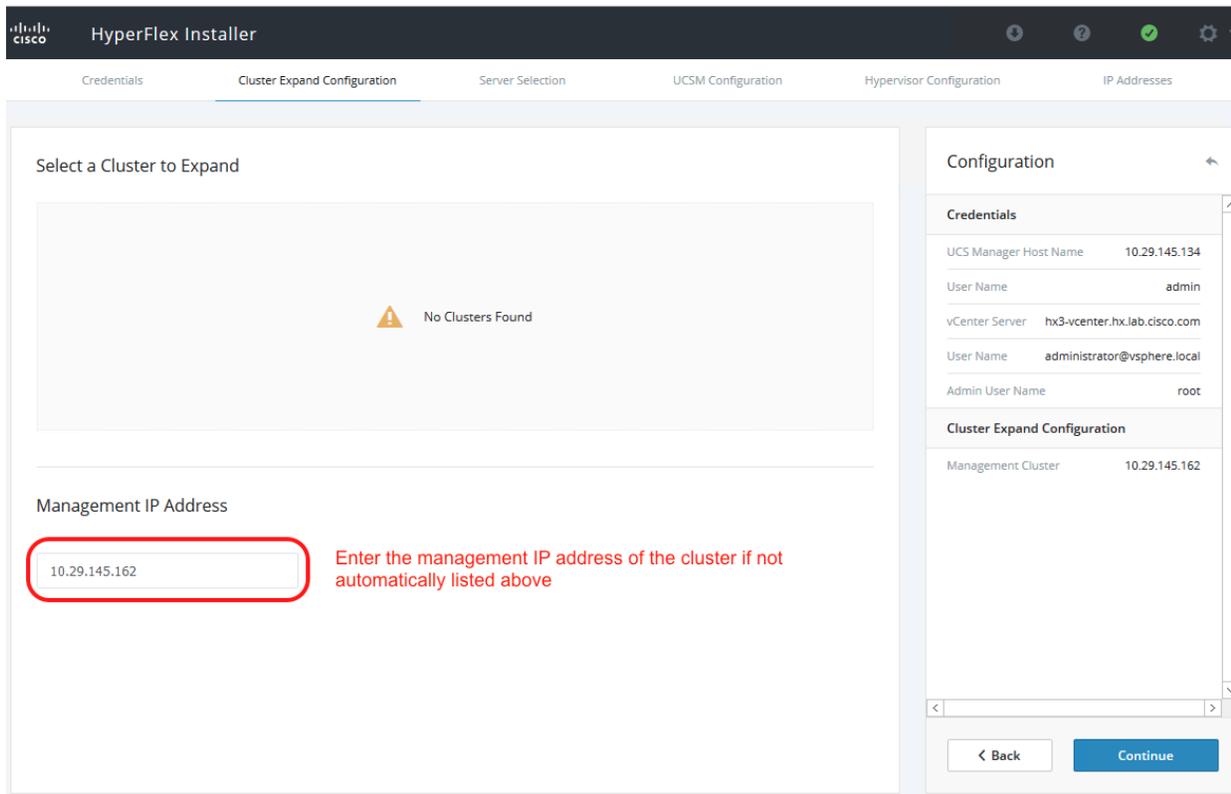


2. Enter the Cisco UCS Manager and vCenter DNS hostname or IP address, the admin usernames, and the passwords. The default Hypervisor credential which comes installed from the factory is username: root with a password of “Cisco123” and are already entered in the installer. You can select the option to see the passwords in clear text. Optionally, you can import a JSON file that has the configuration information, except for the appropriate passwords.

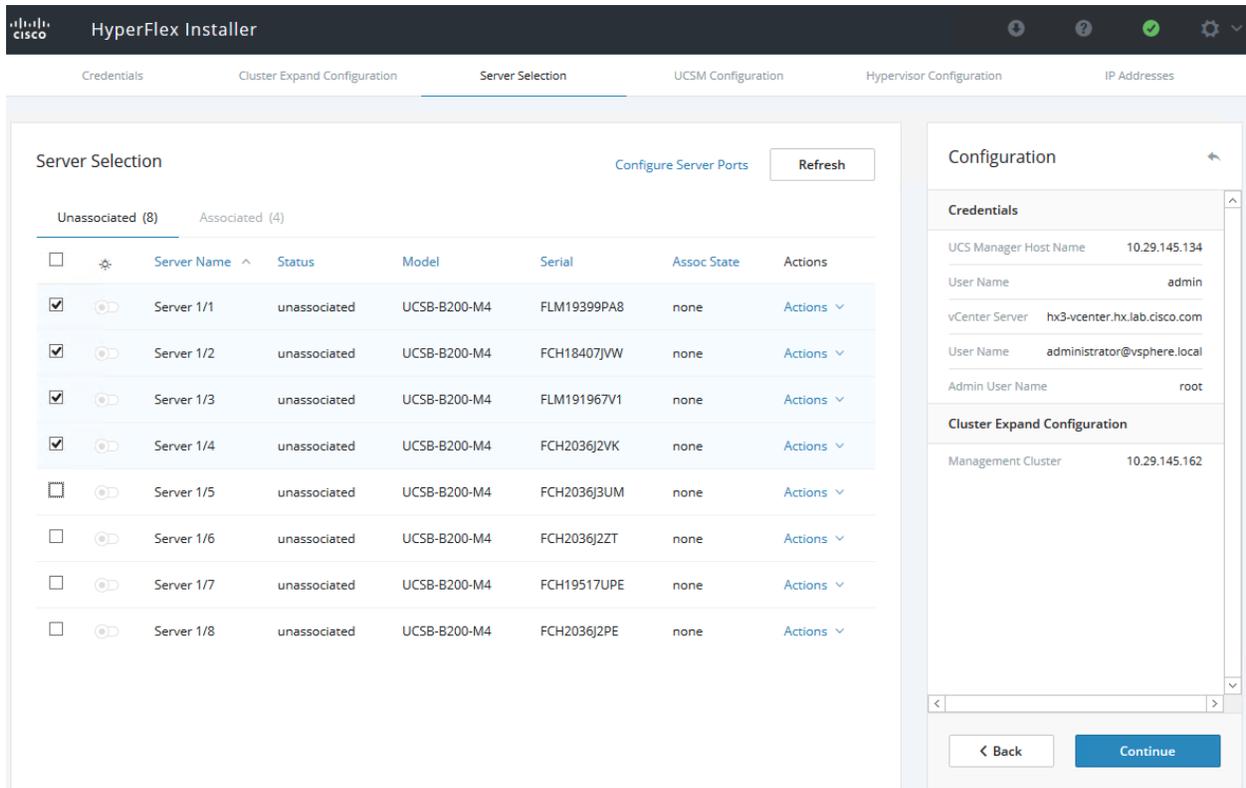


3. Click Continue.

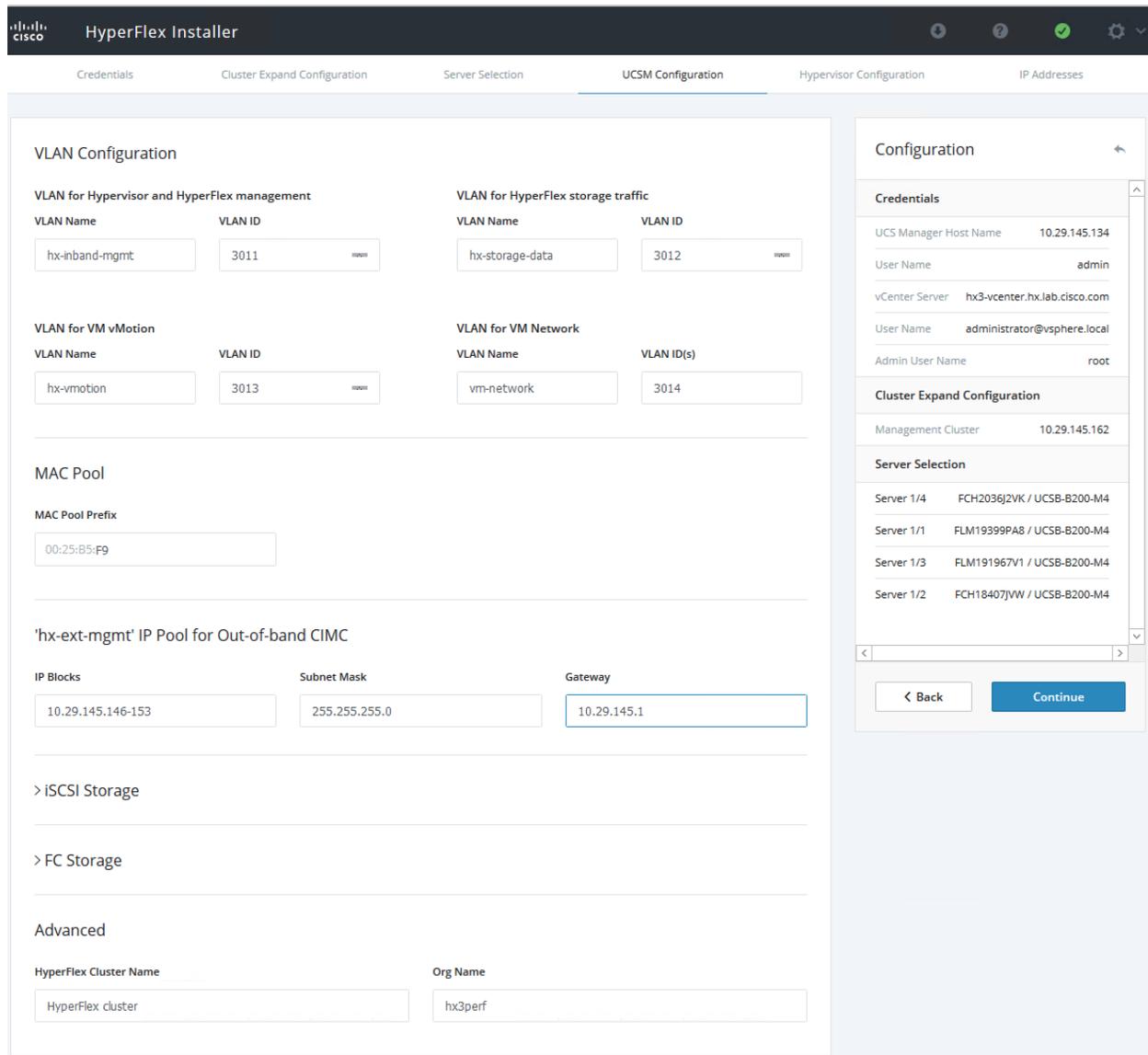
4. Select the HX cluster to expand and click Continue. If the installer has been reset and does not show the previously installed cluster, enter the HX cluster management IP address instead.



5. From the list of unassociated servers, select the blade or rack-mount servers you wish to add to the cluster as compute-only nodes, then click Continue.



- On the Cisco UCS Manager Configuration page, enter the VLAN settings, Mac Pool Prefix, UCS hx-ext-mgmt IP Pool for CIMC, iSCSI Storage setting, FC Storage setting, and sub-organization name, making sure that all the values match the existing settings for the cluster being expanded.



7. Click Continue.
8. Enter the subnet mask, gateway, DNS, and IP addresses for the Hypervisors (ESXi hosts) as well as host names. The IPs will be assigned through Cisco UCS Manager to the new ESXi hosts.

HyperFlex Installer

Credentials Cluster Expand Configuration Server Selection UCSM Configuration **Hypervisor Configuration** IP Addresses

### Configure common Hypervisor Settings

Subnet Mask: 255.255.255.0      Gateway: 10.29.145.1      DNS Server(s): 10.29.133.61

### Hypervisor Settings

Make IP Addresses and Hostnames Sequential

#	Name	Serial	Static IP Address	Hostname
1	Server 1/1	FLM19399PA8	10.29.145.158	hx3-b200-1
2	Server 1/2	FCH18407JWV	10.29.145.159	hx3-b200-2
3	Server 1/3	FLM191967V1	10.29.145.160	hx3-b200-3
4	Server 1/4	FCH2036J2VK	10.29.145.161	hx3-b200-4

### Configuration

**Credentials**

UCS Manager Host Name: 10.29.145.134  
 User Name: admin  
 vCenter Server: hx3-vcenter.hx.lab.cisco.com  
 User Name: administrator@vsphere.local  
 Admin User Name: root

**Cluster Expand Configuration**

Management Cluster: 10.29.145.162

**Server Selection**

Server 1/4: FCH2036J2VK / UCSB-B200-M4  
 Server 1/1: FLM19399PA8 / UCSB-B200-M4  
 Server 1/3: FLM191967V1 / UCSB-B200-M4  
 Server 1/2: FCH18407JWV / UCSB-B200-M4

**UCSM Configuration**

< >

[Back](#) [Continue](#)

9. Click Continue.
10. Enter the additional IP addresses for the Hypervisor Data network of the new ESXi hosts.
11. Enter the current password that is set on the Controller VMs.
12. Enable Jumbo Frames. Since compute-only nodes have no local storage disks, you do not need to select Clean up disk partitions.
13. (Optional) At this step you can manually add more servers for expansion if these servers already have service profiles associated and the hypervisor is ready, by clicking on Add Compute Server or Add Converged Server and then entering the IP addresses for the storage controller management and data networks.

Credentials Cluster Expand Configuration Server Selection UCSM Configuration Hypervisor Configuration IP Addresses

### IP Addresses

Make IP Addresses Sequential

Management - VLAN 3011

Server	Hypervisor	Storage Controller
FLM19399PA8 compute	10.29.145.158	
FCH18407JVW compute	10.29.145.159	
FLM191967V1 compute	10.29.145.160	
FCH2036J2VK compute	10.29.145.161	

Data - VLAN 3012

Server	Hypervisor	Storage Controller
FLM19399PA8 compute	192.168.145.158	
FCH18407JVW compute	192.168.145.159	
FLM191967V1 compute	192.168.145.160	
FCH2036J2VK compute	192.168.145.161	

**Controller VM Password**

Controller VM Password

.....

**Advanced**

Jumbo Frames  Enable Jumbo Frames on Data Network

Disk Partitions  Clean up disk partitions

### Configuration

**Credentials**

UCS Manager Host Name 10.29.145.134

User Name admin

vCenter Server hx3-vcenter.hx.lab.cisco.com

User Name administrator@vsphere.local

Admin User Name root

**Cluster Expand Configuration**

Management Cluster 10.29.145.162

**Server Selection**

Server 1/4 FCH2036J2VK / UCSB-B200-M4

Server 1/1 FLM19399PA8 / UCSB-B200-M4

Server 1/3 FLM191967V1 / UCSB-B200-M4

Server 1/2 FCH18407JVW / UCSB-B200-M4

**UCSM Configuration**

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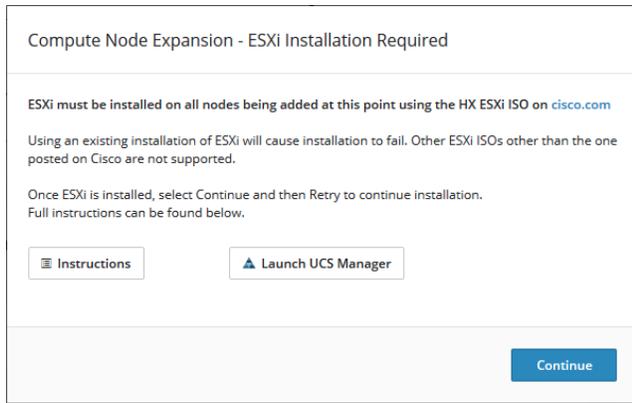
14. Click Start.

15. Validation of the configuration will now start. After validation, the installer will create the compute-only node service profiles and associate them with the selected servers. Once the service profiles are associated, the installer will move on to the Hypervisor Configuration step and display an error. The error shown alerts you to the need to install the ESXi hypervisor onto the compute-only nodes. The following steps show how to install ESXi onto the new compute-only nodes.

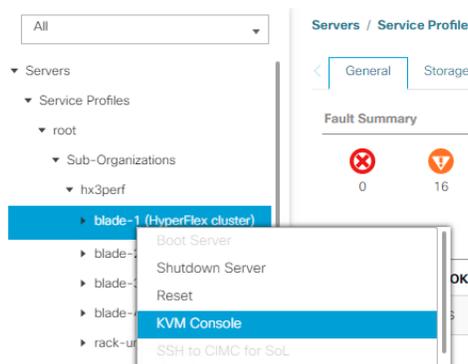
16. Click the Instructions button to see the steps in a PDF document. If necessary, click the Launch UCS Manager button to log in to Cisco UCS Manager in another browser tab.



Note: Do not click Continue at this time.



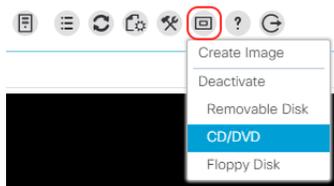
17. In Cisco UCS Manager, click the Servers button on the left-hand side.
18. Expand Servers > Service Profiles > root > Sub-Organizations > <<HX\_ORG>>.
19. Each new compute-only node will have a new service profile, for example: blade-1. Right-click the new service profile and click KVM Console. The remote KVM console will open in a new browser tab. Accept any SSL errors or alerts, then click the link to launch the KVM console.



20. Repeat step 19 for each new service profile, that is associated with the new compute-only nodes.
21. In the remote KVM tab, click the Virtual Media button in the top right-hand corner of the screen, then click Activate Virtual Devices.

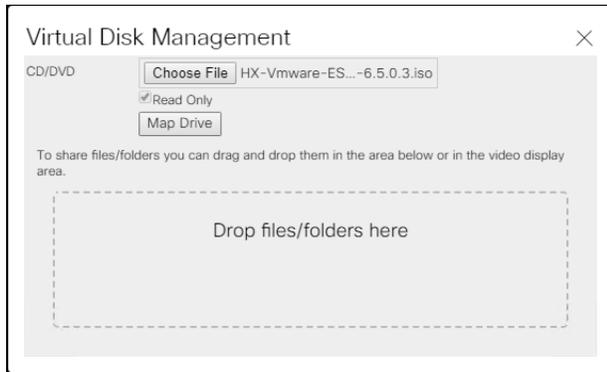


22. In the remote KVM tab, click the Virtual Media button in the top right-hand corner of the screen, then click the CD/DVD option.



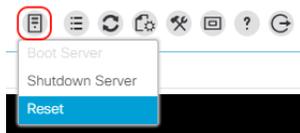
23. Click Choose File, browse for the Cisco custom ESXi ISO installer file, and click Open.

24. Click Map Drive.



25. Repeat steps 21-24 for all the new compute-only nodes.

26. In the remote KVM tab, click the Server Actions button in the top right-hand corner of the screen, then click Reset.



27. Click OK.

28. Choose the Power Cycle option, then click OK.

29. Click OK.

30. Observe the server going through the POST process until the following screen is seen. When it appears, press the F6 key to enter into the boot device selection menu.



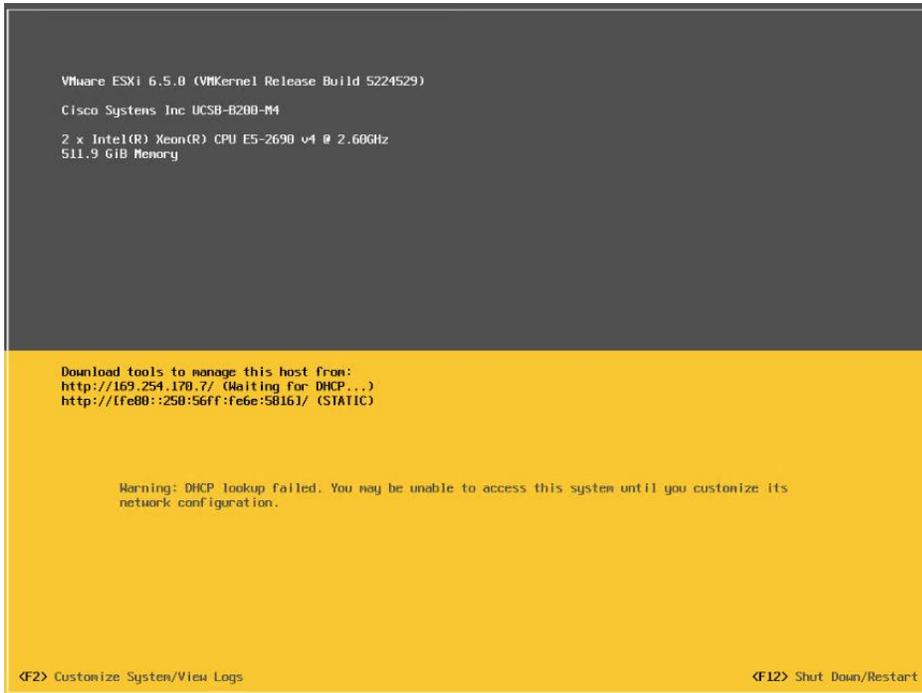
31. Select Cisco vKVM-mapped vDVD1.22, then press Enter.



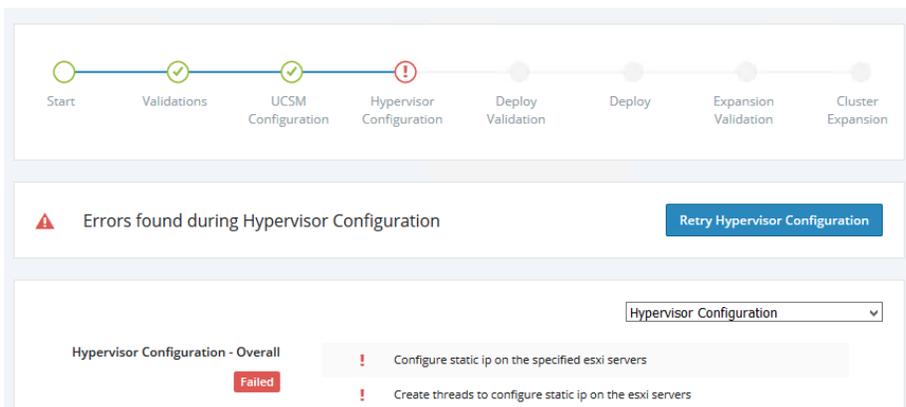
32. The server will boot from the remote KVM mapped ESXi ISO installer and display the following screen:
33. Select the appropriate installation option for the compute-only node you are installing, either installing to SD cards, local disks, or booting from SAN, then press Enter.



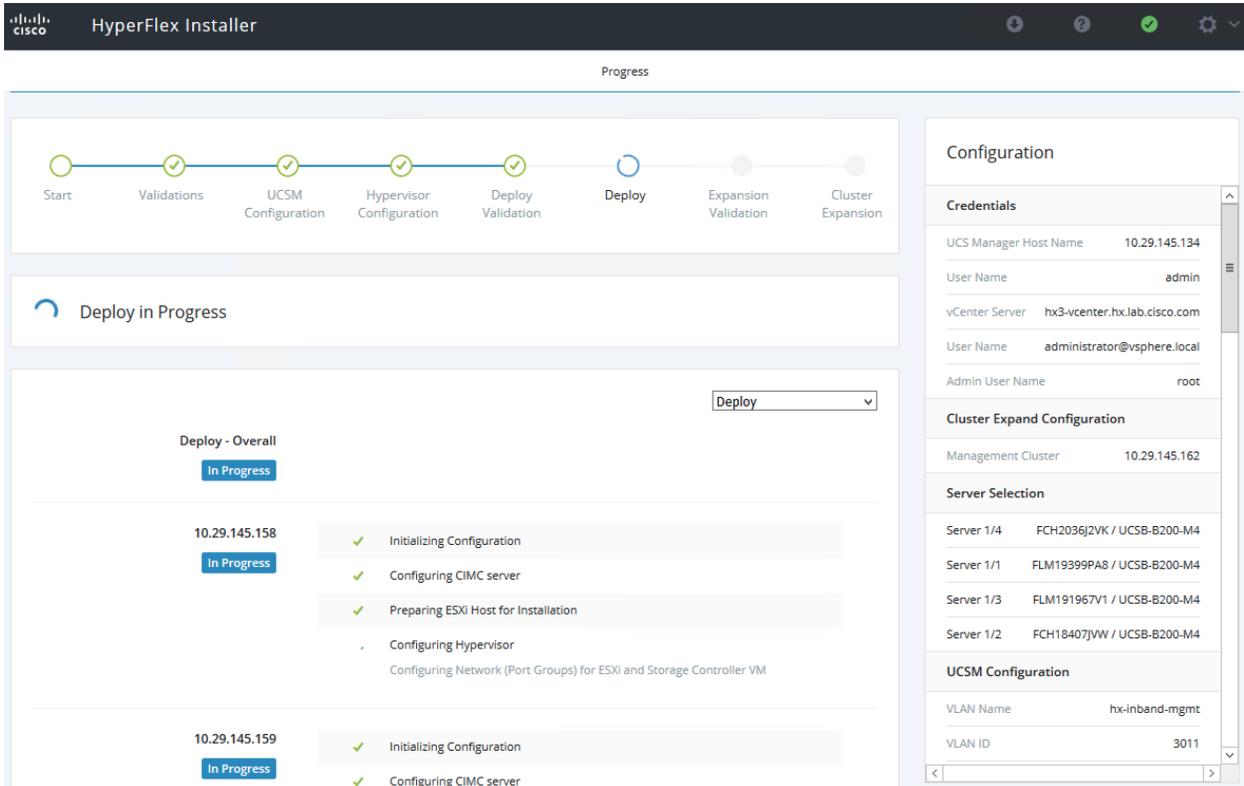
34. Type “yes” and press Enter to accept the warning and continue the installation.
35. The ESXi installer will now automatically perform the installation to the boot media. As you watch the process, some errors may be seen, but they can be ignored. Once the new server has completed the ESXi installation, it will be waiting at the console status screen seen below.



- 36. Repeat steps 26-35 for all the additional new compute-only nodes being added to the HX cluster.
- 37. When all the new nodes have finished their fresh ESXi installations, return to the HX installer, where the error in step 15 was seen. Click Continue.
- 38. Click Retry Hypervisor Configuration.



- 39. The HX installer will now proceed to complete the deployment and perform all the steps listed at the top of the screen along with their status.



40. When the expansion is completed, a summary screen showing the status of the expanded cluster and the expansion operation is shown.

Cluster Name HX3PERF ONLINE HEALTHY

Version	2.5.1b-26284	vCenter Server	hx3-vcenter.hx.lab.cisco.com
Cluster Management IP Address	10.29.145.162	vCenter Datacenter Name	HUIDC
Cluster Data IP Address	192.168.145.162	vCenter Cluster Name	HX3PERF
Replication Factor	3	DNS Server(s)	10.29.133.61
Available Capacity	10.7 TB	NTP Server(s)	72.163.32.44, 171.70.168.238, 10.81.254.202

Servers

Model	Serial Number	Management Hypervisor	Management Storage Controller	Data Network Hypervisor	Data Network Storage Controller
HXAF240C-M4SX	FCH2029V30Z	10.29.145.154	10.29.145.163	192.168.145.154	192.168.145.163
HXAF240C-M4SX	FCH2029V34W	10.29.145.155	10.29.145.164	192.168.145.155	192.168.145.164
HXAF240C-M4SX	FCH2029V34X	10.29.145.156	10.29.145.165	192.168.145.156	192.168.145.165
HXAF240C-M4SX	FCH2029V30R	10.29.145.157	10.29.145.166	192.168.145.157	192.168.145.166
UCSB-B200-M4	FOX1813GDX1	10.29.145.158		192.168.145.158	
UCSB-B200-M4	FOX1813GDX1	10.29.145.159		192.168.145.159	
UCSB-B200-M4	FOX1813GDX1	10.29.145.160		192.168.145.160	
UCSB-B200-M4	FOX1813GDX1	10.29.145.161		192.168.145.161	

Back to Workflow Selection Launch HyperFlex Connect

After the install has completed, the compute-only nodes are added to the cluster and now have access to the existing HX datastores, but some manual post installation steps are required. Most steps can be done by running the `post_install` script from the HX Installer VM, similar to when performing a new installation, or via a custom script. A list of additional configuration steps necessary includes:

- Disable SSH warning
- Creation of the guest VM port groups
- Creation of the vMotion vmkernel port
- Syslog Server Configuration



**Note:** If at a later time the `post_install` script needs to be run against a specific HX cluster, the cluster can be specified by using the `--cluster-ip` switch, and entering the cluster's management IP address.

Example: PowerCLI script to complete tasks on the ESXi host.

```
# Configure_ESXi_post_install.ps1
# Description: Configures ESXi options and settings after HyperFlex installation.
```

```

# Usage: Modify the variables to specify the ESXi root password, the servers to be
# configured, the guest VLAN ID, and the IP addresses used for the vMotion VMkernel
# interfaces.
#
Set-PowerCLIConfiguration -InvalidCertificateAction Ignore -Confirm:$false | Out-Null
$domainname = "hx.lab.cisco.com"
$rootpw = "Cisco123"
$serv-
ers="hx220-01.hx.lab.cisco.com","hx220-02.hx.lab.cisco.com","hx220-03.hx.lab.cisco.com","hx220-04
.hx.lab.cisco.com","hx220-05.hx.lab.cisco.com","hx220-06.hx.lab.cisco.com","hx220-07.hx.lab.cisco
.com","hx220-08.hx.lab.cisco.com"
$ip=11

Foreach ($server in $servers) {

# connect to the ESXi host server
Connect-VIServer -server $server -user root -password $rootpw
$vmhost = Get-VMHost -Name $server

#disable shell warning
$vmhost | Set-VMHostAdvancedConfiguration UserVars.SuppressShellWarning 1

#configure syslog traffic to send to vCenter or syslog server
Set-VMHostSysLogServer -SysLogServer '10.29.133.63:514' -VMHost $vmhost

# retrieve the virtual switch configurations
$vswitch2 = Get-VirtualSwitch -VMHost $vmhost -Name vswitch-hx-vm-network
$vswitch3 = Get-VirtualSwitch -VMHost $vmhost -Name vmotion

# create a port group for the guest VMs
New-VirtualPortGroup -VirtualSwitch $vswitch2 -Name "VM-Network" -VLANID 100

# create the vmotion port group and VMkernel interface
$vmip="192.168.233."+$ip
New-VMHostNetworkAdapter -VMHost $vmhost -VirtualSwitch $vswitch3 -PortGroup "vmotion" -Mtu 9000
-VMotionEnabled $true -IP $vmip -SubnetMask 255.255.255.0 -Confirm:$false
$ip=$ip+1

Disconnect-VIServer -server $server -Confirm:$false
}

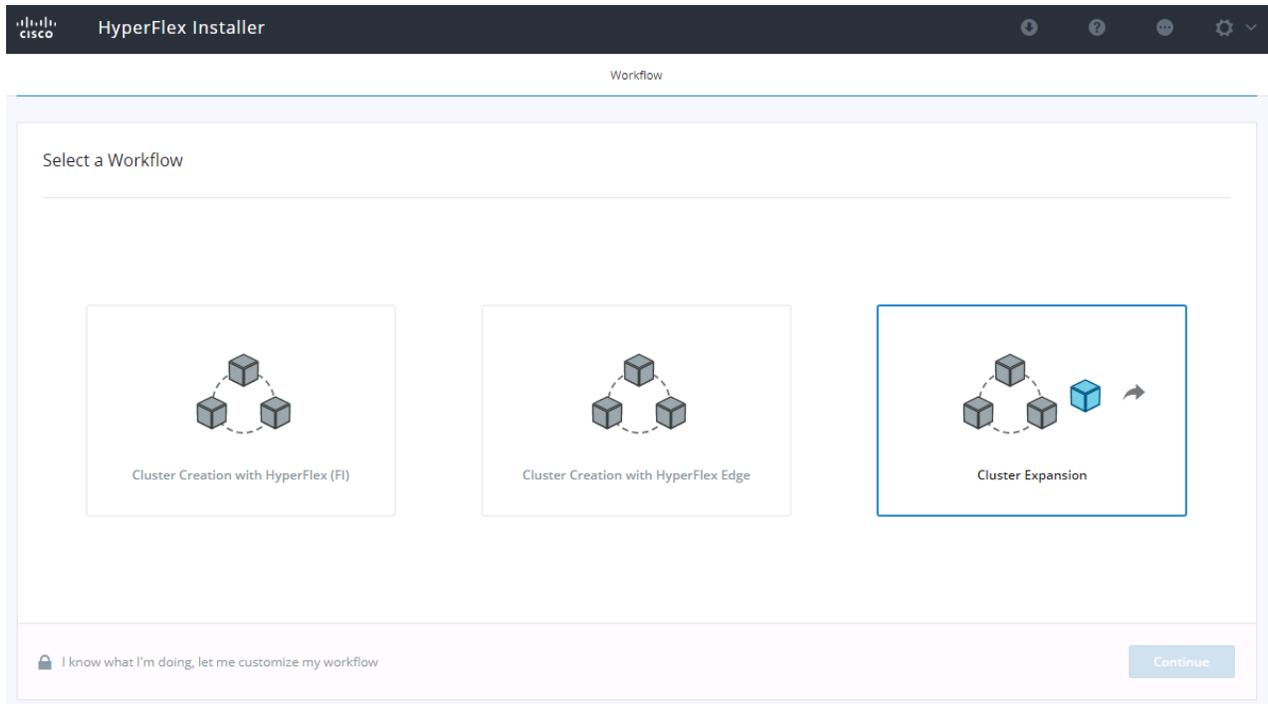
```

To validate our configuration, vMotion a VM to the new compute-only node. You can validate that your VM is now running on the compute only node through the Summary tab of the VM.

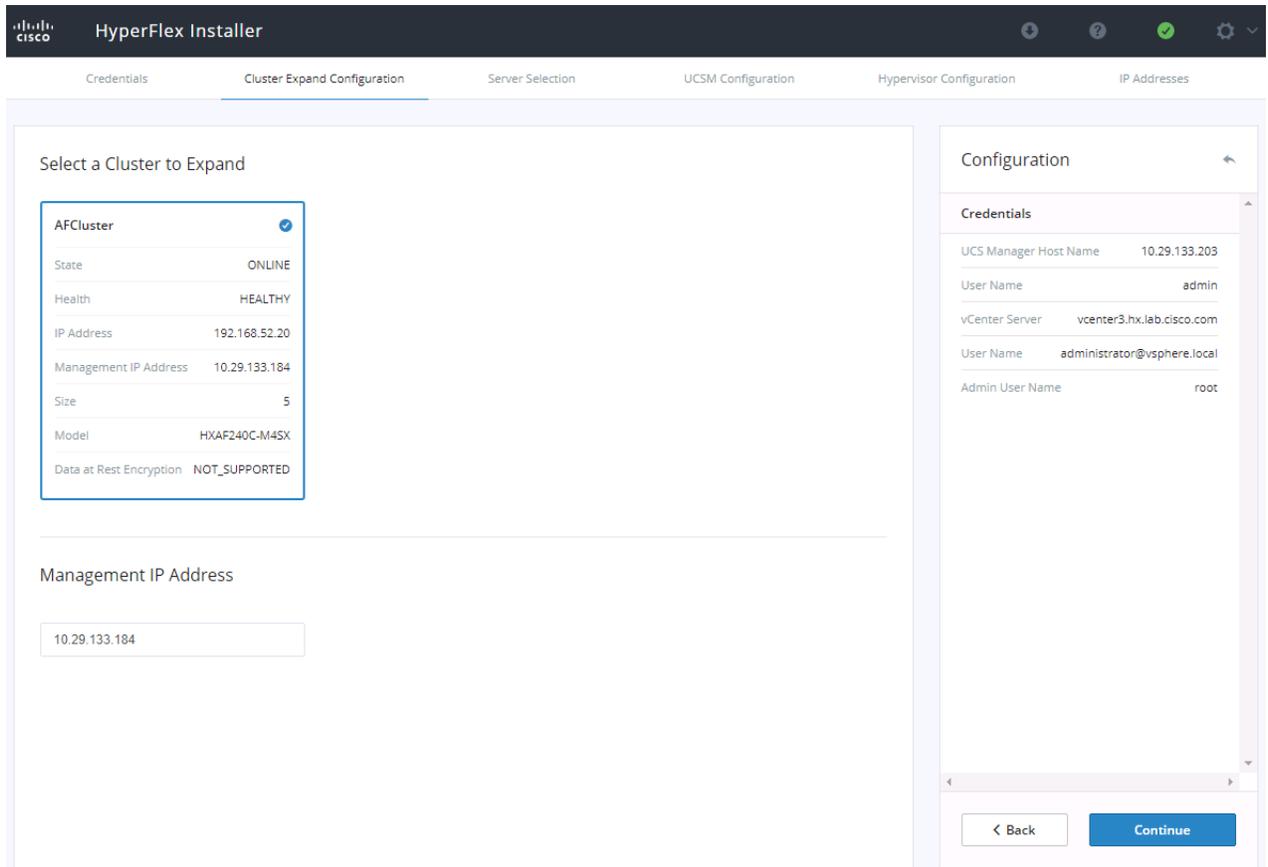
## Expansion with Converged Nodes

The HX installer has a wizard for Cluster Expansion with Converged Nodes. This procedure is very similar to the initial HyperFlex cluster setup. The following process assumes a new Cisco HX node has been ordered, therefore it is pre-configured from the factory with the proper hardware, firmware, and ESXi hypervisor installed. To add converged storage nodes to an existing HyperFlex cluster, complete the following steps:

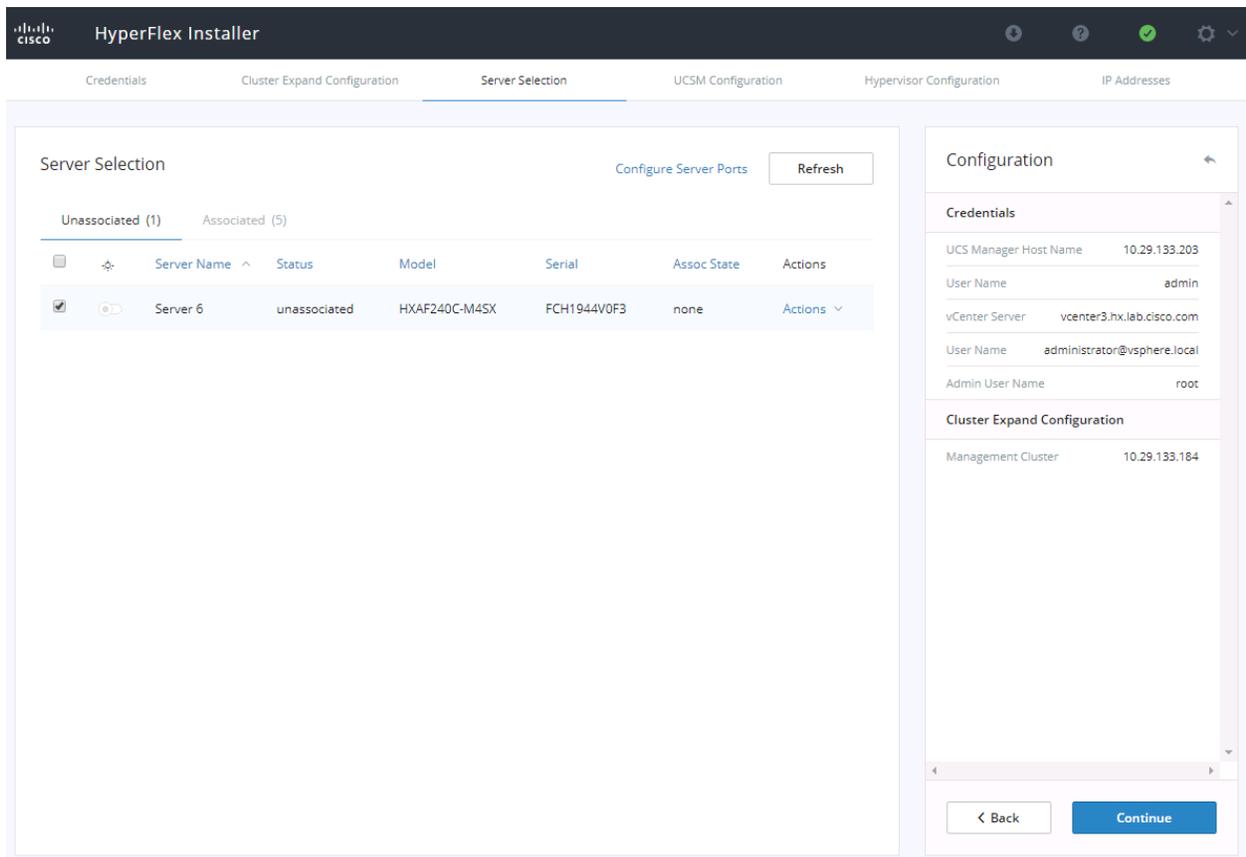
1. On the HyperFlex installer webpage select a Workflow of “Cluster Expansion” .



2. Enter the Cisco UCS Manager and vCenter DNS hostname or IP address, the admin usernames, and the passwords. The default Hypervisor credential which comes installed from the factory is username: root with a password of “Cisco123” and are already entered in the installer. You can select the option to see the passwords in clear text. Optionally, you can import a JSON file that has the configuration information, except for the appropriate passwords.
3. Click Continue.
4. Select the HX cluster to expand and click Continue. If the installer has been reset and does not show the previously installed cluster, enter the HX cluster management IP address instead.



5. Select the unassociated HX servers you want to add to the existing HX cluster. Click Continue.



- On the Cisco UCS Manager Configuration page, enter the VLAN settings, Mac Pool Prefix, UCS hx-ext-mgmt IP Pool for CIMC, iSCSI Storage setting, FC Storage setting, and sub-organization name, making sure that all the values match the existing settings for the cluster being expanded.

The screenshot displays the 'UCSM Configuration' step in the HyperFlex Installer. The main configuration area is divided into several sections:

- VLAN Configuration:**
  - VLAN for Hypervisor and HyperFlex management:** VLAN Name: ; VLAN ID:
  - VLAN for HyperFlex storage traffic:** VLAN Name: ; VLAN ID:
  - VLAN for VM vMotion:** VLAN Name: ; VLAN ID:
  - VLAN for VM Network:** VLAN Name: ; VLAN ID(s):
- MAC Pool:**
  - MAC Pool Prefix:
- 'hx-ext-mgmt' IP Pool for Out-of-band CIMC:**
  - IP Blocks:
  - Subnet Mask:
  - Gateway:
- Advanced:**
  - HyperFlex Cluster Name:
  - Org Name:

The right sidebar, titled 'Configuration', provides a summary of the settings:

- Credentials:**
  - UCS Manager Host Name: 10.29.133.203
  - User Name: admin
  - vCenter Server: vcenter3.hx.lab.cisco.com
  - User Name: administrator@vsphere.local
  - Admin User Name: root
- Cluster Expand Configuration:**
  - Management Cluster: 10.29.133.184
- Server Selection:**
  - Server 6: FCH1944V0F3 / HXAF240C-M45X

Navigation buttons at the bottom of the sidebar include '< Back' and 'Continue'.

7. Click Continue.
8. Enter the subnet mask, gateway, DNS, and IP addresses for the Hypervisors (ESXi hosts) as well as host names. The IPs will be assigned through Cisco UCS Manager to ESXi systems.

**HyperFlex Installer**

Credentials   Cluster Expand Configuration   Server Selection   UCSM Configuration   **Hypervisor Configuration**   IP Addresses

### Configure common Hypervisor Settings

Subnet Mask: 255.255.255.0   Gateway: 10.29.133.1   DNS Server(s): 10.29.133.110

### Hypervisor Settings

Make IP Addresses and Hostnames Sequential

#	Name	Serial	Static IP Address	Hostname
6	Server 6	FCH1944V0F3	10.29.133.181	hx240-06

### Configuration

**Credentials**

UCS Manager Host Name: 10.29.133.203  
 User Name: admin  
 vCenter Server: vcenter3.hx.lab.cisco.com  
 User Name: administrator@vsphere.local  
 Admin User Name: root

**Cluster Expand Configuration**

Management Cluster: 10.29.133.184

**Server Selection**

Server 6: FCH1944V0F3 / HXAF240C-M45X

**UCSM Configuration**

VLAN Name: hx-inband-mgmt  
 VLAN ID: 133  
 VLAN Name: hx-storage-data  
 VLAN ID: 52  
 VLAN Name: hx-vmotion

[Back](#)   [Continue](#)

9. Click Continue.

10. Enter the additional IP addresses for the Management and Data networks of the new nodes.

The screenshot displays the Cisco HyperFlex Installer web interface. The main window is titled "IP Addresses" and contains the following sections:

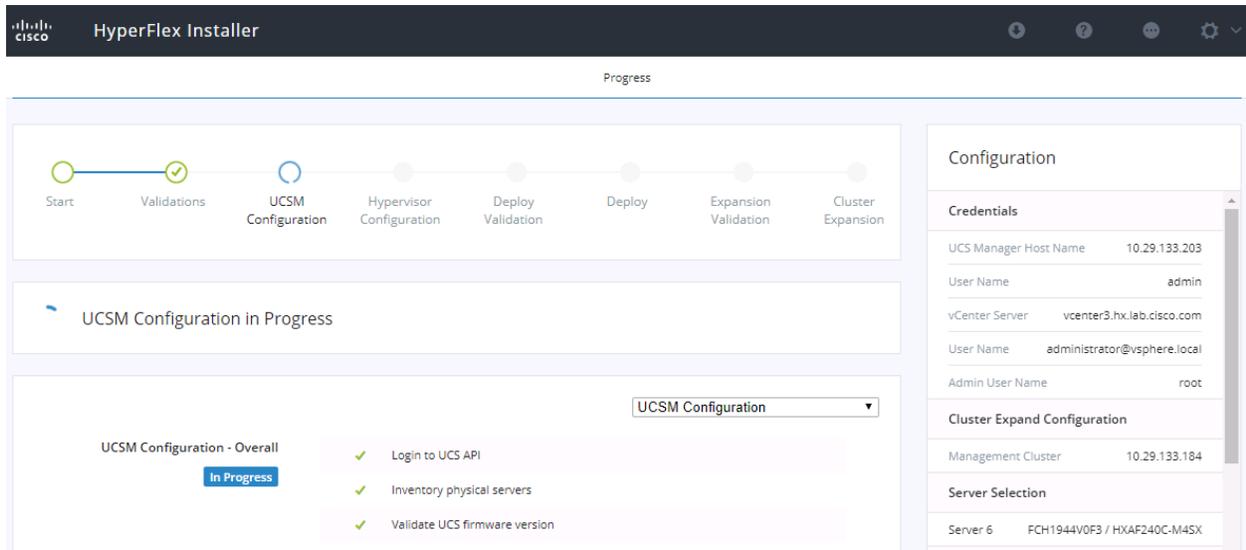
- IP Addresses:** A table with columns for Server, Hypervisor, and Storage Controller. It shows two VLANs: Management - VLAN 133 and Data - VLAN 52. The table contains one server (FCH1944V0F3) with IP addresses 10.29.133.181 and 10.29.133.190 for Management - VLAN 133, and 192.168.52.16 and 192.168.52.26 for Data - VLAN 52.
- Controller VM Password:** A section for entering the Controller VM Password.
- Advanced:** A section for advanced settings, including "Jumbo Frames" and "Disk Partitions".

The right-hand sidebar shows a "Configuration" summary with the following sections:

- Credentials:** UCS Manager Host Name (10.29.133.203), User Name (admin), vCenter Server (vcenter3.hx.lab.cisco.com), User Name (administrator@vsphere.local), Admin User Name (root).
- Cluster Expand Configuration:** Management Cluster (10.29.133.184).
- Server Selection:** Server 6 (FCH1944V0F3 / HXAF240C-M45X).
- UCSM Configuration:** VLAN Name (hx-inband-mgmt), VLAN ID (133), VLAN Name (hx-storage-data), VLAN ID (52), VLAN Name (hx-vmotion).

At the bottom of the sidebar are "Back" and "Start" buttons.

11. Enter the current password that is set on the Controller VMs.
12. Enable Jumbo Frames and select Clean up disk partitions.
13. (Optional) At this step you can manually add more servers for expansion if these servers already have service profiles associated and the hypervisor is ready, by clicking on Add Compute Server or Add Converged Server and then entering the IP addresses for the storage controller management and data networks.
14. Click Start.
15. Validation of the configuration will now start. If there are warnings, you can review and click "Skip Validation" if the warnings are acceptable (e.g. you might get the warning from Cisco UCS Manger validation that the guest VLAN is already assigned). If there are no warnings, the validation will automatically continue on to the configuration process.
16. The HX installer will now proceed to complete the deployment and perform all the steps listed at the top of the screen along with their status.



17. You can review the summary screen after the install completes by selecting Summary on the top right of the window.

After the install has completed, the new converged node is added to the cluster, and its storage, CPU, and RAM resources are immediately available, however the new node still requires some post installation steps in order to be consistent with the configuration of the existing nodes. For example, the new converged node will not have a vMotion vmkernel interface, and it may not have all of the guest VM networks configured. The easiest method to make the changes is to use the post\_install script, or the configuration can be done manually.

## Expansion with M5 Generation Servers for Mixed Clusters

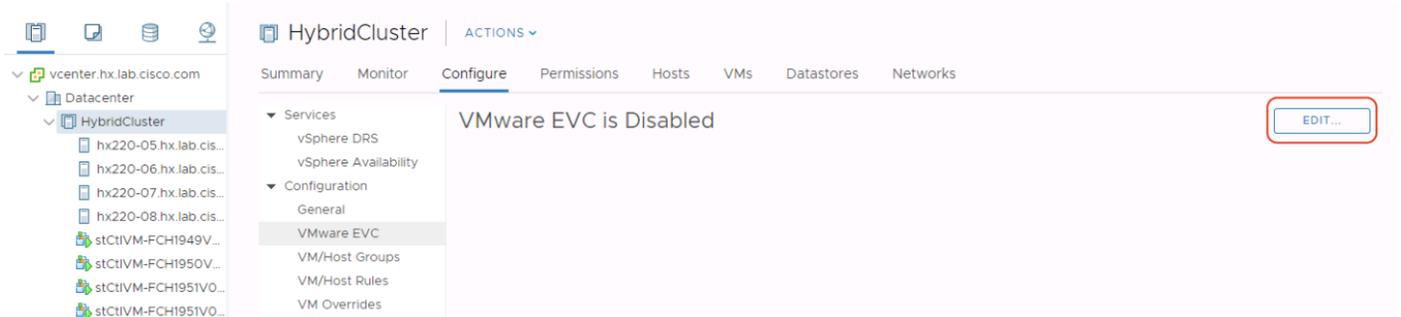
Existing HyperFlex clusters can be expanded by adding new M5 generation servers to a cluster of M4 generation servers, creating a mixed cluster. The creation of mixed HyperFlex clusters is subject to a number of limitations and guidelines, as outlined below:

- A mixed cluster cannot be created by performing an initial cluster installation with a mixture of M4 and M5 generation converged nodes. The only supported method for creating a mixed cluster is to create an initial cluster of only M4 converged nodes, and then expanding that cluster with additional M5 converged nodes.
- Creating an initial cluster of only M5 generation converged nodes, and then expanding that cluster with M4 generation converged nodes is not supported.
- Once a cluster is operating as a mixed cluster with both M4 and M5 generation converged nodes, that cluster can later be expanded further with more M4 or M5 generation converged nodes.
- All of the new M5 generation converged nodes must match the form factor, type, encryption, and disk capacity and quantity of the existing M4 generation converged nodes. For example:
  - All nodes in the cluster must be HX220c or HX240c models. It is not allowed to mix HX220c and HX240c within the same cluster under any circumstance.
  - All nodes in the cluster must be hybrid nodes, or all-flash nodes. It is not allowed to mix hybrid nodes and all-flash nodes within the same cluster under any circumstance.
  - All nodes in the cluster must contain exclusively standard disks. Mixed clusters cannot be created using nodes with self-encrypting disks (SEDs).

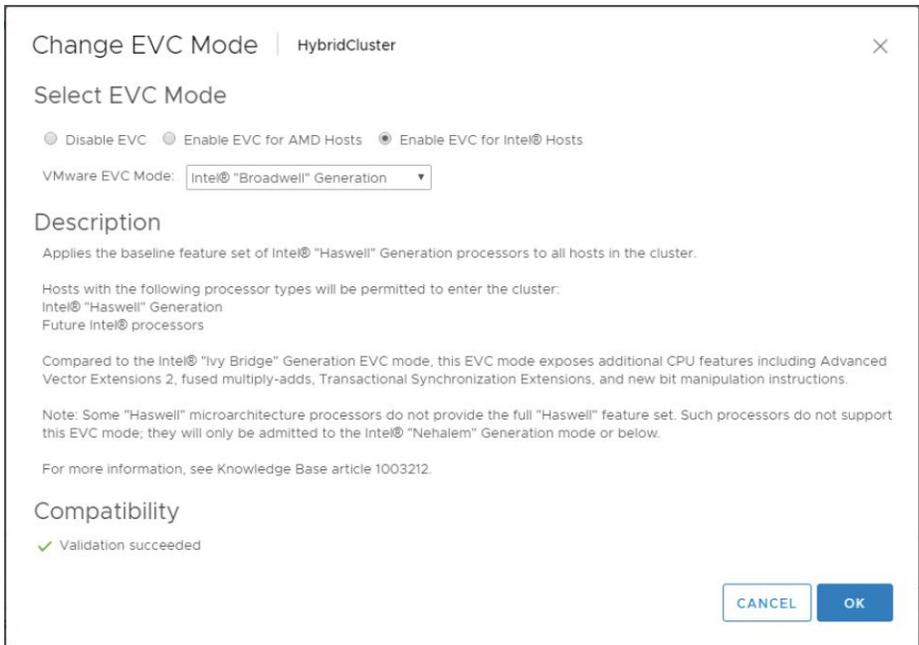
- Capacity disk size and quantities must match across all existing and additional nodes being added. As an example, the HX220c-M4S node can only contain 6 capacity disks, therefore the new HX220c-M5SX nodes can only contain 6 capacity disks, even though they can physically contain up to 8 disks.
- The storage size of all capacity disks must match, but the caching disk sizes do not need to match.
- Existing HyperFlex clusters can be expanded with compute-only nodes of any model or generation in nearly any combination. For example, the following combinations are possible:
  - Expanding an existing mixed cluster with any model of supported compute-only nodes.
  - Expanding an existing M5 generation cluster with any model of supported compute-only nodes, including older M4 and M3 servers.
  - Expanding an existing M4 generation cluster with any model of supported compute-only nodes, including new M5 servers.
- While CPU models in the M4 and M5 generation servers are different, it is recommended to attempt to match CPU core counts and frequencies between the servers as much as possible.
- While RAM speeds and optimal DIMM layouts in the M4 and M5 generation servers are different, it is recommended to attempt to match RAM amounts between the servers.
- Cisco UCS Manager and Fabric Interconnect firmware must be upgraded to version 3.2(2d) or later at minimum to support the new M5 generation servers prior to beginning the expansion.
- The existing M4 generation HyperFlex cluster must be upgraded to HXDP 2.6 before it can be expanded with the additional M5 generation nodes.
- Existing M4 generation servers are recommended to have their firmware revisions upgraded to the included components in version 3.2(2d) or later if their current versions are older than 3.1(3c), after the upgrade to HXDP 2.6.
- The expansion tasks must be completed using the HXDP 2.6 Installer OVA.
- A HyperFlex cluster running an HXDP version older than 1.8 cannot coexist with any M5 generation cluster within the same Cisco UCS domain. This restriction applies to a mixed cluster with M5 and M4 generation nodes, or a non-mixed cluster of only M5 generation nodes.
- The version of VMware ESXi installed on the compute-only nodes and converged nodes of a cluster must all match, regardless of the model of server.
- In order to support the necessary VMware Enhanced vCPU Compatibility (EVC) settings for a mixed cluster, the managing vCenter server must be upgraded to version 6.5. The ESXi hypervisor can remain at version 6.0.
- EVC mode must be enabled in the existing M4 generation cluster, via the vCenter 6.5 server, prior to expanding the cluster to enable Intel Broadwell compatibility mode. Failure to do so will lead to failures of the VMs when attempting to vMotion the VMs between the different generations of servers. The HyperFlex installer will detect this condition and alert you to the requirement.
- EVC mode must also be enabled if an existing M5 generation cluster is being expanded with M4 or M3 generation compute-only nodes. This manual procedure will require a shutdown of the existing cluster to complete.

To expand an existing HyperFlex cluster with M4 generation converged nodes with additional M5 generation converged nodes, follow the steps in the previous section, choosing the new M5 generation servers as the nodes to add to the existing cluster. If EVC mode must be enabled in the cluster, the HyperFlex installer will alert you to the requirement. To enable EVC mode prior to the expansion, creating a mixed cluster, complete the following steps:

1. Log in to the vCenter 6.5 HTML5 vSphere Client.
2. From the Hosts and Clusters view, click on the cluster which is the existing M4 generation based HyperFlex cluster that needs to have EVC mode enabled.
3. On the right-hand side of the screen, click Configure.
4. Under the Configuration menu, click VMware EVC, then click the Edit button on the right.



5. Click the radio button labeled “Enable EVC for Intel Hosts”
6. Click the drop-down menu to choose the generation of CPU to use as the baseline for EVC mode. For example, if the M4 generation servers are equipped with Intel E5 v3 processors, you would choose Intel “Haswell” Generation, but if the CPUs are Intel E5 v4 models, you would choose Intel “Broadwell” Generation.
7. Make sure that the Compatibility check at the bottom shows Validation Succeeded, then click OK.



If the cluster expansion is attempted before enabling EVC mode, the HyperFlex installer will generate a validation error during the deployment validation phase, as seen below. When this happens, do not cancel or restart the cluster expansion, instead enable EVC mode in vCenter 6.5. Once EVC mode has been enabled using the previous steps, return to the HyperFlex installer and click on the Retry Deploy Validation button. The cluster expansion should continue without any further errors.

10.29.133.143

**Warning**

 Validator\_Mixed\_Cluster\_Check

Running a mixed M4/M5 cluster requires EVC mode to be enabled on the vSphere cluster. The EVC mode key (intel-broadwell) is available but not currently enabled on this cluster. Enable the proper EVC mode in vCenter before continuing. Retry the validation once the changes are complete. Skipping this validation is not supported and will cause online upgrades and vMotion migrations to fail.

# Management

---

## HyperFlex Connect

HyperFlex Connect is the new, easy to use, and powerful primary management tool for HyperFlex clusters. HyperFlex Connect is an HTML5 web-based GUI tool which runs on all of the HX nodes, and is accessible via the cluster management IP address.

### Local Access

Logging into HyperFlex Connect can be done using pre-defined local accounts. In order to log in with a local account prepend “local/” to the account name, for example, local/root. The password for the default root account is set during the cluster creation as the cluster password. Using local access is only recommended when vCenter direct or SSO credentials are not available.

### Role-Based Access Control

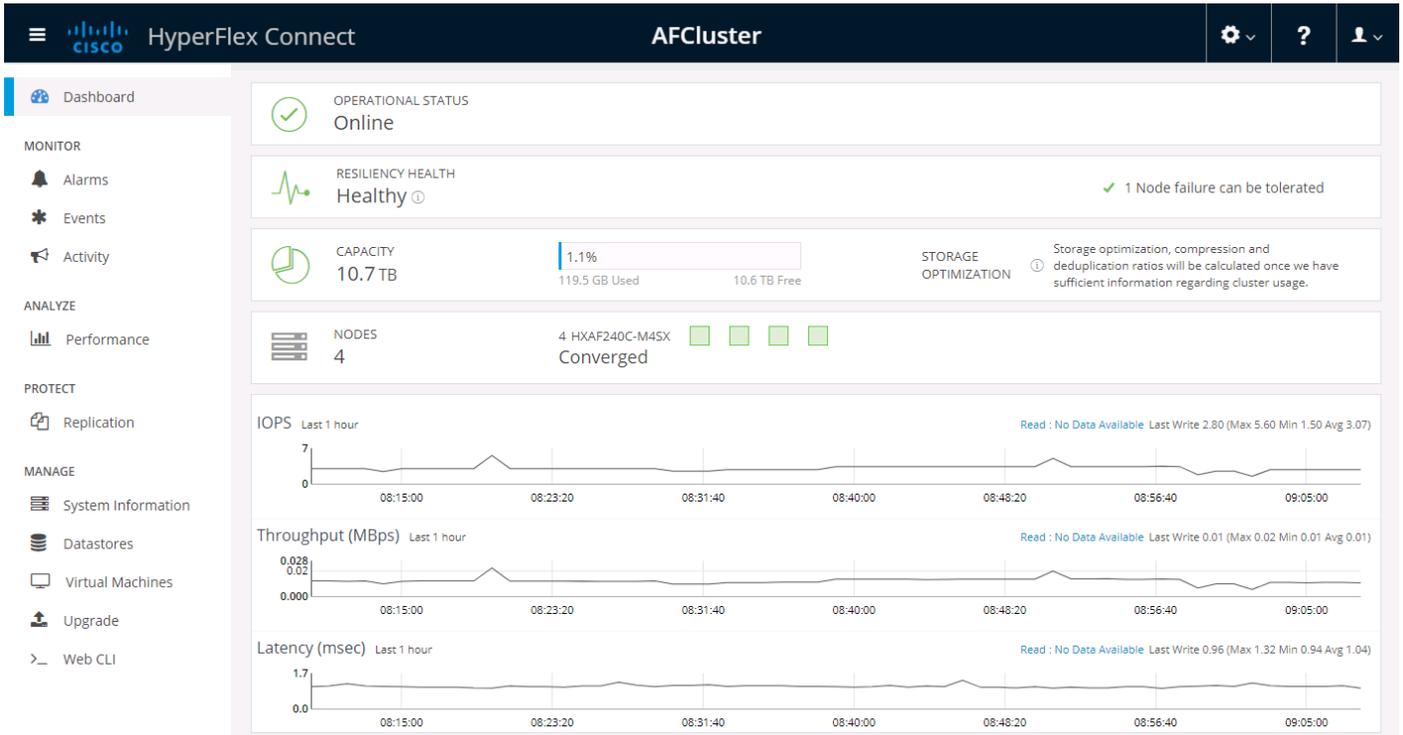
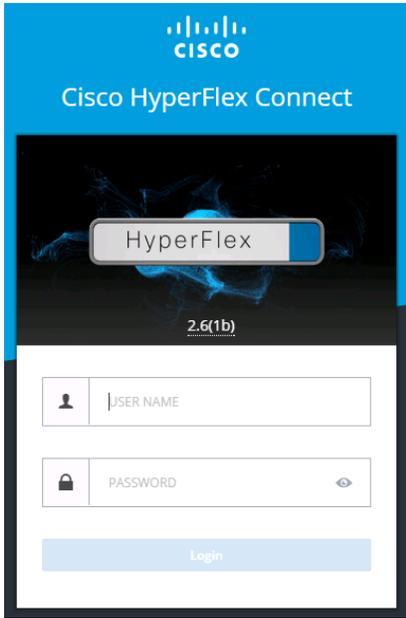
HyperFlex Connect provides Role-Based Access Control (RBAC) via integrated authentication with the vCenter Server managing the HyperFlex cluster. You can have two levels of rights and permissions within the HyperFlex cluster:

- Administrator: Users with administrator rights in the managing vCenter server will have read and modify rights within HyperFlex Connect. These users can make changes to the cluster settings and configuration.
- Read-Only: Users with read-only rights in the managing vCenter server will have read rights within HyperFlex Connect. These users cannot make changes to the cluster settings and configuration.

Users can log in to HyperFlex Connect using direct vCenter credentials, for example, [administrator@vsphere.local](#), or using vCenter Single Sign-On (SSO) credentials, such as an Active Directory user, for example, domain\user. Creation and management of RBAC users and rights must be done via the vCenter Web Client or vCenter 6.5 HTML5 vSphere Client.

To manage the HyperFlex cluster using HyperFlex Connect, complete the following steps:

1. Using a web browser, open the HyperFlex cluster’s management IP address via HTTPS, for example, <https://10.29.133.160>.
2. Enter a local credential, such as local/root, or a vCenter RBAC credential for the username, and the corresponding password.
3. Click Login.
4. The Dashboard view will be shown after a successful login.



## Dashboard

From the Dashboard view, several elements are presented:

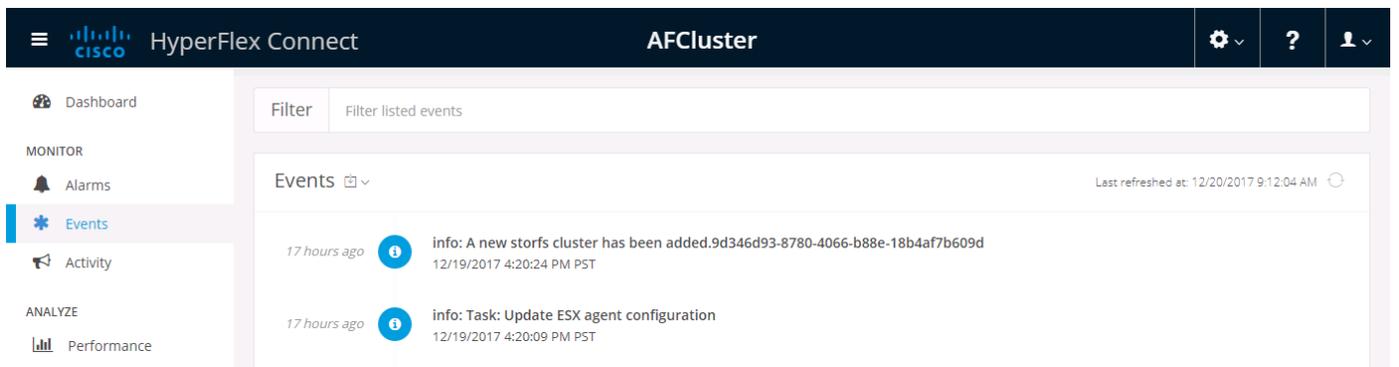
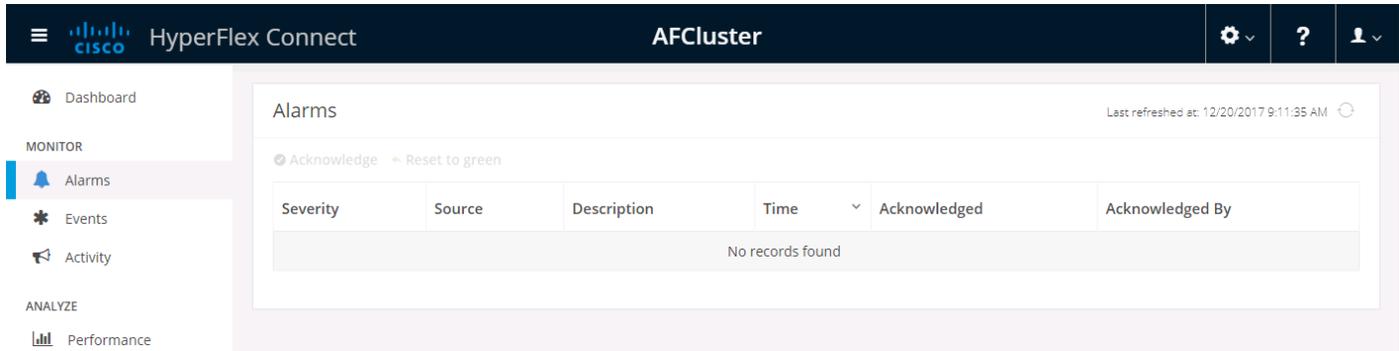
- Cluster operational status, overall cluster health, and the cluster’s current node failure tolerance.
- Cluster storage capacity, used and free space, compression and deduplication savings, and overall cluster storage optimization statistics.
- Cluster size and individual node health.

- Cluster IOPs, storage throughput, and latency for the past 1 hour.

## Monitor

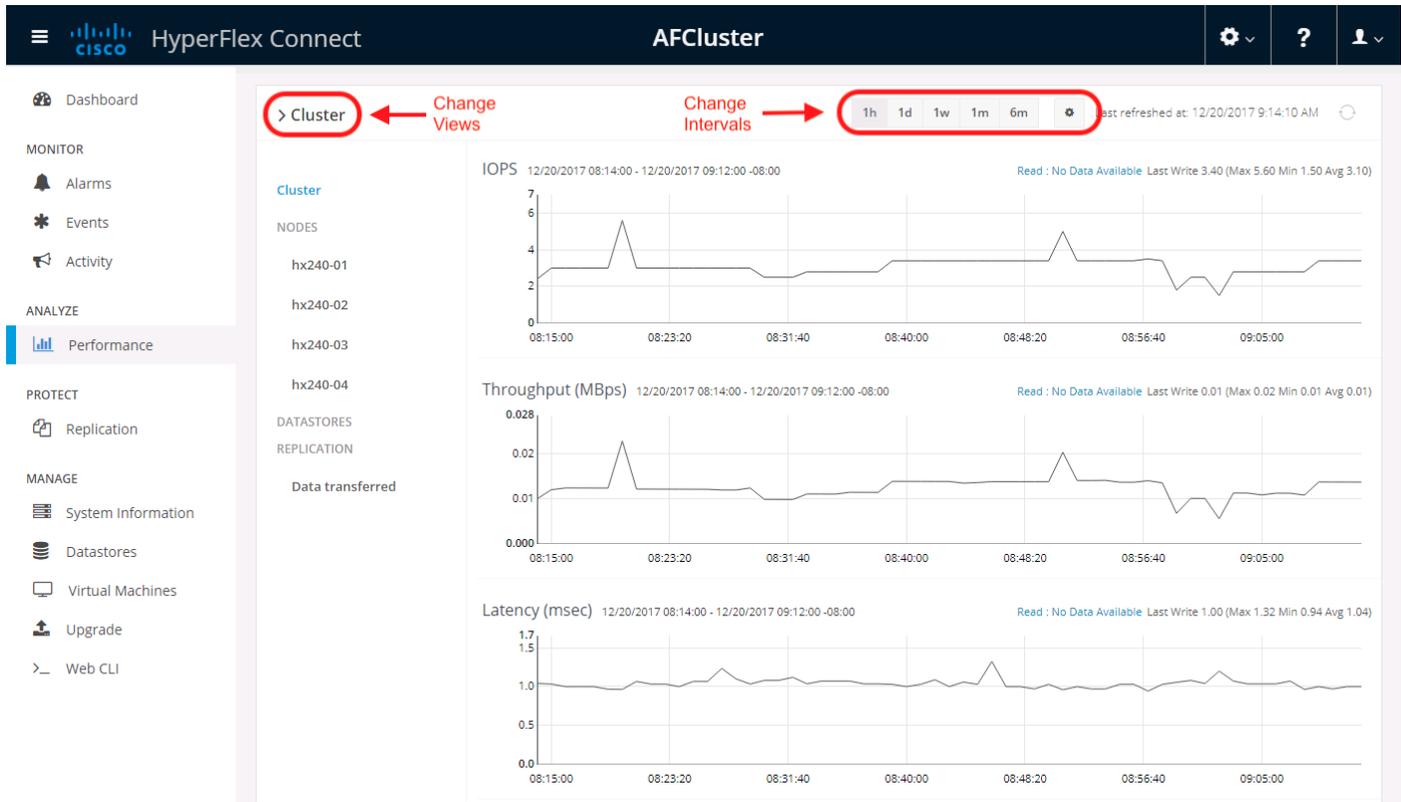
HyperFlex Connect provides for additional monitoring capabilities, including:

- Alarms: Cluster alarms can be viewed, acknowledged and reset.
- Event Log: The cluster event log can be viewed, specific events can be filtered for, and the log can be exported.
- Activity Log: Recent job activity, such as ReadyClones can be viewed and the status can be monitored.



## Analyze

The historical and current performance of the HyperFlex cluster can be analyzed via the built-in performance charts. The default view shows read and write IOPs, bandwidth, and latency over the past 1 hour for the entire cluster. Views can be customized to see individual nodes or datastores, and change the timeframe shown in the charts.



## Protect

HyperFlex Connect is used as the management tool for all configuration of HyperFlex Data Protection features, including VM replication and data-at-rest encryption. Configuration of these features is covered in later sections of this document.

## Manage

HyperFlex Connect presents several views and elements for managing the HyperFlex cluster:

- **System Information:** Presents a detailed view of the cluster configuration, software revisions, hosts, disks, and cluster uptime. Support bundles can be generated to be shared with Cisco TAC when technical support is needed. Views of the individual nodes and the individual disks are available. In these views, nodes can be placed into HX Maintenance Mode, and disks can be securely erased, as described later in this document.
- **Datastores:** Presents the datastores present in the cluster, and allows for datastores to be created, mounted, unmounted, edited or deleted, as described earlier in this document as part of the cluster setup.
- **Virtual Machines:** Presents the VMs present in the cluster, and allows for the VMs to be powered on or off, cloned via HX ReadyClone, and protected via native replication, as described later in this document.
- **Upgrade:** Upgrades to the HXDP software, and Cisco UCS firmware can be initiated from this view.
- **Web CLI:** A web based interface, from which CLI commands can be issued and their output seen, as opposed to directly logging into the SCVMs via SSH.

The screenshot displays the Cisco HyperFlex Connect management console for an AFCluster. The interface is organized into several sections:

- Navigation Menu (Left):** Includes Dashboard, MONITOR (Alarms, Events, Activity), ANALYZE (Performance), PROTECT (Replication), and MANAGE (System Information, Datastores, Virtual Machines, Upgrade, Web CLI).
- System Overview (Main Content):**
  - Cluster Status:** AFCluster is ONLINE (green checkmark). vCenter: https://vcenter2.hx.lab.cisco.com.
  - System Metrics:**
    - Hypervisor: VMware ESXi 6.5.0
    - HXDP Version: 2.6.1b-26700
    - Data Replication Factor: 3
    - Uptime: 16 days, 16 hours, 59 minutes, 18 seconds
    - Total Capacity: 10.7 TB
    - Available Capacity: 10.6 TB
  - DNS Server(s):** 10.29.133.110
  - NTP Server(s):** 2.ntp.esl.cisco.com, 3.ntp.esl.cisco.com, 1.ntp.e
- Node Details (Three Nodes):**
  - hx240-01 | HXAF240C-M45X | 11 Disks (1 Caching, 10 Persistent):** Online (green checkmark). HXDP Version 2.6(1b). Type: Hyper Converged. Hypervisor Status: Online. Hypervisor Address: 10.29.133.176.
  - hx240-02 | HXAF240C-M45X | 11 Disks (1 Caching, 10 Persistent):** Online (green checkmark). HXDP Version 2.6(1b). Type: Hyper Converged. Hypervisor Status: Online. Hypervisor Address: 10.29.133.177.
  - hx240-03 | HXAF240C-M45X | 11 Disks (1 Caching, 10 Persistent):** Online (green checkmark). HXDP Version 2.6(1b). Type: Hyper Converged.

## Cisco Intersight Cloud-Based Management

Cisco Intersight management is enabled via embedded code running on the Cisco UCS Fabric Interconnects, and in the Cisco HyperFlex software, known as device connectors. To enable Intersight management, the device connectors are registered online at the Cisco Intersight website, <https://intersight.com> when logged into the website with a valid cisco.com account used to manage your environments. Cisco Intersight can be used to manage and monitor HyperFlex clusters and UCS domains with the following software revisions:

- Cisco UCS Manager and Infrastructure Firmware version 3.2 and later
- Cisco HyperFlex software version 2.5(1a) or later

The Cisco UCS Fabric Interconnects, and the Cisco HyperFlex nodes must have DNS lookup capabilities and access to the internet. If direct access to the internet is not available, the systems can be configured to connect via an HTTPS proxy server.

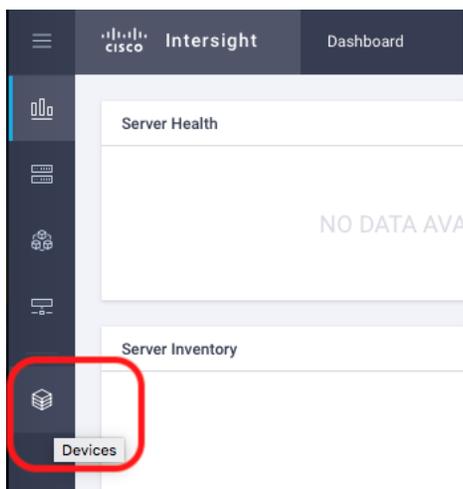
To connect Cisco Intersight to the Cisco HyperFlex cluster(s), and the Cisco UCS Domain(s) in your environments, complete the following steps:

### Connecting Cisco UCS Manager

1. Using a web browser, log on to the Cisco UCS Manager webpage.
2. From a second browser window or tab, log on to the Cisco Intersight webpage at <https://intersight.com> (you must have a valid cisco.com CCO account).



3. In the left-hand navigation buttons, click Devices.



4. Click the “Claim A New Device” button in the top right-hand corner.
5. In Cisco UCS Manager, in the left-hand navigation buttons, click Admin.
6. In the Admin tree, click Device Connector at the bottom.
7. If necessary, click the HTTPS Proxy Settings button, and click the Manual button. Enter the Proxy server IP address or DNS hostname, the TCP port, and a username and password if necessary, then click Save.

### HTTPS Proxy Settings

Proxy Hostname/IP Not a valid Hostname or IP

Proxy Port 0  
Port number not in range(1-65535)

Authentication

Username Required!

Password

- If desired, the Access Mode for Cisco Intersight can be set to Read-only, or management can be disabled from this screen.
- In the main UCS Manager screen, you will see a Device ID and a Claim Code for this Cisco UCS Domain. Copy these two codes to the Device ID and Claim Code fields in the Cisco Intersight “Claim A New Device” window, then click Claim.

The screenshot shows the UCS Manager interface with the following details:

- Navigation:** Left sidebar with 'Device Connector' selected.
- Page Header:** 'All / Device Connector' and system status icons (0 0 0 6).
- STARSHIP MANAGEMENT:**
  - Enabled:
  - Access Mode:  Read-only,  Allow Control
  - Agent Version: 1.0.3-1906
- CONNECTION:**
  - Status: ! Not Claimed
  - HTTPS PROXY SETTINGS button
  - Device ID: SAL [REDACTED]
  - Claim Code: 96 [REDACTED]

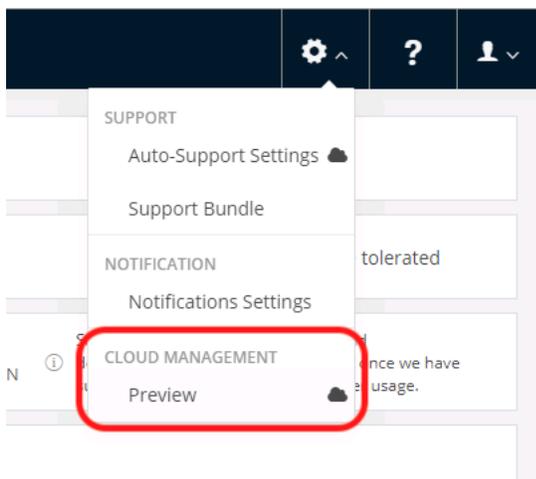
The image shows a web form titled "CLAIM A NEW DEVICE". Below the title is a sub-header: "To claim your device, you must have the Device ID and Claim Code." There are two input fields: "Device ID \*" and "Claim Code \*", each with a horizontal line for text entry. At the bottom right of the form are two buttons: "Cancel" and "Claim".

10. The Cisco UCS Domain will now show the system as Claimed in the Device Connector screen.

### Connecting Cisco HyperFlex Clusters

To connect Cisco HyperFlex Clusters, complete the following steps:

1. Use a web browser to open the HX Connect webpage at the cluster's management IP address, for example: <https://10.29.133.151>
2. Enter a local credential or a vCenter RBAC credential for the username and the corresponding password.
3. Click Login.
4. From a second browser window or tab, log on to the Cisco Intersight webpage at <https://intersight.com> (you must have a valid cisco.com CCO account).
5. In the left-hand navigation buttons, click Devices.
6. Click the "Claim A New Device" button in the top right-hand corner.
7. In the HyperFlex Connect Dashboard page, click Edit Settings in the top right-hand corner, then click Cloud Management Preview.



8. If necessary, click the HTTPS Proxy Settings button, and click the Manual button. Enter the Proxy server IP address or DNS hostname, the TCP port, and a username and password if necessary, then click Save.

The screenshot shows the 'HTTPS Proxy Settings' configuration window. At the top, there are two buttons: 'Off' and 'Manual', with 'Manual' selected. Below this, there are four input fields: 'Proxy Hostname/IP' with a red error message 'Not a valid Hostname or IP', 'Proxy Port' with a red error message 'Port number not in range(1-65535)' and the value '0', 'Username' with a red error message 'Required!', and 'Password'. An 'Authentication' toggle switch is turned on. At the bottom right, there are 'CANCEL' and 'SAVE' buttons.

9. If desired, the Access Mode for Cisco Intersight can be set to Read-only, or management can be disabled from this screen.
10. In the HyperFlex Connect screen, you will see a Device ID and a Claim Code for this HyperFlex cluster. Copy these two codes to the Device ID and Claim Code fields in the Cisco Intersight “Claim A New Device” window, then click Claim.

The screenshot shows the 'HyperFlex Connect' screen. On the left, under 'STARSHIP MANAGEMENT', there is a cloud icon with an 'A', an 'Enabled' toggle switch, and 'Access Mode' options: 'Read-only' (unselected) and 'Allow Control' (selected). The 'Agent Version' is 1.0.3-827. On the right, under 'CONNECTION', the status is 'Not Claimed' with a warning icon. A red box highlights the 'Device ID' and 'Claim Code' fields. The 'Device ID' is '0e[redacted]' and the 'Claim Code' is '93[redacted]'. A 'HTTPS PROXY SETTINGS' button is visible in the top right corner.

### CLAIM A NEW DEVICE

To claim your device, you must have the Device ID and Claim Code.

Device ID \*

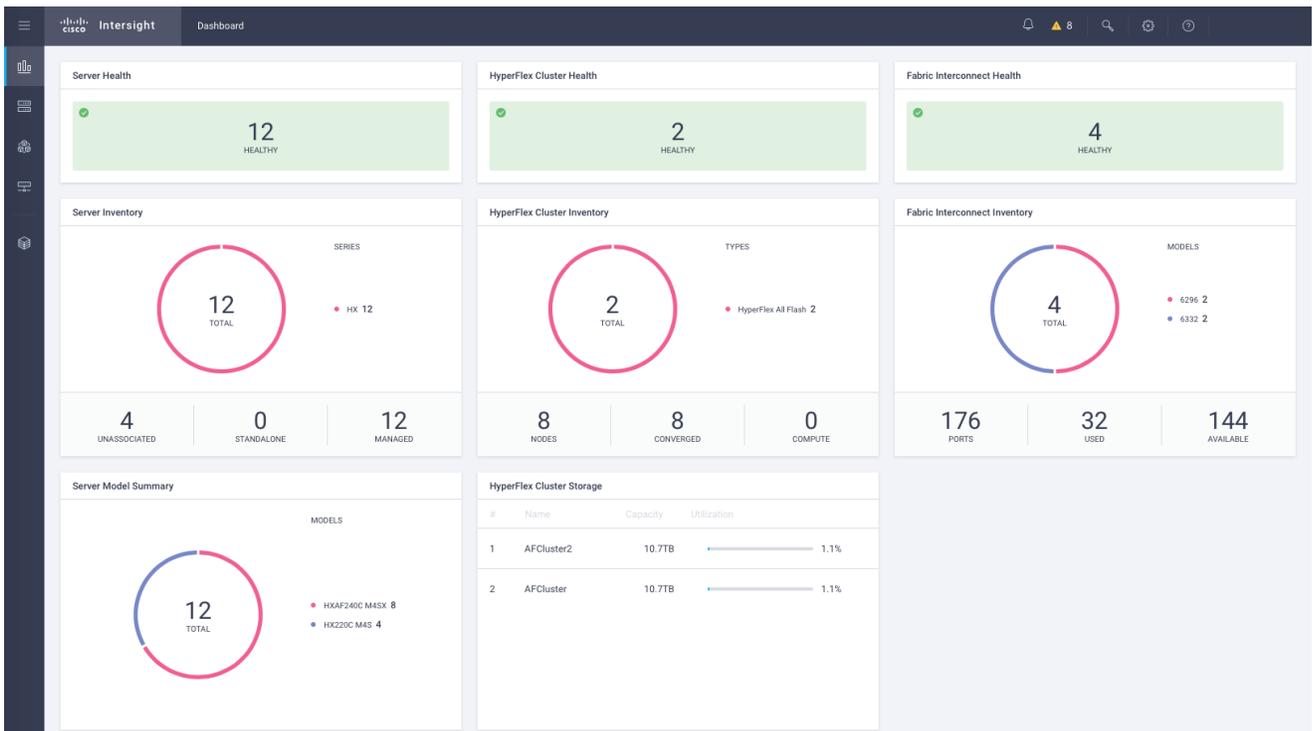
Claim Code \*

Cancel
Claim

11. The Cisco HyperFlex Cluster will now show the system as Claimed in the Device Connector screen.

## Dashboard

The Cisco Intersight Dashboard provides a single screen overview of all connected Cisco UCS Domains, the servers within those domains, the HyperFlex Clusters running in the domains, along with their health statuses, storage utilization, port counts, and more. Elements on the screen are clickable and will drill down into other sections of the page to view further details.



## Servers

The Servers screen provides details of all the individual servers within the connected and managed UCS domains.

Name	Health	Mgmt IP	Model	CPU Capacity (GHz)	Memory Capacity (GB)	UCS Domain	HX Cluster	Firmware Version
SJC02-151-AAK27-3	●	10.29.133.106	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK27		3.0(3f)
SJC02-151-AAK27-1	●	10.29.133.106	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK27		3.0(3f)
SJC02-151-AAK27-4	●	10.29.133.106	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK27		3.0(3f)
SJC02-151-AAK27-2	●	10.29.133.106	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK27		3.0(3f)
SJC02-151-AAK26-8	●	10.29.133.165	HX220C-M4S	52.8	256.0	SJC02-151-AAK26		3.0(3f)
SJC02-151-AAK26-5	●	10.29.133.165	HX220C-M4S	52.8	256.0	SJC02-151-AAK26		3.0(3f)
SJC02-151-AAK26-7	●	10.29.133.165	HX220C-M4S	52.8	256.0	SJC02-151-AAK26		3.0(3f)
SJC02-151-AAK26-6	●	10.29.133.165	HX220C-M4S	52.8	256.0	SJC02-151-AAK26		3.0(3f)
SJC02-151-AAK26-3	●	10.29.133.165	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK26		3.0(3f)
SJC02-151-AAK26-4	●	10.29.133.165	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK26		3.0(3f)
SJC02-151-AAK26-2	●	10.29.133.165	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK26		3.0(3f)
SJC02-151-AAK26-1	●	10.29.133.165	HXAF240C-M4SX	72.8	512.0	SJC02-151-AAK26		3.0(3f)

### HyperFlex Clusters

The HyperFlex Clusters screen provides details of all the HyperFlex clusters that are connected and managed by Cisco Intersight. By clicking the ellipses (⋮) the HyperFlex Connect GUI for the clusters can be directly connected to in another browser window or tab.

Name	Health	Type	Hx Version	Hypervisor Version	Storage Capacity (TB)	Storage Utilization	Storage Optimization	Server Nodes
AFCluster2	●	HyperFlex All Flash	2.6.1b-26700	VMware ESXi 6.5.0 bui...	10.7	1.1%	0%	4
AFCluster	●	HyperFlex All Flash	2.6.1b-26700	VMware ESXi 6.5.0 bui...	10.7	1.1%	0%	4

### Fabric Interconnects

The Fabric Interconnects screen provides details of all the UCS domains that are connected and managed by Cisco Intersight. By clicking the ellipses (⋮) the Cisco UCS Manager webpage for the domain can be directly connected to in another browser window or tab, or a session can be opened to the CLI of the Fabric Interconnect.

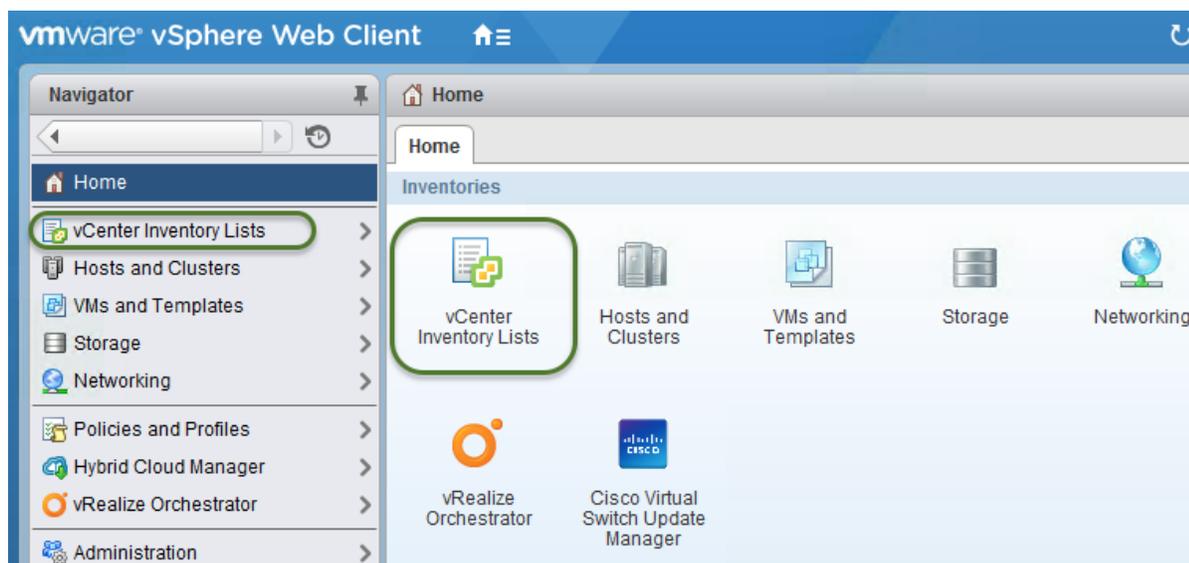
Name	Health	Mgmt IP	Model	Expansion Modules	Total	Used	Available	Firmware Version
SJC02-151-AAK27 FI-A	●	10.29.133.104	UCS-FI-6332-16UP	0	40	6	34	5.0(3)N2(3.22b)
SJC02-151-AAK27 FI-B	●	10.29.133.105	UCS-FI-6332-16UP	0	40	6	34	5.0(3)N2(3.22c)
SJC02-151-AAK26 FI-A	●	10.29.133.163	UCS-FI-6296UP	0	48	10	38	5.0(3)N2(3.22c)
SJC02-151-AAK26 FI-B	●	10.29.133.164	UCS-FI-6296UP	0	48	10	38	5.0(3)N2(3.22b)

## vCenter Web Client Plugin

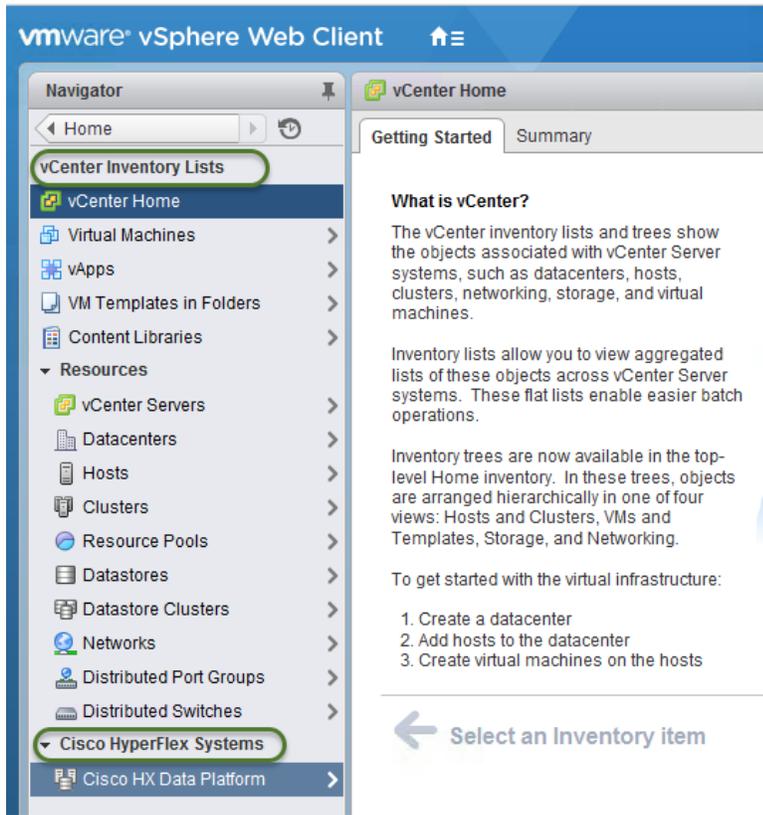
The Cisco HyperFlex vCenter Web Client Plugin is installed by the HyperFlex installer to the specified vCenter server or vCenter appliance. The plugin is accessed as part of the vCenter Web Client (Flash) interface, and is a secondary tool used to monitor and configure the HyperFlex cluster. This plugin is not integrated into the new vCenter 6.5 HTML5 vSphere Client. In order to manage a HyperFlex cluster via an HTML5 interface, i.e. without the Adobe Flash requirement, use the new HyperFlex Connect management tool.

To manage the HyperFlex cluster using the vCenter Web Client Plugin, complete the following steps:

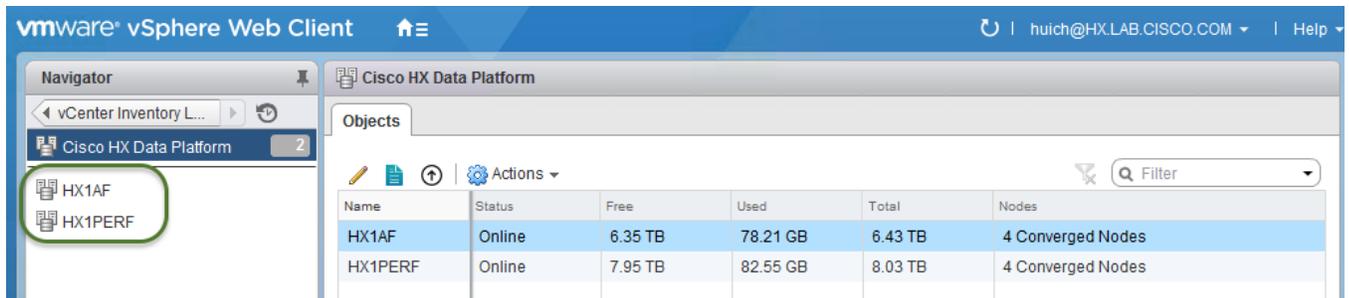
1. Open the vCenter Web Client, and login with admin rights.
2. In the home pane, from the home screen click vCenter Inventory Lists.



3. In the Navigator pane, click Cisco HX Data Platform.



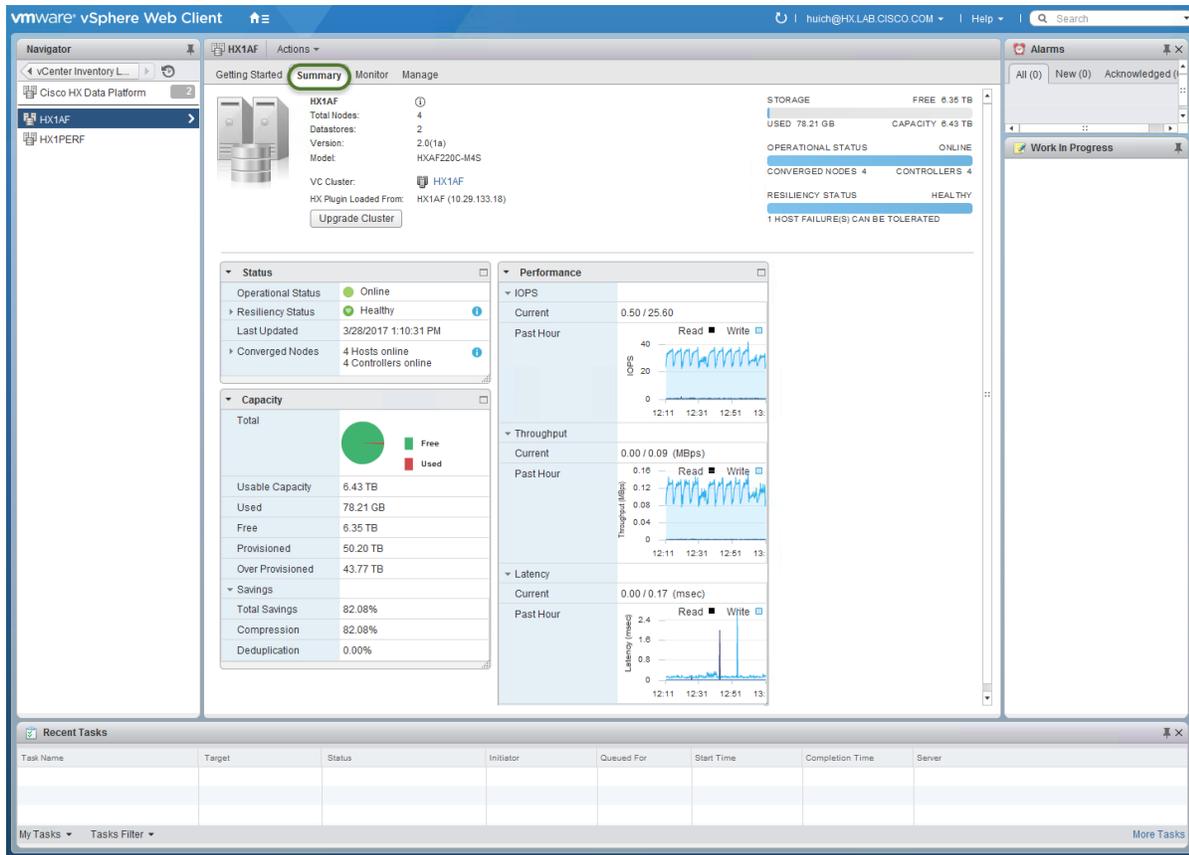
4. In the Navigator pane, choose the HyperFlex cluster you want to manage and click the name.



## Summary

From the Web Client Plugin Summary screen, several elements are presented:

- Overall cluster usable capacity, used capacity, free capacity, datastore capacity provisioned, and the amount of datastore capacity provisioned beyond the actual cluster capacity.
- Deduplication and compression savings percentages calculated against the data stored in the cluster.
- The cluster operational status, the health state, and the number of node failures that can occur before the cluster goes into read-only or offline mode.
- A snapshot of performance over the previous hour, showing IOPS, throughput, and latencies.



## Monitor

From the Web Client Plugin Monitor tab, several elements are presented:

- Clicking the Performance button displays a larger view of the performance charts. If a full webpage screen view is desired, click the Preview Interactive Performance charts hyperlink. Enter the username (root) and the password for the HX controller VM to continue.



- Clicking the Events button displays a HyperFlex event log, which can be used to diagnose errors and view system activity events.

Performance Events

Actions Filter

Description	Type	Date Time
event.ClusterHealthNormalEvent.fullFormat (ClusterHealthNormalEvent)	event.ClusterHealthNormalEvent.category	Wed Mar 22 17:05:52 GMT-0700
event.ClusterPolicyComplianceSatisfiedEvent.fullFormat (ClusterPolicyCo	event.ClusterPolicyComplianceSatisfiedEw	Wed Mar 22 17:05:51 GMT-0700
event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)	event.NodeReadyForIOEvent.category	Wed Mar 22 17:05:40 GMT-0700
event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)	event.NodeReadyForIOEvent.category	Wed Mar 22 17:03:16 GMT-0700
event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)	event.NodeReadyForIOEvent.category	Wed Mar 22 17:03:10 GMT-0700

VC Cluster Events 71 of 71

**Date Time:** Wed Mar 22 17:05:40 GMT-0700 2017  
**User:** com.springpath.sysmgmt  
**Description:** event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)  
**Target:** hx1-c220-6.hx.lab.cis.co.com  
**Type:** event.NodeReadyForIOEvent.category

## Manage

From the Web Client Plugin Manage tab, several elements are presented:

- Clicking the Cluster button displays an inventory of the HyperFlex cluster and the physical assets of the cluster hardware.

The screenshot shows the HX1AF management interface. At the top, there's a navigation bar with 'HX1AF' and 'Actions'. Below it, a secondary navigation bar includes 'Getting Started', 'Summary', 'Monitor', and 'Manage' (which is highlighted). On the left, there are buttons for 'Cluster' and 'Datastores'. The main content area is divided into two sections. The top section shows details for a cluster named 'hx1-c220-1.hx.lab.cisco.com'. Below this, there are tabs for 'Disks' and 'NICs', with 'Disks' selected. A table of disks is displayed with columns for Slot, Serial Number, Raw Capacity, Firmware, Status, Version, and Vendor.

Slot	Serial Number	Raw Cap...	Firmware	Status	Version	Ven...
Slot 1.1.2	BTHC626602M9480MGN	447.13 GB	INTEL_SSDSC2BX480G4K	Ready	G201CS01	Intel
Slot 1.1.3	S4020ZJ80000K65020KS	1.09 TB	ST1200MM0088	Ready	N003	Seag
Slot 1.1.4	S40211NQ0000K65005Q8	1.09 TB	ST1200MM0088	Ready	N003	Seag

- Clicking the Datastores button allows datastores to be created, edited, deleted, mounted and unmounted, along with space summaries and performance snapshots of that datastore.

The screenshot shows the Cisco HyperFlex management interface. At the top, there are tabs for 'Getting Started', 'Summary', 'Monitor', and 'Manage' (which is selected). Below the tabs, there are buttons for 'Cluster' and 'Datastores'. A toolbar contains icons for refresh, edit, delete, and actions. A search filter is also present.

Name	Mount Status	Provisioned	Used	Free
hx1af1	Normal	200.00 GB	3.61 MB	200.00 GB
HX1AFDS	Normal	50.00 TB	5.04 MB	50.00 TB

Below the table, the 'hx1af1' datastore is selected, showing its 'Summary' and 'Trends'.

**Summary**

**Details**

Total	
Status	Normal
Provisioned	200.00 GB
Used	3.61 MB
Free	200.00 GB
Hosts	4

**Trends**

IOPs

## Management Best Practices

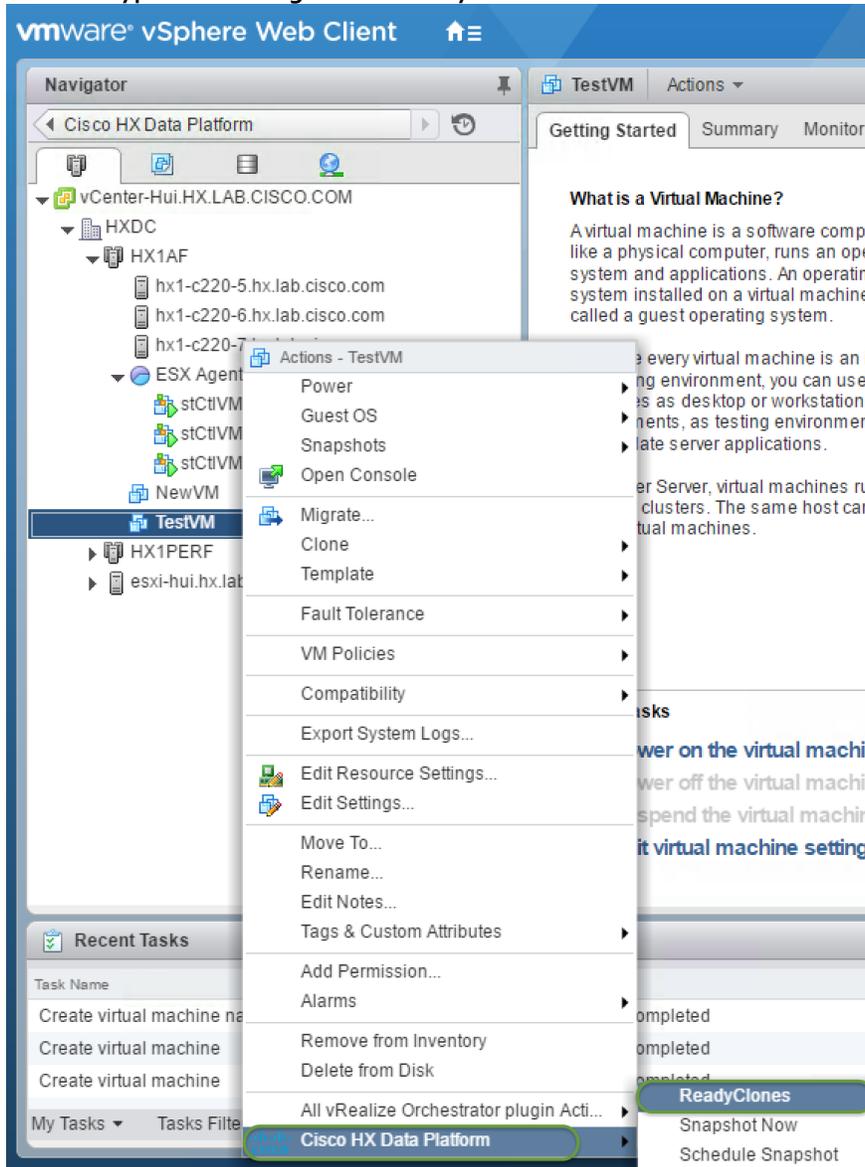
In this section, various best practices and guidelines are given for management and ongoing use of the Cisco HyperFlex system. These guidelines and recommendations apply only to the software versions upon which this document is based, listed in [Software Components](#).

### ReadyClones

For the best possible performance and functionality of the virtual machines that will be created using the HyperFlex ReadyClone feature, the following guidelines for preparation of the base VMs to be cloned should be followed:

- Base VMs must be stored in a HyperFlex datastore.
- All virtual disks of the base VM must be stored in the same HyperFlex datastore.
- Base VMs can only have HyperFlex native snapshots, no VMware redo-log based snapshots can be present.
- For very high IO workloads with many clone VMs leveraging the same base image, it might be necessary to use multiple copies of the same base image for groups of clones. Doing so prevents referencing the same blocks across all clones and could yield an increase in performance. This step is typically not required for most uses cases and workload types.

**59. HyperFlex Management - ReadyClones**

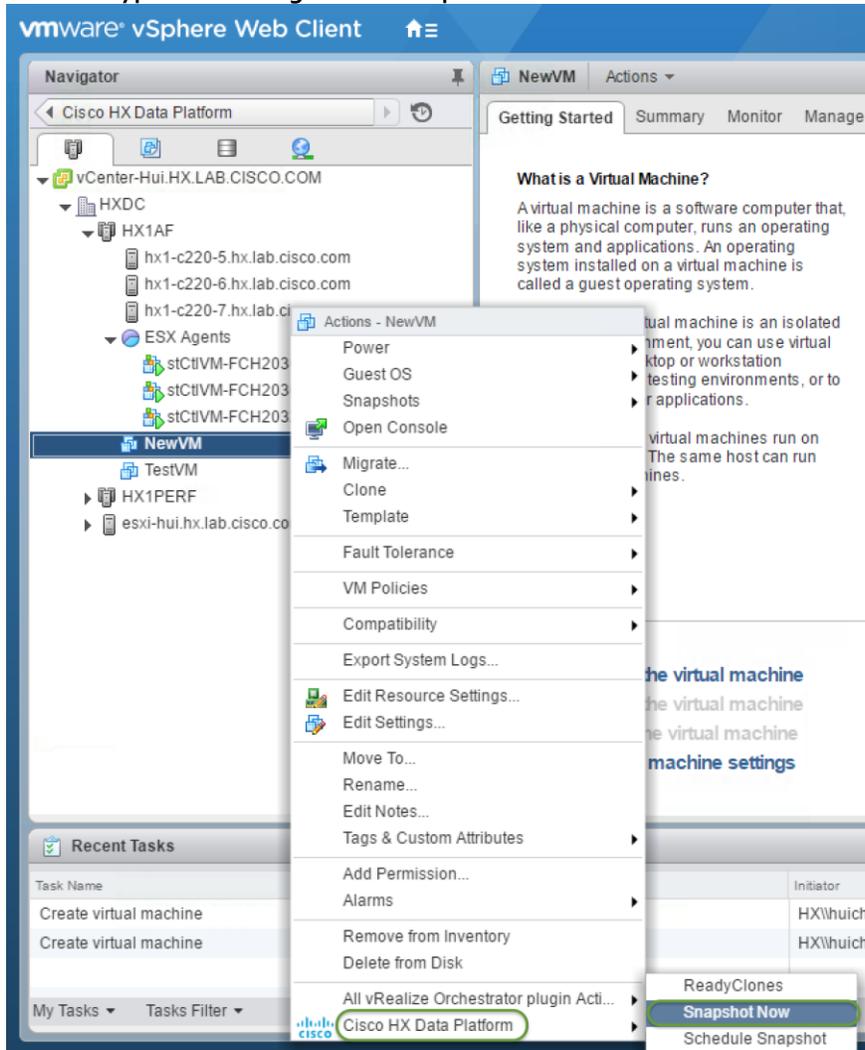


**Snapshots**

HyperFlex native snapshots are high performance snapshots that are space-efficient, crash-consistent, and application consistent, taken by the HyperFlex Distributed Filesystem, rather than using VMware redo-log based snapshots. For the best possible performance and functionality of HyperFlex native snapshots, the following guidelines should be followed:

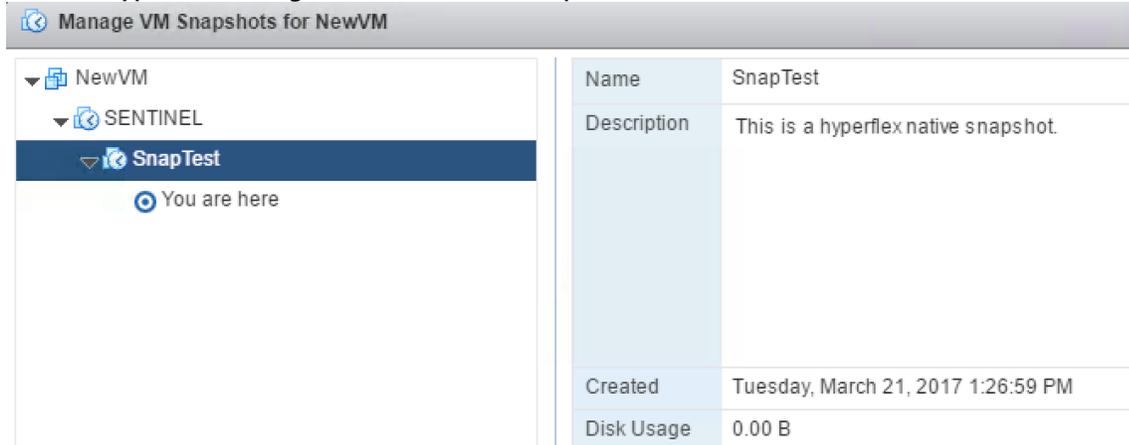
- Make sure that the first snapshot taken of a guest VM is a HyperFlex native snapshot, by using the “Cisco HX Data Platform” menu item in the vSphere Web Client, and choosing Snapshot Now or Schedule Snapshot. Failure to do so reverts to VMware redo-log based snapshots. (☒ 6o. )

## 60. HyperFlex Management - Snapshot Now



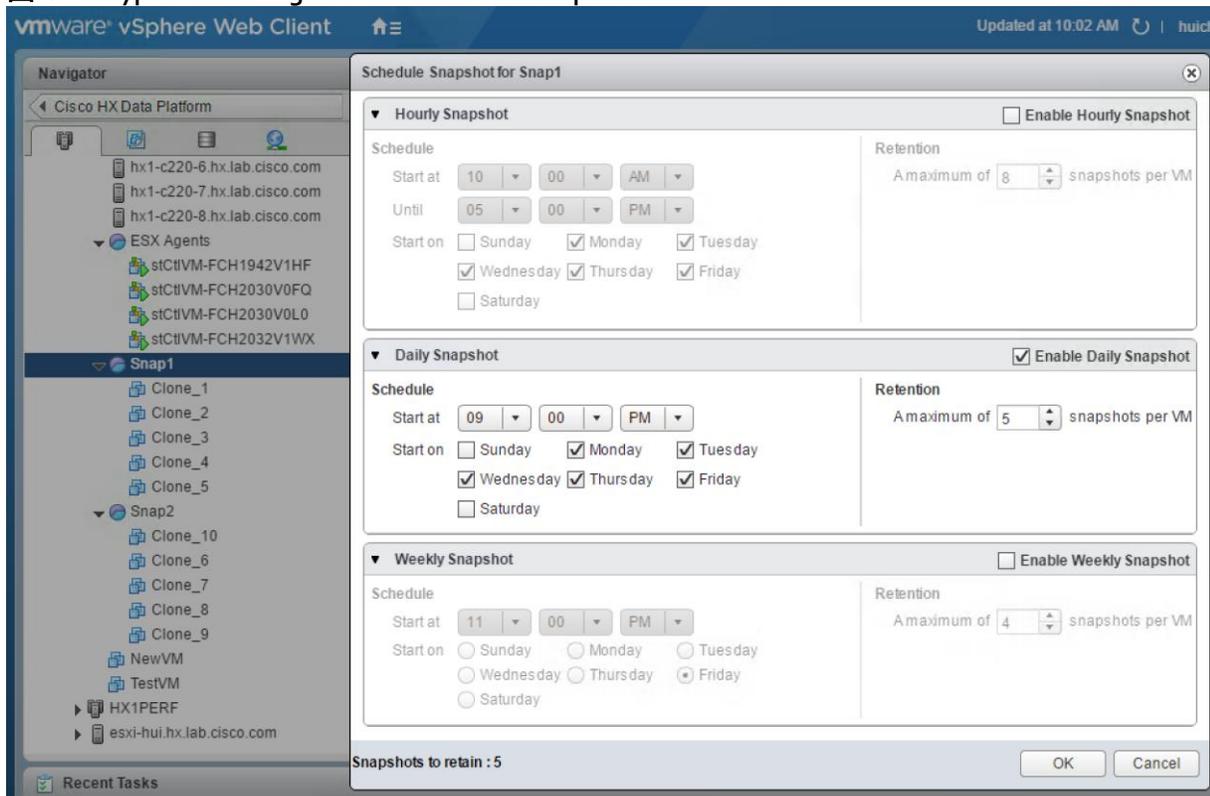
- A Sentinel snapshot becomes a base snapshot that all future snapshots are added to, and prevents the VM from reverting to VMware redo-log based snapshots. Failure to do so can cause performance degradation when taking snapshots later, while the VM is performing large amounts of storage IO.
- Additional snapshots can be taken via the “Cisco HX Data Platform” menu, or the standard vSphere client snapshot menu. As long as the initial snapshot was a HyperFlex native snapshot, each additional snapshot is also considered to be a HyperFlex native snapshot.
- Do not delete the Sentinel snapshot unless you are deleting all the snapshots entirely.
- Do not revert the VM to the Sentinel snapshot. ( 61. )

**61. HyperFlex Management - Sentinel Snapshot**



- If large numbers of scheduled snapshots need to be taken, distribute the time of the snapshots taken by placing the VMs into multiple folders or resource pools. For example, schedule two resource groups, each with several VMs, to take snapshots separated by 15 minute intervals in the scheduler window. Snapshots will be processed in batches of 8 at a time, until the scheduled task is completed. (62. )

**62. HyperFlex Management - Schedule Snapshots**



**Storage vMotion**

The Cisco HyperFlex Distributed Filesystem can create multiple datastores for storage of virtual machines. While there can be multiple datastores for logical separation, all of the files are located within a single distributed filesystem. As such, performing storage vMotions of virtual machine disk files has little value in the HyperFlex system. Furthermore, storage

vMotions create additional filesystem consumption and generate additional unnecessary metadata within the filesystem, which must later be cleaned up via the filesystem's internal cleaner process.



**Note:** It is recommended to not perform storage vMotions of the guest VMs between datastores within the same HyperFlex cluster. Storage vMotions between different HyperFlex clusters, or between HyperFlex and non-HyperFlex datastores are permitted.

---

## Virtual Disk Placement

HyperFlex clusters can create multiple datastores for logical separation of virtual machine storage, yet the files are all stored in the same underlying distributed filesystem. The only difference between one datastore and another are their names and their configured sizes. Due to this, there is no compelling reason for a virtual machine's virtual disk files to be stored on a particular datastore versus another.



**Note:** All of the virtual disks that make up a single virtual machine must be placed in the same datastore. Spreading the virtual disks across multiple datastores provides no benefit, and can cause ReadyClone and Snapshot errors.

---

## Maintenance Mode

In HyperFlex Connect, from the System Information screen, in the Nodes view, the individual nodes can be placed into HX Maintenance Mode. Also, within the vCenter Web Client, a specific menu entry for "HX Maintenance Mode" has been installed by the HyperFlex plugin. This option directs the storage platform controller on the node to shutdown gracefully, redistributing storage IO to the other nodes with minimal impact. Using the standard Maintenance Mode menu in the vSphere Web Client, or the vSphere (thick) Client can be used, but graceful failover of storage IO and shutdown of the controller VM is not guaranteed.



**Note:** In order to minimize the performance impact of placing a HyperFlex converged storage node into maintenance mode, it is recommended to use the HX Maintenance Mode menu selection to enter or exit maintenance mode whenever possible.

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### 63. HyperFlex Connect - HX Maintenance Mode

System Overview Nodes Disks Last refreshed at: 08/08/2017 10:43:05 AM

Enter HX Maintenance Mode
  Exit HX Maintenance Mode
 Filter

Node	Hypervisor Address	Hypervisor Status	Controller Address	Controller Status	Model	Version	Disks
hx220-05	10.29.133.147	Online	192.168.51.25	Online	HX220C-M4S	2.5(1a)	7
hx220-06	10.29.133.148	Online	192.168.51.26	Online	HX220C-M4S	2.5(1a)	7
hx220-07	10.29.133.149	Online	192.168.51.27	Online	HX220C-M4S	2.5(1a)	7
hx220-08	10.29.133.150	Online	192.168.51.28	Online	HX220C-M4S	2.5(1a)	7

Showing 1 - 4 of 4

### 64. vCenter Web Client - HX Maintenance Mode

vmware vSphere Web Client

Navigator: Cisco HX Data Platform > vCenter-Hui.HX.LAB.CISCO.COM > HXDC > HX1AF > hx1-c220-5.hx.lab.cisco.com

Getting Started Summary Monitor Manage

What is a Host?  
A host is a computer that uses virtualization software such as ESX and ESXi, to run virtual machines. Hosts provide the CPU and memory resources that virtual machines use. Virtual machines access to storage and network connectivity.

Actions - hx1-c220-5.hx.lab.cisco.com

- New Virtual Machine
- New vApp
- New Resource Pool...
- Deploy OVF Template...
- Connection
- Maintenance Mode
- Power
- Certificates
- Storage
- Add Networking...
- Add Diagnostic Partition...
- Host Profiles
- Edit Default VM Compatibility...
- Export System Logs...
- Reconfigure for vSphere HA
- Assign License...
- Settings
- Move To...
- Tags & Custom Attributes
- Add Permission...
- Alarms
- Remove from Inventory
- Disassociate Host
- All vRealize Orchestrator plugin Acti...
- Cisco HX Maintenance Mode

Enter HX Maintenance Mode  
Exit HX Maintenance Mode

## Encryption

---

HyperFlex 2.5 introduced new data protection features, including data-at-rest encryption. HyperFlex clusters can be ordered with self-encrypting disks (SED) which encrypt all of the data stored on them. A cluster using SEDs will store all of its data in an encrypted format, and the disks themselves perform the encryption and decryption functions. Since the hardware handles all the encryption and decryption functions, no additional load is placed on the CPUs of the HyperFlex nodes. Storing the data in an encrypted format prevents data loss and data theft, by making the data on the disk unreadable if it is removed from the system. This protection of the data enables HyperFlex to be used in environments where high security is desired, or compliance with industry security standards is required, such as healthcare providers (HIPAA), financial accounting systems (SOX), credit card transactions (PCI), and more.

Each SED contains a factory generated data encryption key (DEK) which is stored on the drive in a secured manner, and is used by the internal encryption circuitry to perform the encryption of the data. In truth, an SED always encrypts the data, but the default operation mode is known as the unlocked mode, wherein the drive can be placed into any system and the data can be read from it. To provide complete security, the SED needs to be locked, and reconfigured into what is called auto-unlock mode. This is accomplished via software, using another encryption key, called the authentication key (AK). The authentication key is generated externally from the SED and used to encrypt the DEK. When an SED operates in auto-unlock mode its DEK is encrypted, so when the SED is powered on, the AK must be provided by the system, via the disk controller, to decrypt the DEK, which then allows the data to be read. Once unlocked, the SED will continue to operate normally until it loses power, when it will automatically lock itself. If a locked SED is removed from the system, then there is no method for providing the correct AK to unlock the disk, and the data on the disk will remain encrypted and unreadable.

In order to configure a HyperFlex cluster for encryption, all of the disks on all of the nodes of the cluster must be SEDs. The authentication keys which are used to encrypt the data encryption keys on the disks must be supplied by the HyperFlex cluster. The authentication keys can be provided in one of three ways:

- Local keys in Cisco UCS Manager derived from an encryption passphrase. Local keys are simpler to configure, and are intended for use in testing, proof-of-concept builds, or environments where an external Key Management System (KMS) is not available. Local key configurations create a single authentication key (AK) which is used to encrypt all the disks on all the nodes of the cluster.
- Remote keys, where Cisco UCS Manager retrieves the keys via Key Management Interoperability Protocol (KMIP) from a remote KMS. The client/server communications between the HX nodes and the KMIP server are secured using trusted certificate authority (CA) signed keys, created from certificate signing requests (CSR). Remote key configurations create a unique authentication key for each node, and that AK is used for all disks on that node, providing an even higher level of security.
- Remote keys, where Cisco UCS Manager retrieves the keys via Key Management Interoperability Protocol (KMIP) from a remote KMS, but the client/server communications between the HX nodes and the KMIP server are secured using self-signed certificates.

Cisco has tested remote and self-signed keys using KMS systems, including Gemalto SafeNet KeySecure, and Vormetric DSM. A large number of steps are required to perform the configuration of a certificate authority (CA), root certificates, and signing certificates. Additionally, these steps are significantly different depending on the KMS being used. Because of this, the specific steps needed to configure encryption with remote keys is not covered in this design document.



**Note:** The HyperFlex Connect encryption menu and configuration options are only available when the cluster contains encryption capable hardware on all of the nodes.

---

To enable encryption using locally managed keys in Cisco UCS Manager, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.

2. Click Encryption in the menu on the left, then click the Configure encryption button.



3. Enter the Cisco UCS Manager IP address or hostname, an administrative username, and password, then click Next.

The dialog box is titled 'Encryption configuration: UCS Manager credentials'. It prompts the user to 'Enter UCS Manager credentials to start the configuration process.' There are three input fields: 'UCS Manager host name' with the value '10.29.133.106', 'User name' with the value 'admin', and 'Password' which is masked with dots. At the bottom right, there are 'Cancel' and 'Next' buttons.

4. Click the option for Local key, then click Next.

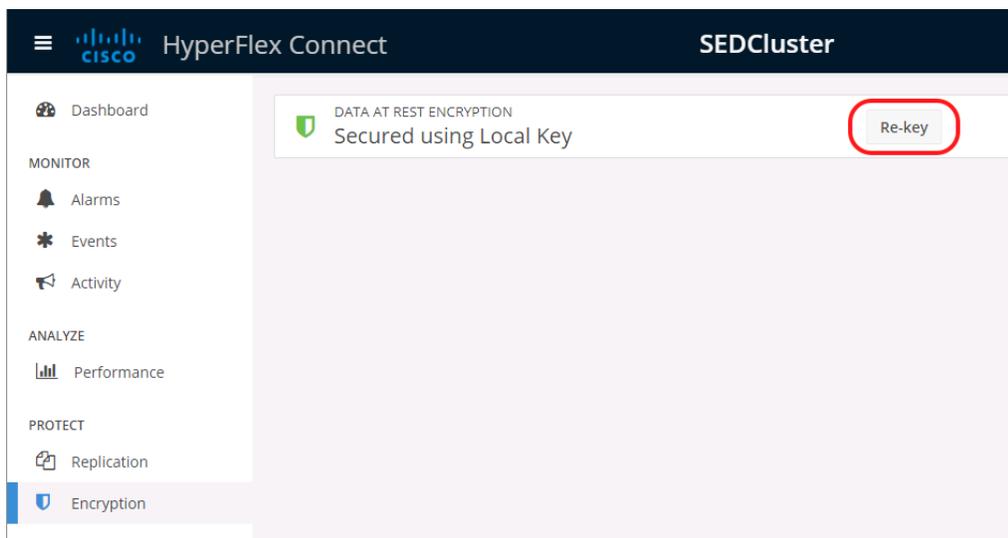
The dialog box is titled 'Encryption configuration: Encryption method'. It asks 'Do you want to use a Key Management Server or local key for encrypting this cluster?'. There are two main radio button options: 'Key Management Server' and 'Local key'. Under 'Key Management Server', there are two sub-options: 'Use certificate authority signed certificates' and 'Use self-signed certificates'. The 'Local key' option is selected. At the bottom right, there are 'Back' and 'Next' buttons.

5. Enter an encryption key passphrase, which must be exactly 32 characters long, then click Enable Encryption.

## Rekey

At any time, it may be determined for security purposes that it is necessary to regenerate the authentication keys in the cluster, which are used to unlock the encrypted contents of the disks. A rekey operation can be run to regenerate the keys, in case the existing keys may have been compromised, or as part of company policy. A rekey operation is non-destructive to the existing data, and the data remains encrypted at all times. To rekey the drives, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.
2. Click Encryption in the menu on the left, then click the Re-key button.



3. Enter the Cisco UCS Manager IP address or hostname, an administrative username, and password, then click Next.
4. Enter the existing encryption passphrase, and a new 32 character encryption passphrase, then click Re-key.

Encryption configuration: Re-key
ⓘ ×

Enter the existing encryption key (passphrase) for this cluster.

.....
👁

Enter a new encryption key (passphrase) for this cluster.

.....
👁

Back
Re-key

## Secure Erase

If an encrypted drive is failed, a predicted failure alarm is triggered, or if a drive is otherwise going to be removed from a node, the drive can be securely erased before its removal. Erasing a drive is a destructive event to the data on that disk, however the data still exists as replicas in other locations across the cluster. A disk secure erase will trigger an event in the cluster similar to a disk failure, and the lost data segments will be recreated in other online locations in the cluster, in order to return the data to its configured replication factor. To securely erase a drive, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.
2. Click System Information in the menu on the left, then click Disks.
3. Highlight the disk to be erased, then click Secure Erase.

☰ HyperFlex Connect
SEDCluster
📄 ⚙️ ? 👤

**MONITOR**

- 🔔 Alarms
- ⚙️ Events
- 📡 Activity

**ANALYZE**

- 📊 Performance

**PROTECT**

- 🔄 Replication
- 🔒 Encryption

**MANAGE**

- 📄 System Information

System Overview   Nodes   **Disks**
Last refreshed at: 08/08/2017 10:44:42 AM

Turn On Locator LED   Turn Off Locator LED   🗑 Secure erase
📄 Filter

Node	Slot	Capacity	Status	Encrypted	Type	Usage
hx220-05	2	745.2 GB	Normal	Enabled	Solid State	Cache
hx220-05	8	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	6	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	5	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	4	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	3	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	7	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-06	2	745.2 GB	Normal	Enabled	Solid State	Cache
hx220-06	8	1.1 TB	Normal	Enabled	Rotational	Persistent

4. For a cluster using local encryption keys, enter the encryption passphrase, for remote key configurations, no action is necessary.
5. Click Secure Erase.

6. Click “Yes, erase this disk” at the confirmation pop-up.
7. When complete, the disk status will change to “Ok to remove” .
8. Remove the disk from the HX node.



**WARNING!** If an SED is securely erased, it cannot be put back into service in the same or even a different HX cluster. The only method to reuse an erased SED is to insert the drive into an HX node and install/reinstall that cluster from scratch.

---

## Replication

HyperFlex 2.5 introduced new data protection features, including snapshot-based VM level replication between two HyperFlex clusters. Replication can be used to migrate or recover a single VM in the secondary HX cluster, groups of VMs can be coordinated and recovered, or all VMs can be recovered as part of a disaster recovery scenario. In order to start using replication, two HyperFlex clusters must be installed and have network connectivity between them. The clusters can be extended clusters, and beginning with HyperFlex 2.6, it is now possible to replicate between hybrid and all-flash clusters. The clusters are allowed to use self-encrypting disks or standard disks in either location, both of them, or neither of them, there is no restriction in that respect. To avoid complications with duplicate VM IDs, it is recommended that the two replicating HyperFlex clusters be managed by two different VMware vCenter servers.

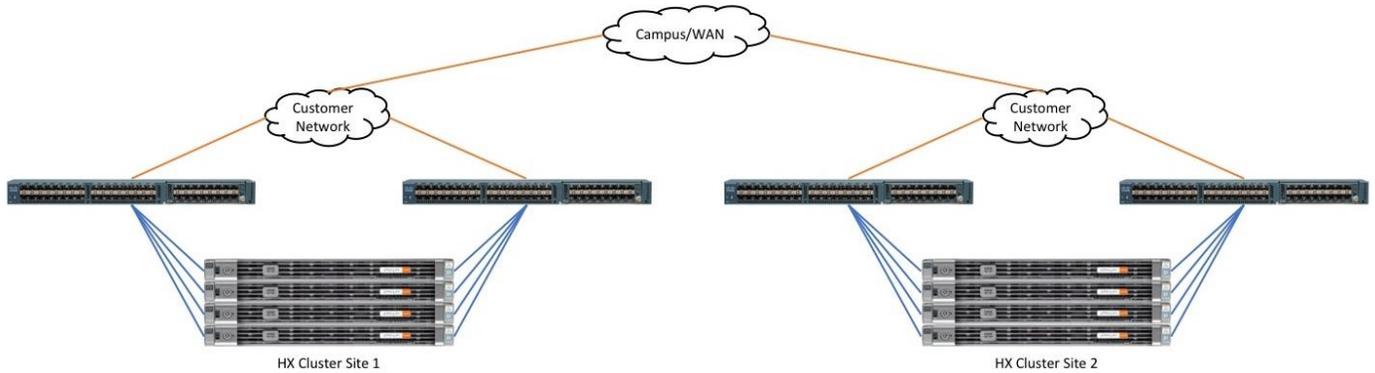
After a HyperFlex cluster is installed, none of the networking configuration required for replication is in place. In order to use replication, the replication networking must first be configured in HyperFlex Connect, which automates the changes in Cisco UCS Manager, configures the ESXi port groups, and assigns the new replication IP addresses to the SCVMs. Once the networking configuration work is completed for both clusters that will replicate to each other, a partnership, or pairing between the two clusters is established in HyperFlex Connect. After this replication pair is established, VMs can be protected individually, or they can be placed into protection groups, which are created to protect multiple VMs with the same replication settings. VMs can be replicated in intervals as often as once per 15 minutes, up to once per 24 hours, which is analogous to the Recovery Point Objective (RPO). Care must be taken to ensure that the two clusters have enough storage capacity to store the replicated snapshots of the remote cluster's VMs, and also have enough CPU and RAM resources to run those VMs in case they must be recovered. HyperFlex Connect can be used to monitor the status of the protected VMs. Protected VMs can be recovered in the secondary site via the HyperFlex CLI using the `stcli` command line tool.

## Replication Networking

The two HyperFlex clusters that will replicate must have TCP/IP connectivity between them, and additional IP addresses must be provided to an internal IP address pool that the HX SCVMs will use. The minimum number of IP addresses required is the number of nodes in the cluster, plus 1 additional address. More addresses than are currently needed can be placed into the pool to allow for future growth of the HX cluster. An existing VLAN ID and subnet can be used, although it is more typical to configure a specific VLAN and subnet to carry replication traffic that will traverse the campus or WAN links between the two clusters. The VLANs that will be used for replication traffic must already be trunked to the Cisco UCS Fabric Interconnects from the northbound network by the upstream switches, and this configuration step must be done manually prior to beginning the HyperFlex Connect configuration. The bandwidth usage of the replication traffic can be set to a limit so as not to saturate the interconnecting network links, or it may be left unlimited. The bandwidth consumption will be directly affected by the number of VMs being protected, and the frequency of their replication.

The interconnection between the two clusters at the two sites can be done in several ways. In most cases, the uplinks from the HX clusters will carry all the needed VLAN IDs on the same set of interfaces, including HX management, vMotion, storage traffic, guest VM traffic, and the replication traffic. In some cases, it is desired that the replication traffic will traverse a set of independent uplinks, which is referred to as a split L2 topology. Due to a technical limitation of implementing a split L2 topology, the configuration of replication networking cannot accommodate a split L2 configuration. Specifically, a single Cisco UCS vNIC cannot carry multiple VLANs that traverse multiple uplink groups. Since the default configuration uses `vmnic0` and `vmnic1` to carry HX management traffic and replication traffic, both of those VLANs must arrive to UCS across a single set of uplinks. The replication subnets and VLANs used in the two sites can be different routed subnets, or they can be a single subnet if other technologies, such as OTV, are in use by the WAN. Replication traffic originates and terminates on the SCVMs running on each HX host.

### 65. Replication Networking



Configuring replication networking in HyperFlex Connect automates the following tasks:

- Creates the replication VLAN in Cisco UCS Manager.
- Adds the new replication VLAN to the VNIC templates named hv-mgmt-a and hv-mgmt-b in the appropriate sub-organization in Cisco UCS Manager.
- Sets the VLAN ID of the Storage Controller Replication Network port group on all ESXi nodes.
- Creates a pool of IP addresses internal to the HyperFlex cluster, from which each SCVM will draw one IP address, plus 1 additional IP will be used as a roaming clustered address.
- Instructs the SCVMs to request an individual IP address, and configures the clustered IP address.

To configure the replication network, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.
2. Click Replication in the menu on the left, then click the Configure button.



3. Enter the VLAN name and VLAN ID that will be created in Cisco UCS Manager, and assigned to the Storage Controller Replication Network port group on the ESXi hosts.
4. Enter the Cisco UCS Manager IP address or hostname, an administrative username, and password.

5. Enter the replication subnet in CIDR notation, i.e. a.b.c.d/n, and the gateway IP address for the subnet.
6. Enter the starting and ending IP addresses for the range that will be added to the pool assigned to the SCVMs, and click the Add button.
7. If outbound bandwidth limits must be set, check the box to enable it and enter a value between 10 and 100,000 Mbps. Cisco recommends limiting the bandwidth to 1000 Mbps or less.
8. Click Configure.

## Replication Pairing

The two HyperFlex clusters that will be able to replicate VMs to each other must first be paired before the replication can begin. Prior to pairing, the replication networking on both clusters must be configured and datastores must have been created on both clusters. You must know the administrative login credentials of the remote cluster, and the remote cluster's management IP address in order to proceed.

To configure the replication pair, perform the following steps:

1. Open HyperFlex Connect and log in with admin privileges.
2. Click Replication in the menu on the left, then click the Create Replication Pair button.

CLUSTER REPLICATION NETWORK  
Network configured. Unused IPs: 1

Unlimited  
Maximum Bandwidth

PROTECTION OVERVIEW

0	0	0
VMs Protected	Exceeds Interval	Protection Groups

REPLICATION OVERVIEW

0	0
In Progress	Incoming

**Create Replication Pair**

Replications | Protected Virtual Machines | Protection Groups | Replication Pairs

Last refreshed at: 07/27/2017 3:30:16 PM

Virtual Machine	Remote Cluster	Status	Start Time	End Time	Protection Group	Direction	Data Transferred
No records found							

3. Enter a name for the replication pair, then click Next.
4. Enter the cluster management IP address or FQDN for the remote cluster, the username, and the password, then click Pair. The username and password must have admin rights in the vCenter server managing the remote cluster.

Create New Replication Pair

Name | Remote Connection | Datastore Mapping | Summary

Establish a connection to a remote cluster

Management IP or FQDN: 10.29.133.151

User Name: administrator@vsphere.local

Password: .....

Enter single sign-on or cluster credentials for remote cluster

Back | Pair

5. Pick the local datastore and remote datastore to pair on the two clusters, then click Next.

- At the summary screen, click Map Datastores.

## Protection Groups

Once a replication pair is established, and datastores are mapped to each other across two HX clusters, VM Protection can be configured. VMs can be protected individually, or they can be added to a new or existing Protection Group. Protection Groups can be created to allow for a common configuration of replication parameters to be applied to a collection of VMs, without configuring them individually. A good example would be creating multiple Protection Groups for several classes of protection, each with a different replication schedule, such as a “Gold” group with a 15-minute schedule, a “Silver” group with a 2 or 4 hour schedule, and a “Bronze” group with a 12 or 24 hour schedule. A maximum of 32 VMs can be added to a protection group.

Migration or recovery operations can be carried out against an entire protection group. If a protection group is halted, marking it for recovery, then all VMs within the group must be recovered on the secondary, or target cluster. If a VM is a member of a protection group, it cannot be individually migrated or recovered. If an individual VM must be migrated or recovered, but it is a member of a protection group, that VM must be removed from the group, thereby unprotecting it, then it must be individually protected again. Care must be taken that the individual protection replicates at least one snapshot before attempting a migration or recovery.

To create a Protection Group, complete the following steps:

- Open HyperFlex Connect and log in with admin privileges.
- Click Replication in the menu on the left, then click Protection Groups, then click Create Protection Group.

CLUSTER REPLICATION NETWORK  
 Network configured. Unused IPs: 1 Unlimited  
Maximum Bandwidth Edit

PROTECTION OVERVIEW 1 VM Protected 0 Exceeds Interval 2 Protection Groups

REPLICATION OVERVIEW 0 In Progress 0 Incoming 1 Replication Pair

Replications **Protected Virtual Machines** Protection Groups Replication Pairs Last refreshed at: 08/01/2017 12:32:45 PM

Create Protection Group Edit Schedule Delete Filter

Protection Group	Protection Status	Last Protection Time	Direction	Interval
> Bronze <span>1 VM</span>	Active	-	Outgoing	Every 24 hours
> Silver <span>0 VM</span>	Active	-	Outgoing	Every 4 hours

Showing 1 - 2 of 2

3. Enter a name for the group.
4. Choose the replication interval from the drop-down menu.
5. Choose a time for the replication to start, either immediately or at a future time.
6. Check the box if you wish to quiesce the VM's activity via VMware Tools during the snapshot, then click Create Protection Group.

**Create Protection Group** ? ✕

Protection Group Name

Protect virtual machines in this group every

Start protecting the virtual machines immediately  
 Start protecting the virtual machines at

Cluster time zone: UTC -07:00 PDT  
 Current time on cluster: 12:36:40 PM  
 11 hours, 24 minutes from now

Use VMware Tools to quiesce the virtual machine

Cancel Create Protection Group

## Virtual Machine Protection

Virtual machines can be configured for protection, i.e. replication, individually, or be placed into a Protection Group. The protection settings that can be configured on an individual VM are the same as the settings that are configured for a protection group. In most cases, it is easier to configure multiple Protection Groups, each with the settings that are required, and then add VMs to those groups. This process simplifies operations and helps ensure that replication schedules are not set improperly.

To protect a virtual machine, or group of virtual machines, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.
2. Click Virtual Machines in the menu on the left.
3. Check the box next to one or more VMs in the list, then click Protect.

The screenshot shows the HyperFlex Connect interface for the SEDCluster. The top navigation bar includes the Cisco logo, the text 'HyperFlex Connect', and the cluster name 'SEDCluster'. On the left, a sidebar menu lists various functions: Dashboard, MONITOR (Alarms, Events, Activity), ANALYZE (Performance), PROTECT (Replication, Encryption), and MANAGE (System Information, Datastores, Virtual Machines, Upgrade, Web CLI). The 'Virtual Machines' option is currently selected.

The main content area displays a summary of virtual machines: 3 VMs are Powered On (indicated by a green power icon and the number 3), 0 are Suspended (indicated by an orange power icon and the number 0), 0 are Powered Off (indicated by a red power icon and the number 0), and 1 are Protected (indicated by a shield icon and the number 1). Below this summary is a table titled 'Virtual Machines' with a 'Ready Clones' button and a 'Protect' button circled in red. The table has columns for Name, Status, IP Address, Guest OS, Protection Status, Storage Provisioned, and Storage Used. Three VMs are listed: Bronze1 (Protected), Gold1 (Unprotected), and Silver1 (Unprotected). The Silver1 row is selected, and a '1 selected' indicator is visible in the top left of the table area.

Name	Status	IP Address	Guest OS	Protection Status	Storage Provisioned	Storage Used
Bronze1	Powered On	192.168.100.101	SUSE Linux Enterprise 12 (64-bit)	Protected (Bronze)	36 GB	0 B
Gold1	Powered On	192.168.100.102	SUSE Linux Enterprise 12 (64-bit)	Unprotected	36 GB	0 B
Silver1	Powered On	192.168.100.103	SUSE Linux Enterprise 12 (64-bit)	Unprotected	36 GB	0 B

4. Choose the option Add to an existing protection group, and choose the group to add the VM(s) to, then click Protect Virtual Machine.

Or

5. Choose the option Protect this virtual machine independently, then choose the replication interval, choose a time for the replication to start, either immediately or at a future time, and choose if you would like to use the VMware Tools to quiesce the virtual machines, then click Protect Virtual Machine.

Protect Virtual Machine
?
✕

Add to an existing protection group Silver

Protect this virtual machine independently

Protect this virtual machine every 1 hour

Start protecting the virtual machines immediately

Start protecting the virtual machines at 00:00

Cluster time zone UTC -07:00 PDT

Current time on cluster 12:52:43 PM

11 hours, 8 minutes from now

Use VMware Tools to quiesce the virtual machine

Cancel
Protect Virtual Machine



**Note:** When selecting multiple VMs to protect, the only options available are to place those VMs into a protection group, or create a new protection group. To protect multiple VMs with individual settings, each VM must be configured for protection, one-by-one.

## Replication Monitoring

The HyperFlex Connect HTML GUI can be used to monitor the status of ongoing VM protection and replication.

The Replications view shows the status of each individual snapshot replication operation.

### 66. Source Replications View

CLUSTER REPLICATION NETWORK  
Network configured. Unused IPs: 1

Unlimited  
Maximum Bandwidth

Edit

PROTECTION OVERVIEW

3 VMs Protected

0 Exceeds Interval

3 Protection Groups

REPLICATION OVERVIEW

0 In Progress

0 Incoming

1 Replication Pair

Replications

Protected Virtual Machines
Protection Groups
Replication Pairs

Last refreshed at: 08/01/2017 3:29:12 PM

Filter

Virtual Machine	Remote Cluster	Status	Start Time	End Time	Protection Group	Direction	Data Transferred
Gold1	HybridCluster	Completed	08/01/2017 3:15:27 PM	08/01/2017 3:15:27 PM	Gold	Outgoing	7.6 MB
Gold1	HybridCluster	Completed	08/01/2017 3:01:24 PM	08/01/2017 3:01:24 PM	Gold	Outgoing	8.3 MB
Bronze1	HybridCluster	Completed	08/01/2017 2:47:18 PM	08/01/2017 2:47:39 PM	Bronze	Outgoing	6.3 GB
Silver1	HybridCluster	Completed	08/01/2017 2:47:18 PM	08/01/2017 2:47:39 PM	Silver	Outgoing	6.3 GB

The Protected Virtual Machines View shows the protection status of all VMs which have been configured for protection. The green Protected icon indicates that the VM is being successfully protected according to the configured replication interval, or RPO.

**77. Source Protected Virtual Machines**

Virtual Machine Name	Protection Status	Last Protection Time	Direction	Protection Group	Interval
Bronze1	Protected	08/01/2017 2:47:18 PM	Outgoing	Bronze	Every 24 hours
Gold1	Protected	08/01/2017 3:15:27 PM	Outgoing	Gold	Every 15 minutes
Silver1	Protected	08/01/2017 2:47:18 PM	Outgoing	Silver	Every 4 hours

The Protection Groups view will indicate the status of all VMs that are members of a Protection Group. The Protection Groups can be expanded by clicking on the carat on the left-hand side, to see the status of the individual VMs in that Protection Group.

**78. Source Protection Groups**

Protection Group	Protection Status	Last Protection Time	Direction	Interval
> Bronze (1 VM)	Protected	08/01/2017 2:47:18 PM	Outgoing	Every 24 hours
> Gold (1 VM)	Protected	08/01/2017 3:15:27 PM	Outgoing	Every 15 minutes
> Silver (1 VM)	Protected	08/01/2017 2:47:18 PM	Outgoing	Every 4 hours

The Bandwidth Monitor in the upper right-hand corner can be hovered over to see a pop-up box indicating the replication bandwidth used, or the graph can be clicked on to see an expanded view of the bandwidth consumed by the outgoing or incoming replication traffic.

**79. Bandwidth Monitor**

HyperFlex Connect HybridCluster

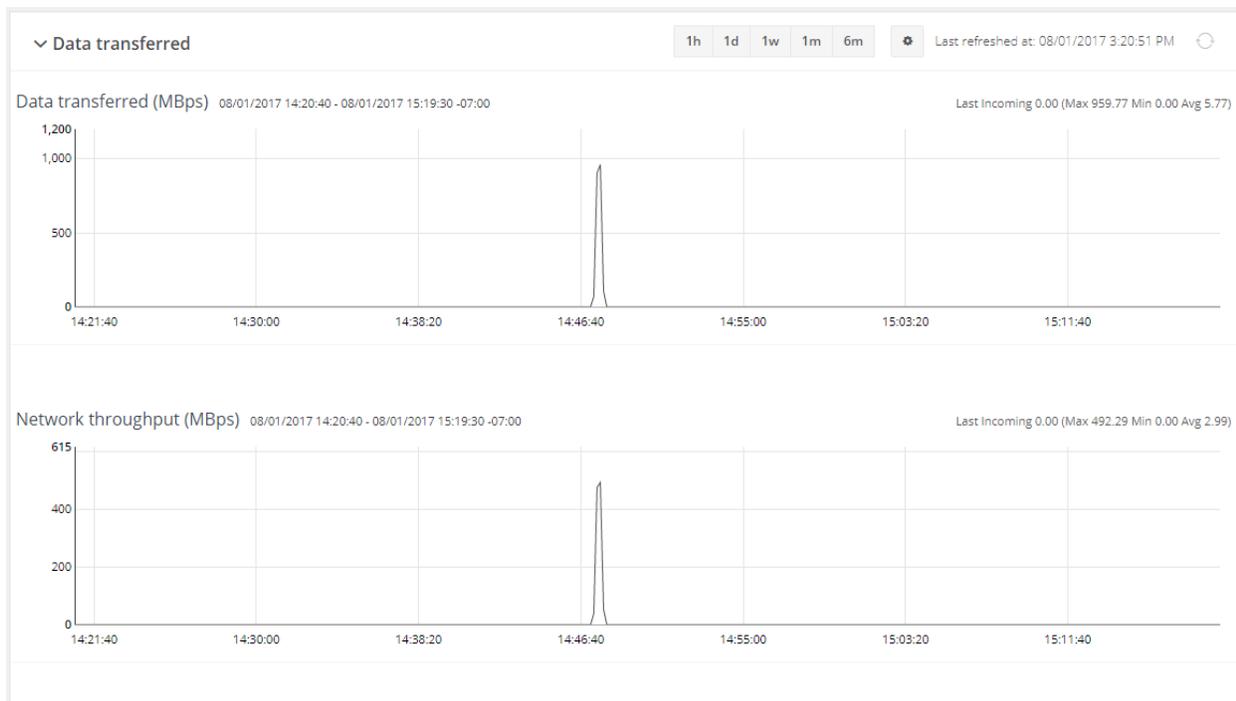
CLUSTER REPLICATION NETWORK  
Network configured. Unused IPs: 1

Unlimited  
Maximum Bandwidth

Time: 08/01/2017 2:47:40 PM  
Network throughput (Mbps) Incoming 492.29

Edit

**80. Bandwidth Charts**



All of the replication monitoring views can also be accessed via the secondary, or target HX cluster, and the same VMs and protection groups will be presented, only as incoming VMs and groups instead of outgoing. Two paired HX clusters can replicate VMs in both directions, therefore the replication status of all VMs and Protection Groups, incoming and outgoing, are presented in the replication monitor of both clusters.

## Replication Management

When configured, replication will run continuously in the background according to the configured schedules for the VMs and Protection Groups. If it is necessary to pause replication, for example during a maintenance activity such as an upgrade, replication can be paused and resumed via the HyperFlex CLI.

To pause replication, complete the following steps:

1. Log in to the HyperFlex cluster's management IP address via SSH as root.
2. At the command line, enter the command:

```
stcli dp schedule pause
```

To resume replication, complete the following steps:

3. Log in to the HyperFlex cluster's management IP address via SSH as root.
4. At the command line, enter the command:

```
stcli dp schedule resume
```

## Virtual Machine Recovery Operations

The snapshots taken by the HX Data Protection engine are separate from the HyperFlex native snapshots. Data Protection snapshots are triggered and tracked by the HX Data Platform software internally, and can only be used for the recovery of a virtual machine in the secondary, or target paired HX cluster. These snapshots are not visible in the snapshot manager of

the VMware vSphere Web Client, the C# (thick) vSphere Client, or HTML5 vSphere Client, therefore they cannot be used to roll back a VM to an earlier state in the primary cluster location. In order to have the ability to roll back a VM to an earlier snapshot in the primary, or source location, HX snapshots must be scheduled on the VMs in addition to the Data Protection replication snapshots.

## Virtual Machine Migration

When routine scheduled maintenance activities are required, or for other management purposes, virtual machines can be migrated from the source cluster to the target cluster. Migration of a virtual machine leaves the replication pairing between the two clusters in place, so that the VM can be protected again in the opposite direction of the original replication. As an overview of the process, a VM migration includes:

- Stopping the replication of the specific VM to be migrated
- Shutting down the VM in the primary, or source HX cluster
- Performing a recovery of the VM on the secondary, or target cluster
- Unprotecting the VM to remove the replication configuration of that VM
- Deleting the original source VM
- Protecting the VM, replicating the VM from the secondary cluster, back to the original cluster

Virtual machine migration and recovery operations are executed via the HyperFlex CLI. To perform a virtual machine migration, complete the following steps:

1. Log in to the secondary, or target HyperFlex cluster's management IP address via SSH as root.

1. List the virtual machines being replicated by entering the CLI command:

```
stcli dp vm list --brief
```

2. Determine the VM to be migrated and copy the UUID listed from the output of the previous command.

3. Alternatively, the UUIDs for the Protection Group itself, and all the VMs in the group can be found in the output from running the following CLI command:

```
stcli dp group list --groupname <<GROUP_NAME>>
```

```
vmGroupEr:
  type: dp vmgroup
  id: 8b9fa36f-13a2-4199-9147-b39bc31b6162
  name: Silver
members:
-----
  idtype: 2
  type: dp vm
  id: 421a0ff3-a147-9ae8-881c-f91cf822e273
  name: Silver1
-----
  idtype: 2
  type: dp vm
  id: 421a38da-5c4a-e843-0728-583e317a7ad5
  name: Bronzel
-----
```

4. Halt the VM replication by entering the following command:

```
stcli dp vm halt --vmid <<VM_UUID>>
```

- Alternatively, if the VMs are part of a Protection Group, the Protection Group must be halted using the following command:

```
stcli dp group halt --groupid <<GROUP_ID>>
```



**WARNING!** If a Protection Group is halted, all VMs in that group must be migrated or recovered. There is no way to resume replication of a Protection Group once it has been halted. If a single VM needs to be migrated, and it is part of a Protection Group, the VM must be removed from the group and protected individually before attempting to migrate or recover the VM.

- Verify the status of the VM or Protection Group shows Halted in HyperFlex Connect of both the source and target clusters.
- Shut down the source VM in the primary, or source cluster, using the vSphere Web Client, or the HTML5 vSphere Client.
- Run the migration by entering the CLI command:

```
stcli dp vm recover failover --vmid <<VM_UUID>>
```

Additional CLI syntax switches are available during a VM recovery operation:

Option	Required	Description
--vmid	Yes	Perform the recovery on the VM with the provided BIOS UUID.
--resourcepool-id	No	Place the recovered VM(s) in the resource pool with the specified ID. Specify a resource pool or folder, but not both.
--resourcepool-name	No	Place the recovered VM(s) in the resource pool with the specified name. Specify a resource pool or folder, but not both.
--folder-id	No	Place the recovered VM(s) in the folder with the specified ID. Specify a resource pool or folder, but not both.
--folder-name	No	Place the recovered VM(s) in the folder with the specified name. Specify a resource pool or folder, but not both.
--network-mapping	No	Modify the source VM to recovered VM network port group mapping. Use the format: <code>source_network:destination_network</code>
--poweron	No	Power on the recovered VM after the recovery job completes.
--force	No	Force the recovery job to run without validation of the arguments.



**Note:** Protection Groups can be recovered; however, the process involves recovering all of the VMs within the group one at a time. Each VM recovery must be completed before beginning the next recovery, in a serial fashion. Parallel recovery operations of multiple VMs within the same Protection Group are not supported. Recovery of multiple VMs in parallel can be done as long as each VM is a member of a separate Protection Group. For example, parallel recovery of 1 VM in the Bronze Protection Group and 1 VM in the Silver Protection Group can be done.

- The recovery failover command will output a job ID for the operation. To view the status of the recovery job, copy the job ID and enter the CLI command:

```
stcli dp vm recover status --id <<JOB_ID>>
```

10. When the job completes, verify the status of the VM shows Recovered in HyperFlex Connect of both the source and target clusters.
11. Power on the migrated VM via the vSphere Web Client or the HTML5 vSphere Client to test its functionality.
12. Perform any necessary post-recovery tasks on the VM, such as changing IP addresses, or updating DNS records, in order to make the VM and its applications available on the network.
13. From the HyperFlex Connect Replication page of the primary, or source cluster, click the Protected Virtual Machines menu, select the VM that was recovered, then click Unprotect. Alternatively, the VM protection can be removed via the CLI from the primary, or source cluster, using the “stcli dp vm delete” command.

Virtual Machine Name	Protection Status	Last Protection Time	Direction	Protection Group	Interval
Bronze1	Recovered	08/03/2017 12:21:03 PM	Outgoing	-	Every 12 hours
Gold1	Protected	08/03/2017 12:35:13 PM	Outgoing	-	Every 15 minutes
Silver1	Protected	08/03/2017 12:21:03 PM	Outgoing	-	Every 2 hours

14. Delete the source VM in the primary, or source cluster, using the vSphere Web Client, or the HTML5 vSphere Client.
15. Repeat steps 2 - 14 for each VM you wish to migrate.
16. If an entire Protection Group was migrated, once all the VMs have been recovered in the secondary, or target cluster, the Protection Group status will show as Recovered. The Protection Group must be deleted from the primary, or source cluster, as it is no longer possible to add VMs to a recovered group, nor is it possible to make the group active again.
17. Optionally, use HyperFlex Connect to reconfigure protection for the migrated VM(s), only now the protection would be in the opposite direction of the previous snapshots.

An example of the command line activities is given below:

```
# stcli dp vm list --brief
```

```
vmInfo:
```

```
-----
name: Bronze1
uuid: 421a38da-5c4a-e843-0728-583e317a7ad5
-----
name: Gold1
uuid: 421a8b07-6111-6701-9331-f418d88d8b4f
-----
name: Silver1
uuid: 421a0ff3-a147-9ae8-881c-f91cf822e273
-----
```

```
# stcli dp vm halt --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
# stcli dp vm recover failover --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
3976d406-e13a-4e5c-8f45-3577237436ca
# stcli dp vm recover status --id 3976d406-e13a-4e5c-8f45-3577237436ca
summary_step_state: SUCCEEDED
```

```

Description: Successfully completed Failover recovery for VMID
421a38da-5c4a-e843-0728-583e317a7ad5
time_submitted: 08/03/17_19:39
time_elapsed millis: 10635
Jobid: 3976d406-e13a-4e5c-8f45-3577237436ca
state: COMPLETED
Message: Performing Failover recovery for VMID 421a38da-5c4a-e843-0728-583e317a7ad5
time_started: 08/03/17_19:39
#

```

## Virtual Machine Recovery Testing

A virtual machine recovery test can be conducted to verify that recovery of a VM can be completed successfully. The recovery test does not cause any interruption to the ongoing replication of the VM, nor does it break the replication pairing between the two clusters. The recovery test recovers the VM to a virtual machine folder in vCenter named “HxTestRecovery” .

All virtual machine migration and recovery operations are executed via the HyperFlex CLI. To perform a virtual machine recovery test, complete the following steps:

1. Log in to the secondary, or target HyperFlex cluster’s management IP address via SSH as root.
2. List the virtual machines being replicated by entering the CLI command:

```
stcli dp vm list --brief
```

3. Determine the VM to be tested and copy the UUID listed from the output of the previous command.
4. Alternatively, the UUIDs for the Protection Group itself, and all the VMs in the group can be found in the output from running the following CLI command:

```
stcli dp group list --groupname <<GROUP_NAME>>
```

```

vmGroupEr:
  type: dp vmgroup
  id: 8b9fa36f-13a2-4199-9147-b39bc31b6162
  name: Silver
members:
-----
  idtype: 2
  type: dp_vm
  id: 421a0ff3-a147-9ae8-881c-f91cf822e273
  name: Silver1
-----
  idtype: 2
  type: dp_vm
  id: 421a38da-5c4a-e843-0728-583e317a7ad5
  name: Bronzel
-----

```

5. Run the recovery test by entering the CLI command:
- ```
stcli dp vm recover test --vmid <<VM_UUID>>
```
6. The recovery test command will output a job ID for the operation. To view the status of the recovery job, copy the job ID and enter the CLI command:
- ```
stcli dp vm recover status --id <<JOB_ID>>
```
7. Once the job completes, verify the VM has been recovered to the HxRecoveryTest folder.

8. Repeat steps 3 - 7 for each VM you wish to test.
9. Power on the recovered VMs via the vSphere Web Client or the HTML5 vSphere Client to test their functionality.

An example of the command line activities is given below:

```
# stcli dp vm list --brief
vmInfo:
-----
name: Silver1
uuid: 421a0ff3-a147-9ae8-881c-f91cf822e273
-----
name: Gold1
uuid: 421a8b07-6111-6701-9331-f418d88d8b4f
-----
name: Bronze1
uuid: 421a38da-5c4a-e843-0728-583e317a7ad5
-----

# stcli dp vm recover test --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
79d97050-d470-4616-ba60-b892b6d00d14
# stcli dp vm recover status --id 79d97050-d470-4616-ba60-b892b6d00d14
summary_step_state: SUCCEEDED
Description: Successfully completed Test recovery for VMID 421a38da-5c4a-e843-0728-583e317a7ad5
time_submitted: 08/02/17_17:21
time_elapsed_millis: 361826
Jobid: 79d97050-d470-4616-ba60-b892b6d00d14
state: COMPLETED
Message: Performing Test recovery for VMID 421a38da-5c4a-e843-0728-583e317a7ad5
time_started: 08/02/17_17:21
#
```

## Virtual Machine Disaster Recovery

In the case of a site outage, or the failure of a cluster, VMs can be recovered to their state as of the last successfully transmitted snapshot, running on the secondary, or target cluster as part of a disaster recovery operation. The recovery operation described assumes that the primary, or source site and cluster is either offline, or isolated in such a way that it can no longer communicate with the secondary, or target site, nor can it be managed. A recovery operation stops all replication and breaks the pairing of the two clusters, so that replication can be reestablished at a later time after the faults or outages have been repaired. As an overview of the process, a VM disaster recovery includes:

- Stopping the replication of the VM(s) to be recovered
- Performing a recovery of the VM(s) on the secondary, or target cluster
- Unpairing the two replicating HX clusters
- Unprotecting the VM(s) to remove the replication configuration
- Repair or bring the original cluster back online, and remove its replication configuration
- Delete the original source VMs
- Pairing the HX cluster with the running VMs to a new cluster, or to the original cluster once it is back online
- Protecting the VMs, replicating the VM from the running cluster, to a new cluster, or back to the original cluster

Virtual machine migration and recovery operations are executed via the HyperFlex CLI. To perform a virtual machine recovery, complete the following steps:

1. Log in to the secondary, or target HyperFlex cluster’s management IP address via SSH as root.
2. List the virtual machines being replicated by entering the CLI command:

```
stcli dp vm list --brief
```

3. Determine the VM to be recovered and copy the UUID listed from the output of the previous command.
4. Alternatively, the UUIDs for the Protection Group itself, and all the VMs in the group can be found in the output from running the following CLI command:

```
stcli dp group list --groupname <<GROUP_NAME>>
```

```
vmGroupEr:
  type: dp vmgroup
  id: 8b9fa36f-13a2-4199-9147-b39bc31b6162
  name: Silver
members:
-----
  idtype: 2
  type: dp vm
  id: 421a0ff3-a147-9ae8-881c-f91cf822e273
  name: Silver1
-----
  idtype: 2
  type: dp vm
  id: 421a38da-5c4a-e843-0728-583e317a7ad5
  name: Bronzel
-----
```

5. Halt the VM replication by entering the following command:

```
stcli dp vm halt --vmid <<VM_UUID>>
```

6. Alternatively, if the VMs are part of a Protection Group, the Protection Group must be halted using the following command:

```
stcli dp group halt --groupid <<GROUP_ID>>
```



**WARNING!** If a Protection Group is halted, all VMs in that group must be migrated or recovered. There is no way to resume replication of a Protection Group once it has been halted. If a single VM needs to be migrated, and it is part of a Protection Group, the VM must be removed from the group and protected individually before attempting to migrate or recover the VM.

7. Verify the status of the VM or Protection Group shows Halted in HyperFlex Connect of the secondary, or target cluster.
8. Run the recovery by entering the CLI command:

```
stcli dp vm recover failover --vmid <<VM_UUID>>
```

Additional CLI syntax switches are available during a VM recovery operation:

Option	Required	Description
--vmid	Yes	Perform the recovery on the VM with the provided BIOS UUID.
--resourcepool-id	No	Place the recovered VM(s) in the resource pool with the specified ID. Specify a resource pool or folder, but not both.

--resourcepool-name	No	Place the recovered VM(s) in the resource pool with the specified name. Specify a resource pool or folder, but not both.
--folder-id	No	Place the recovered VM(s) in the folder with the specified ID. Specify a resource pool or folder, but not both.
--folder-name	No	Place the recovered VM(s) in the folder with the specified name. Specify a resource pool or folder, but not both.
--network-mapping	No	Modify the source VM to recovered VM network port group mapping. Use the format: <code>source_network:destination_network</code>
--poweron	No	Power on the recovered VM after the recovery job completes.
--force	No	Force the recovery job to run without validation of the arguments.



**Note:** Protection Groups can be recovered; however, the process involves recovering all of the VMs within the group one at a time. Each VM recovery must be completed before beginning the next recovery, in a serial fashion. Parallel recovery operations of multiple VMs within the same Protection Group are not supported. Recovery of multiple VMs in parallel can be done as long as each VM is a member of a separate Protection Group. For example, parallel recovery of 1 VM in the Bronze Protection Group and 1 VM in the Silver Protection Group can be done.

9. The recovery failover command will output a job ID for the operation. To view the status of the recovery job, copy the job ID and enter the CLI command:
 

```
stcli dp vm recover status --id <<JOB_ID>>
```
10. When the job completes, verify the status of the VM shows Recovered in HyperFlex Connect of the secondary, or target cluster.
11. Repeat steps 3 - 10 for each VM you need to recover.
12. Power on the recovered VMs via the vSphere Web Client or the HTML5 vSphere Client to test their functionality.
13. Perform any necessary post-recovery tasks on the VMs, such as changing IP addresses, or updating DNS records, in order to make the VMs and their applications available on the network.
14. List the HX cluster peers, and find the name of the pairing by using the following CLI command:
 

```
stcli dp peer list
```
15. Delete the replication pairing between the two clusters by using the following CLI command:
 

```
stcli dp peer forget --name <<PAIR_NAME>>
```
16. From the HyperFlex Connect Replication page of the secondary, or target cluster, click the Protected Virtual Machines menu, select all the VMs that were recovered, then click Unprotect. Alternatively, the VM protection can be removed via the CLI from the secondary, or target cluster, using the “`stcli dp vm delete`” or “`stcli dp group vm delete`” command.
17. If an entire Protection Group was migrated, once all the VMs have been recovered in the secondary, or target cluster, the Protection Group status will show as Recovered. The Protection Group must be deleted, as it is no longer possible to add VMs to a recovered group, nor is it possible to make the group active again. All the VMs in the group must be unprotected, as described in the previous step, before the group can be deleted. From the HyperFlex Connect Replica-

tion page of the secondary, or target cluster, click the Protection Groups menu, select Protection Groups that were recovered, then click Delete. Alternatively, the groups can be removed via the CLI from the secondary, or target cluster, using the “stcli dp group delete” command.



**Note:** The initial group delete command may give an error if issued immediately after removing protection from the VMs within the group. Wait a few minutes before retrying the command, and it should complete successfully.

An example of the command line activities is given below:

```
# stcli dp vm list --brief
vmInfo:
-----
name: Bronzel
uuid: 421a38da-5c4a-e843-0728-583e317a7ad5
-----
name: Gold1
uuid: 421a8b07-6111-6701-9331-f418d88d8b4f
-----
name: Silver1
uuid: 421a0ff3-a147-9ae8-881c-f91cf822e273
-----

# stcli dp group list
clusterEr:
  type: cluster
  id: 1257435955901676010:6385789462100613663
  name: SEDCluster
vmGroupState: active
vmGroupEr:
  type: dp_vmgroup
  id: 91e54586-2536-4f71-8925-348c1bbee2c2
  name: DR_Gold
members:
  idtype: 2
  type: dp_vm
  id: 421a8b07-6111-6701-9331-f418d88d8b4f
  name: Gold1
schedules:
  replicationSchedule:
    targetClusterEr:
      type: cluster
      id: 1949045506490781161:5096245698033261308
      name: HybridCluster
    enabled: True
    mode: 1
    startTime: 08/11/17_15:57
    nextSnapshotTime: 1502467040255
    intervalInMinutes: 15

# stcli dp group halt --groupid 91e54586-2536-4f71-8925-348c1bbee2c2

# stcli dp vm halt --vmid 421a0ff3-a147-9ae8-881c-f91cf822e273

# stcli dp vm halt --vmid 421a38da-5c4a-e843-0728-583e317a7ad5

# stcli dp vm recover failover --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
022457f7-2596-4881-97d1-011d6bb76aff

# stcli dp vm recover status --id 022457f7-2596-4881-97d1-011d6bb76aff
summary_step_state: SUCCEEDED
```

```

Description: Successfully completed Failover recovery for VMID
421a38da-5c4a-e843-0728-583e317a7ad5
time_submitted: 08/11/17_16:27
time_elapsed millis: 12771
Jobid: 022457f7-2596-4881-97d1-011d6bb76aff
state: COMPLETED
Message: Performing Failover recovery for VMID 421a38da-5c4a-e843-0728-583e317a7ad5
time_started: 08/11/17_16:27

# stcli dp vm recover failover --vmid 421a0ff3-a147-9ae8-881c-f91cf822e273
7186364f-8631-47a2-a6b0-c7c85b772fba

# stcli dp vm recover status --id 7186364f-8631-47a2-a6b0-c7c85b772fba
summary_step_state: SUCCEDED
Description: Successfully completed Failover recovery for VMID
421a0ff3-a147-9ae8-881c-f91cf822e273
time_submitted: 08/11/17_16:28
time_elapsed millis: 9872
Jobid: 7186364f-8631-47a2-a6b0-c7c85b772fba
state: COMPLETED
Message: Performing Failover recovery for VMID 421a0ff3-a147-9ae8-881c-f91cf822e273
time_started: 08/11/17_16:28

# stcli dp vm recover failover --vmid 421a8b07-6111-6701-9331-f418d88d8b4f
e82efb50-035e-40b2-a680-653d2ba34d10

# stcli dp vm recover status --id e82efb50-035e-40b2-a680-653d2ba34d10
summary_step_state: SUCCEDED
Description: Successfully completed Failover recovery for VMID
421a8b07-6111-6701-9331-f418d88d8b4f
time_submitted: 08/11/17_16:28
time_elapsed millis: 11088
Jobid: e82efb50-035e-40b2-a680-653d2ba34d10
state: COMPLETED
Message: Performing Failover recovery for VMID 421a8b07-6111-6701-9331-f418d88d8b4f
time_started: 08/11/17_16:28

# stcli dp peer list
Datastores:
  aDs:
    clEr:
      confignum: 0
      type: cluster
      id: 1257435955901676010:6385789462100613663
      name: SEDCluster
    dsEr:
      confignum: 0
      type: datastore
      id: 00000000d31828f8:0000000000010103
      name: DS1SED
  bDs:
    clEr:
      type: cluster
      id: 1949045506490781161:5096245698033261308
      name: HybridCluster
    dsEr:
      type: datastore
      id: 00000000f5986cf9:00000000000100ed
      name: DS1HY
Name: HX1HX2
Replication IP: 192.168.150.16
Description:
Management IP: 10.29.133.160

```

```
# stcli dp peer forget --name HX1HX2
```

## Disaster Recover Post Operations

After a disaster has been declared, and all VMs have been recovered to the secondary, or target cluster, work can begin to repair the primary, or source cluster. To complete disaster recovery post operation steps on the original source cluster, complete the following steps:

1. Repair the faults or failures in the original source HX cluster, and bring the cluster online in a healthy state. Do not power on the VMs that have been recovered in the secondary site. If for any reason the original cluster had to be reinstalled, no further action is necessary, and you may skip to step 7.
2. From the HyperFlex Connect Replication page of the primary, or source cluster, click the Protected Virtual Machines menu, select all the VMs that were recovered, then click Unprotect. Alternatively, the VM protection can be removed via the CLI from the secondary, or target cluster, using the “stcli dp vm delete” or “stcli dp group vm delete” command.
3. If an entire Protection Group was migrated, once all the VMs have been recovered in the secondary, or target cluster, the Protection Group status will show as Recovered. The Protection Group must be deleted, as it is no longer possible to add VMs to a recovered group, nor is it possible to make the group active again. All the VMs in the group must be unprotected, as described in the previous step, before the group can be deleted. From the HyperFlex Connect Replication page of the primary, or source cluster, click the Protection Groups menu, select Protection Groups that were recovered, then click Delete. Alternatively, the groups can be removed via the CLI from the primary, or source cluster, using the “stcli dp group delete” command.



**Note:** The initial group delete command may give an error if issued immediately after removing protection from the VMs within the group. Wait a few minutes before retrying the command, and it should complete successfully.

---

4. From the primary, or source cluster, list the HX cluster peers, and find the name of the pairing by using the following CLI command:

```
stcli dp peer list
```

5. Delete the replication pairing between the two clusters by using the following CLI command:

```
stcli dp peer forget --name <<PAIR_NAME>>
```

6. Delete the original source VMs on the primary, or source cluster.
7. At this point, the VMs have all been recovered, and both clusters have no replication pairing or configuration. The two clusters can be paired again, and the VMs can be migrated back to the original source cluster using the VM Migration steps documented earlier. Alternatively, the secondary, or target cluster, can be paired with a completely different cluster and replication can be established.

## Validation

---

This section provides a list of items that should be reviewed after the HyperFlex system has been deployed and configured. The goal of this section is to verify the configuration and functionality of the solution, and ensure that the configuration supports core availability requirements.

### Post Install Checklist

The following tests are critical to functionality of the solution, and should be verified before deploying for production:

1. Verify the expected number of converged storage nodes and compute-only nodes are members of the HyperFlex cluster in the vSphere Web Client plugin manage cluster screen.
2. Verify the expected cluster capacity is seen in the vSphere Web Client plugin summary screen. (See [Appendix A](#))
3. Create a test virtual machine that accesses the HyperFlex datastore and is able to perform read/write operations.
4. Perform the virtual machine migration (vMotion) of the test virtual machine to a different host on the cluster.
5. During the vMotion of the virtual machine, make sure the test virtual machine can perform a continuous ping to default gateway and to check if the network connectivity is maintained during and after the migration.

### Verify Redundancy

The following redundancy checks can be performed to verify the robustness of the system. Network traffic, such as a continuous ping from VM to VM, or from vCenter to the ESXi hosts should not show significant failures (one or two ping drops might be observed at times). Also, all of the HyperFlex datastores must remain mounted and accessible from all the hosts at all times.

1. Administratively disable one of the server ports on Fabric Interconnect A which is connected to one of the HyperFlex converged storage hosts. The ESXi virtual switch uplinks for fabric A should now show as failed, and the standby uplinks on fabric B will be in use for the management and vMotion virtual switches. Upon administratively re-enabling the port, the uplinks in use should return to normal.
2. Administratively disable one of the server ports on Fabric Interconnect B which is connected to one of the HyperFlex converged storage hosts. The ESXi virtual switch uplinks for fabric B should now show as failed, and the standby uplinks on fabric A will be in use for the storage virtual switch. Upon administratively re-enabling the port, the uplinks in use should return to normal.
3. Place a representative load of guest virtual machines on the system. Put one of the ESXi hosts in maintenance mode, using the HyperFlex HX maintenance mode option. All the VMs running on that host should be migrated via vMotion to other active hosts through vSphere DRS, except for the storage platform controller VM, which will be powered off. No guest VMs should lose any network or storage accessibility during or after the migration. This test assumes that enough RAM is available on the remaining ESXi hosts to accommodate VMs from the host put in maintenance mode. The HyperFlex cluster will show in an unhealthy state.
4. Reboot the host that is in maintenance mode, and exit it from maintenance mode after the reboot. The storage platform controller will automatically start when the host exits maintenance mode. The HyperFlex cluster will show as healthy after a brief time to restart the services on that node. vSphere DRS should rebalance the VM distribution across the cluster over time.



Note: Many vCenter alerts automatically clear when the fault has been resolved. Once the cluster health is verified, some alerts may need to be manually cleared.

---

5. Reboot one of the two Cisco UCS Fabric Interconnects while traffic is being sent and received on the storage datastores and the network. The reboot should not affect the proper operation of storage access and network traffic generated by the VMs. Numerous faults and errors will be noted in Cisco UCS Manager, but all will be cleared after the FI comes back online.

## Appendix

---

### A: Cluster Capacity Calculations

A HyperFlex HX Data Platform cluster capacity is calculated as follows:

$$\left( \frac{\langle \text{capacity disk size in GB} \rangle \times 10^9}{1024^3} \right) \times \langle \text{number of capacity disks per node} \rangle \times \langle \text{number of HyperFlex nodes} \rangle \times 0.92 / \text{replication factor}$$

Divide the result by 1024 to get a value in TiB

The replication factor value is 3 if the HX cluster is set to RF=3, and the value is 2 if the HX cluster is set to RF=2.

The 0.92 multiplier accounts for an 8% reservation set aside on each disk by the HX Data Platform software for various internal filesystem functions.

Calculation example:

$\langle \text{capacity disk size in GB} \rangle = 1200$  for 1.2 TB disks

$\langle \text{number of capacity disks per node} \rangle = 15$  for an HX240c-M4SX model server

$\langle \text{number of HyperFlex nodes} \rangle = 8$

replication factor = 3

Result:  $\left( \frac{(1200 \times 10^9)}{1024^3} \right) \times 15 \times 8 \times 0.92 / 3 = 41127.2049$

$41127.2049 / 1024 = 40.16$  TiB

### B: HyperFlex Sizer

HyperFlex sizer is a cloud based end-to-end tool that can help the customers and partners find out how many Cisco HyperFlex nodes are needed and how the nodes can be configured to meet their needs for the compute resources, storage capacity and performance requirements in the datacenter. The sizing guidance of the HX system is calculated according to the information of workloads collected from the users. This cloud application can be accessed from anywhere at Cisco website (CCO login required):

<https://hyperflexsizer.cloudapps.cisco.com>

Improvements in the sizing tool for HXDP 2.5 release include:

- Replication support: workloads can be sized to account for replication
- Encryption support: systems can be sized using self-encrypting disks
- Performance enhancements in HXDP 2.5, including NVMe caching disk support
- Fully populate the HXAF240 model server with all disks, and M10 GPU support
- Provide sizing estimates against the HX Workload Profiler tool output

#### 71. HyperFlex Sizer

	Cluster	Site	Settings	Part	Type	Description	Count
Replication Pair	Cluster 1	A	RF 3 N+1	HXAF-SP-240M45-BV	Bundle	2xIntel Xeon Processor E5-2630 v4, 10 cores, 2.2GHz   384 GB ( 256 GB Base 128 GB Add-On ) DDR4 RAM   10x960GB, 2.5 *SSD   2 RUs	5
	Cluster 2	B	RF 3 N+1	HXAF-SP-220M45-BV	Bundle	2xIntel Xeon Processor E5-2630 v4, 10 cores, 2.2GHz   256 GB DDR4 RAM   6x960GB, 2.5 *SSD   1 RU	3

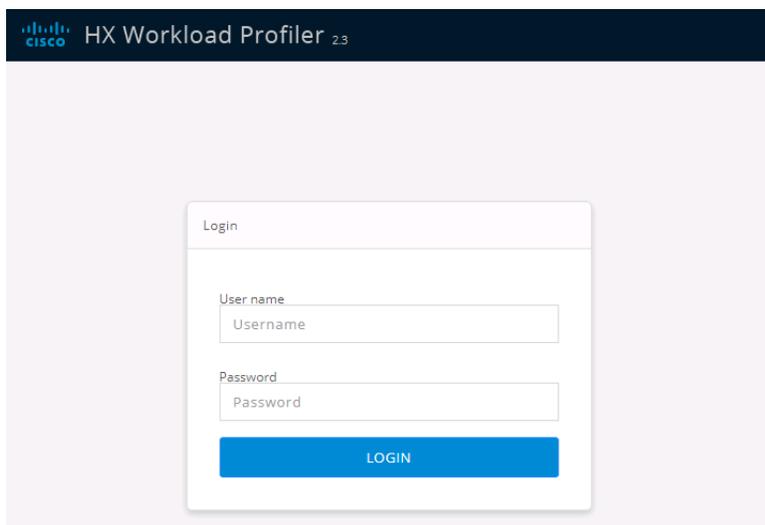


Note: The HyperFlex Sizer tool is designed to provide general guidance in evaluating the optimum solution for using selected Cisco products. The tool is not intended as a substitute for your own judgment or for that of your professional advisors.

## C: HyperFlex Workload Profiler

Also available at the <https://hyperflexsizer.cloudapps.cisco.com> website is an updated HyperFlex Workload Profiler, version 2.3. The HyperFlex Workload Profiler tool is used to capture storage usage and performance statistics from an existing VMware ESX cluster, enabling you to use that data to assist with sizing a HyperFlex cluster which would assume that workload. The workload profiler is distributed as an OVA file, which can be deployed using static or DHCP assigned addressing, on an existing VMware ESXi host. Once deployed, the profiler tool connects to an existing VMware vCenter server to gather storage statistics for the selected ESXi hosts. To capture performance data using the HyperFlex Workload Profiler, complete the following steps:

1. Deploy the HyperFlex Workload Profiler VM by using the Deploy OVF Template wizard, on the chosen existing ESXi host. Assign a static IP address or use DHCP addressing as part of the deployment wizard.
2. Using a web browser, connect to the IP address assigned or leased by the Workload Profiler VM.



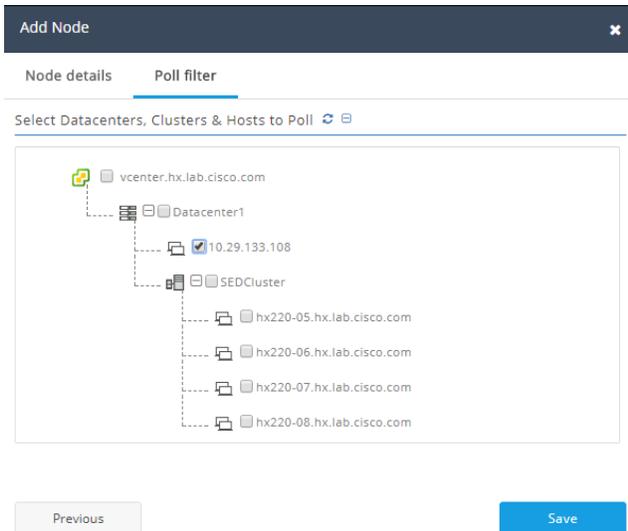
3. Enter the username and password, the default username and password is “monitoring” , then click Login.
4. On first login, the Add Node wizard will run. Enter the vCenter server name or IP, a username with administrative rights, and the password, then click Connect.

The image shows a screenshot of the "Add Node" wizard in the HX Workload Profiler. The window title is "Add Node" with a close button. There are two tabs: "Node details" (selected) and "Poll filter". The form contains the following fields:

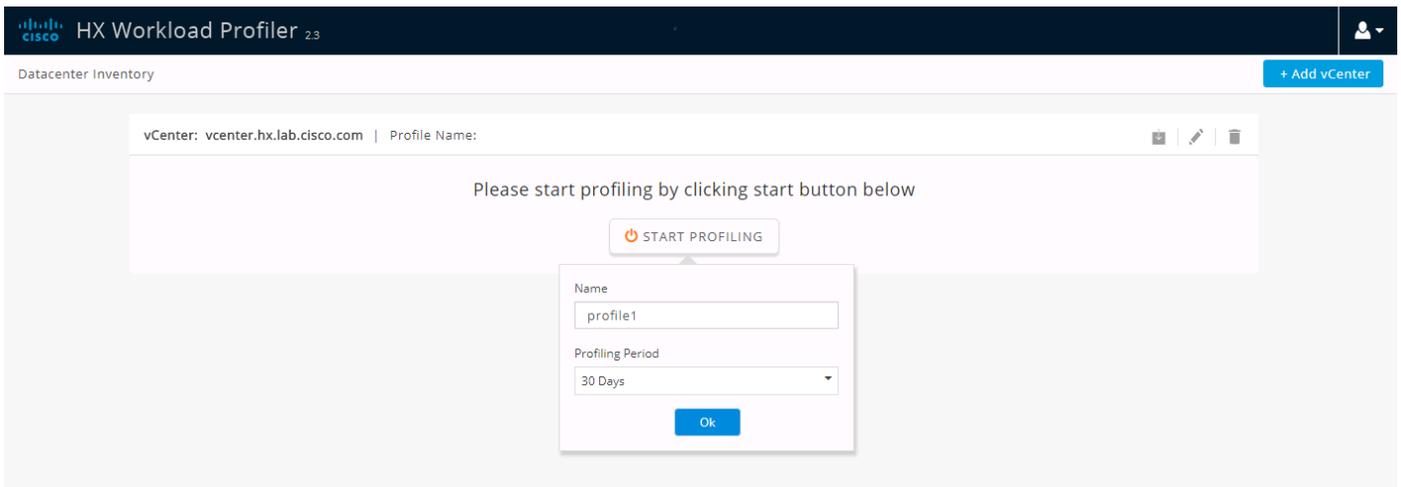
- vCenter Name: vcenter.hx.lab.cisco.com
- User Name: administrator@vsphere.local
- Password: masked with asterisks and a toggle icon
- Polling Interval (seconds): 480

At the bottom of the form is a blue "Connect" button.

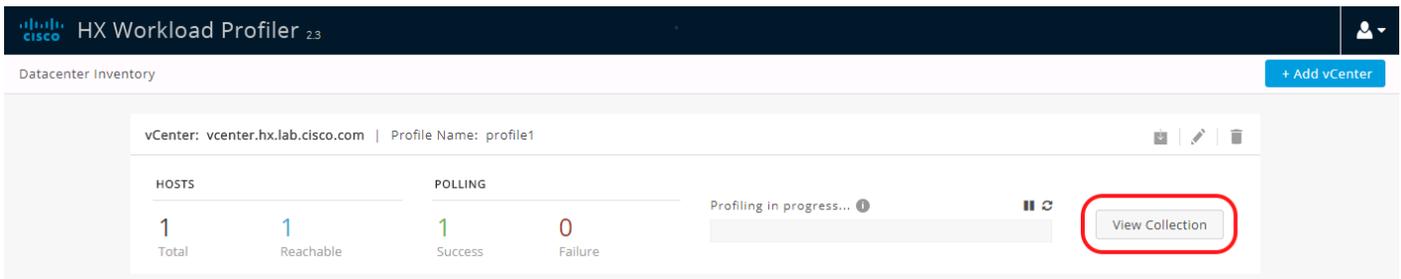
5. When the vCenter server is connected, click Next to select the hosts to monitor.
6. Check the box next to the hosts to poll for data, then click Save.

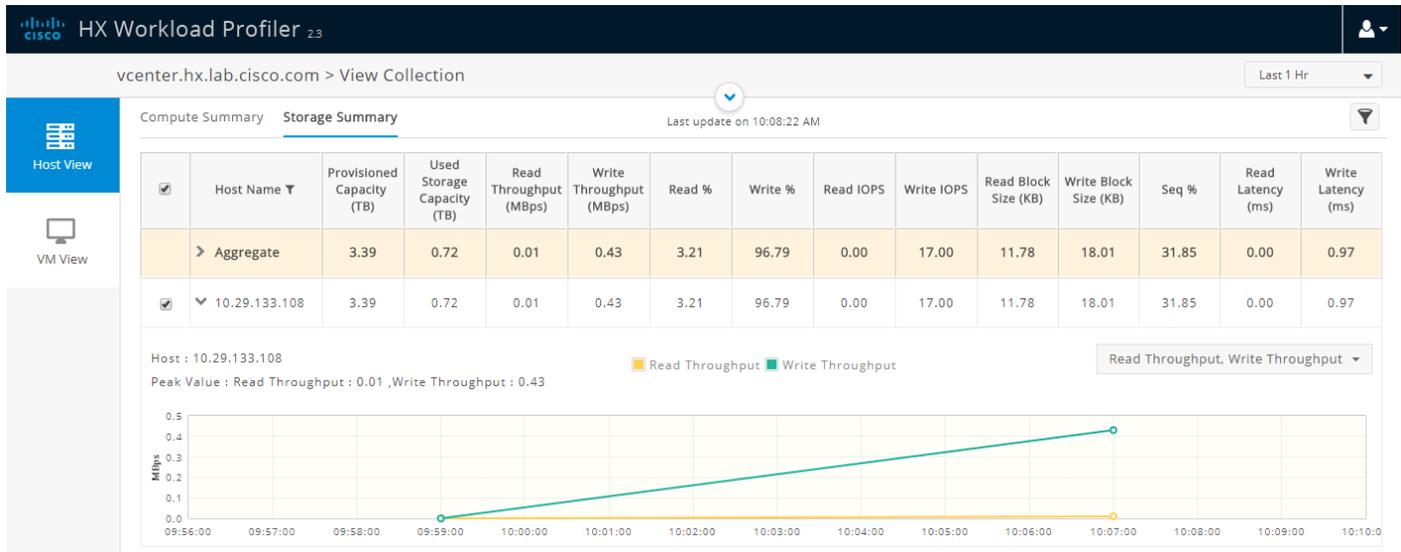


7. In the main screen, the vCenter server being polled will be listed. Click the Start Profiling button.



8. Choose a time interval to collect data on the system, then click OK. A 30-day collection is recommended for accurate sizing activities.
9. At any time during the collection polling, the data can be viewed by clicking on the View Collection button. The data for CPU and memory utilization, and storage statistics can be viewed, as an aggregate of all hosts, one host at a time, or from a per VM perspective.





- When the collection is complete, the complete dataset can be exported as a comma-separated file, and the data can be automatically imported into the HyperFlex sizer tool to help with computing and storage sizing efforts, or otherwise analyzed to help with sizing decisions.

## D: Example Cisco Nexus 9372 Switch Configurations

### Switch A

```
hostname HX-9K-A

no feature telnet
no telnet server enable
cfs eth distribute
feature interface-vlan
feature lacp
feature vpc

ip domain-lookup
ip domain-list cisco.com
ip name-server 171.70.168.183 173.36.131.10
logging event link-status default
policy-map type network-qos jumbo
  class type network-qos class-default
  mtu 9216
system qos
  service-policy type network-qos jumbo
clock timezone PST -8 0
clock summer-time PST
ntp server 171.68.38.65
ntp server 171.68.38.66

vrf context management
vlan 1
vlan 133
  name Management
vlan 51
  name HXCluster1
vlan 100
  name VM-Prod-100
vlan 200
```

```
name VMotion

cdp enable

vpc domain 50
  role priority 10
  peer-keepalive destination 10.29.133.102 source 10.29.133.101
  auto-recovery
  delay restore 150

interface Vlan1

interface port-channel50
  description VPC-Peer
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  spanning-tree port type network
  vpc peer-link

interface port-channel10
  description VPC to 6248-A
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type edge trunk
  spanning-tree bpduguard enable
  mtu 9216
  vpc 10

interface port-channel20
  description VPC to 6248-B
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type edge trunk
  spanning-tree bpduguard enable
  mtu 9216
  vpc 20

interface Ethernet1/1
  description uplink
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type network

interface Ethernet1/2
  description NX9372-A_P1/2--UCS6248-A_2/1
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  channel-group 10 mode active

interface Ethernet1/4
  description NX9372-A_P1/4--UCS6248-B_2/1
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  channel-group 20 mode active

interface Ethernet1/47
  description NX9372-A_P1/47--NX9372-B_P1/47
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  channel-group 50 mode active

interface Ethernet1/48
  description NX9372-A_P1/48--NX9372-B_P1/48
  switchport mode trunk
```

```

switchport trunk allowed vlan 1,51,100,133,200
channel-group 50 mode active

interface mgmt0
 ip address 10.29.133.101/24

vrf context management
ip route 0.0.0.0/0 10.29.133.1

```

## Switch B

```

hostname HX-9K-B

no feature telnet
no telnet server enable
cfs eth distribute
feature interface-vlan
feature lacp
feature vpc

ip domain-lookup
ip domain-list cisco.com
ip name-server 171.70.168.183 173.36.131.10
logging event link-status default
policy-map type network-qos jumbo
 class type network-qos class-default
  mtu 9216
system qos
 service-policy type network-qos jumbo
clock timezone PST -8 0
clock summer-time PST
ntp server 171.68.38.65
ntp server 171.68.38.66

vrf context management
vlan 1
vlan 133
 name Management
vlan 51
 name HXCluster1
vlan 100
 name VM-Prod-100
vlan 200
 name VMotion

cdp enable

vpc domain 50
 role priority 10
 peer-keepalive destination 10.29.133.101 source 10.29.133.102
 auto-recovery
 delay restore 150

interface Vlan1

interface port-channel50
 description VPC-Peer
 switchport mode trunk
 switchport trunk allowed vlan 1,51,100,133,200
 spanning-tree port type network
 vpc peer-link

interface port-channel10
 description VPC to 6248-A

```

```

switchport mode trunk
switchport trunk allowed vlan 51,100,133,200
spanning-tree port type edge trunk
spanning-tree bpduguard enable
mtu 9216
vpc 10

interface port-channel20
description VPC to 6248-B
switchport mode trunk
switchport trunk allowed vlan 51,100,133,200
spanning-tree port type edge trunk
spanning-tree bpduguard enable
mtu 9216
vpc 20

interface Ethernet1/1
description uplink
switchport mode trunk
switchport trunk allowed vlan 51,100,133,200
spanning-tree port type network

interface Ethernet1/2
description NX9372-A_P1/2--UCS6248-A_2/3
switchport mode trunk
switchport trunk allowed vlan 51,100,133,200
channel-group 10 mode active

interface Ethernet1/4
description NX9372-A_P1/4--UCS6248-B_2/3
switchport mode trunk
switchport trunk allowed vlan 51,100,133,200
channel-group 20 mode active

interface Ethernet1/47
description NX9372-B_P1/47--NX9372-A_P1/47
switchport mode trunk
switchport trunk allowed vlan 1,51,100,133,200
channel-group 50 mode active

interface Ethernet1/48
description NX9372-B_P1/48--NX9372-A_P1/48
switchport mode trunk
switchport trunk allowed vlan 1,51,100,133,200
channel-group 50 mode active

interface mgmt0
ip address 10.29.133.102/24

vrf context management
ip route 0.0.0.0/0 10.29.133.1

```

## E: Example Connecting to External Storage Systems

The following examples demonstrate scenarios where a newly built HX cluster connects to the existing third-party storage devices, using either iSCSI or FC protocols. The new HX system is built with its own Fabric Interconnect switches then connecting to upstream Ethernet switches or Fibre Channel switches where the existing storage devices reside.

### Connecting to iSCSI Storage

The HX installer can guide you through the process of setting up your HX cluster allowing you to connect to existing third-party storage systems via the iSCSI protocol. The installer will automatically configure Cisco UCS profiles, and HX

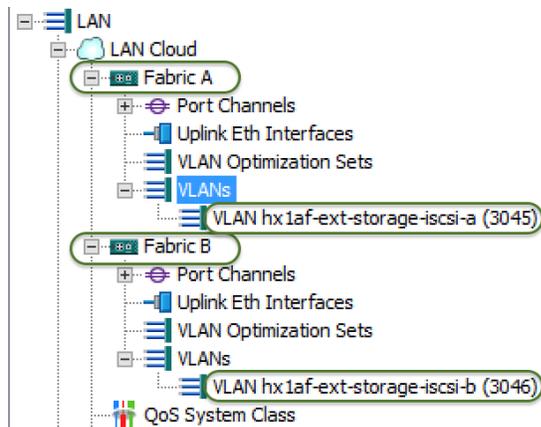
cluster nodes with extra vNICs for iSCSI, and proper VLANs in the setup. The procedure is described [here](#) in this CVD. It is assumed that the third-party storage system is already configured per a Cisco Validated Design and all networking configuration is completed on the upstream switches. For iSCSI, the VLANs are configured on the A fabric and B fabric separately, as per best practice. In this example topology, the HX hosts connect to the Cisco UCS Fabric Interconnects, that are in turn connected to the upstream Ethernet switches, e.g. Nexus 9000 series. The third-party storage is connected to the Ethernet switches. To configure the HX system with iSCSI external storage for HyperFlex, complete the following steps:

1. Prior to installation of HX, identify the iSCSI settings from the existing environment. Make sure that the third-party storage device has two iSCSI VLANs. Record them in the following table (Table 51 ). This information will be needed for later use during the HX install. Record the IP addresses of the iSCSI controller interfaces for the A and B path targets, and the iSCSI IQN name of the target device. Depending on how the redundant storage paths are configured in the production, more than two controlling interfaces might be recorded here. For example, in a Cisco validated FlexPod setup, where the NetApp storage array connects to Cisco Nexus 9000 series switches via VPC, normally four iSCSI IP addresses are assigned, two for each path (A and B).

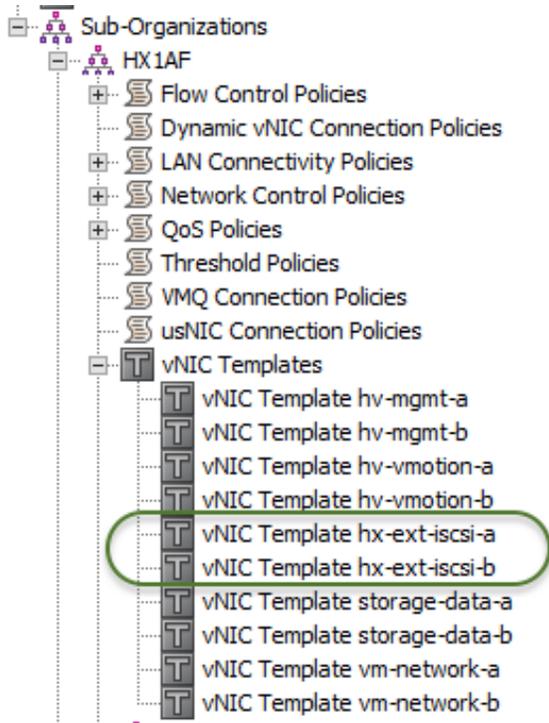
**Table 51 iSCSI Storage Settings**

Items	Fabric A	Fabric B	
iSCSI VLAN ID			
iSCSI Target Ports	IP Address-A	IP Address-B	iSCSI IQN Name
iSCSI Storage Controller #1			
iSCSI Storage Controller #2			

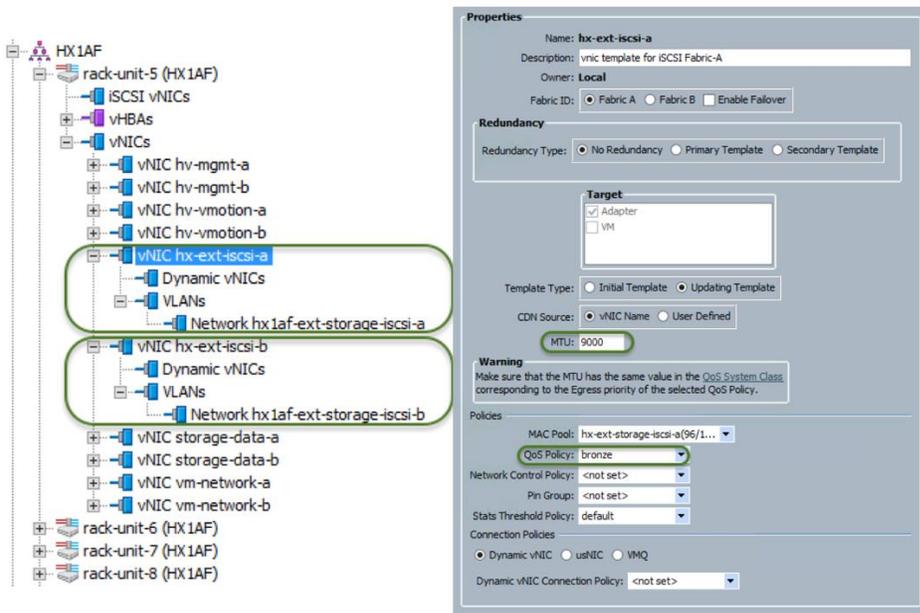
2. Follow [these steps](#) to create HX cluster with the external storage adapters using the same VLAN ID's obtained from Step 1 for both Fabric A and B. Upon completion of HX install two additional vNICs for iSCSI will be created for each HX host.
3. Open Cisco UCS Manager, expand LAN > LAN Cloud > Fabric A > VLANs, then Fabric B > VLANs to verify that the iSCSI VLANs are created and assigned to Fabric A and B.



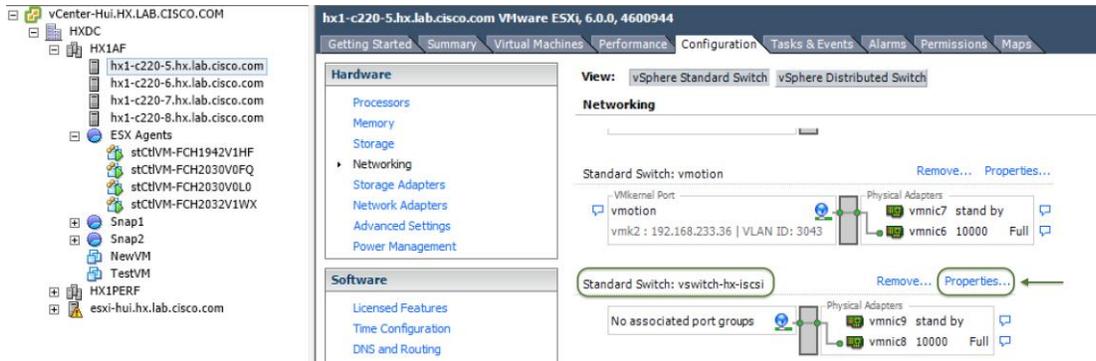
4. On the LAN tab, expand Policies > root > Sub-Organizations, go to the HX sub-organization just created, view the iSCSI templates that were created.



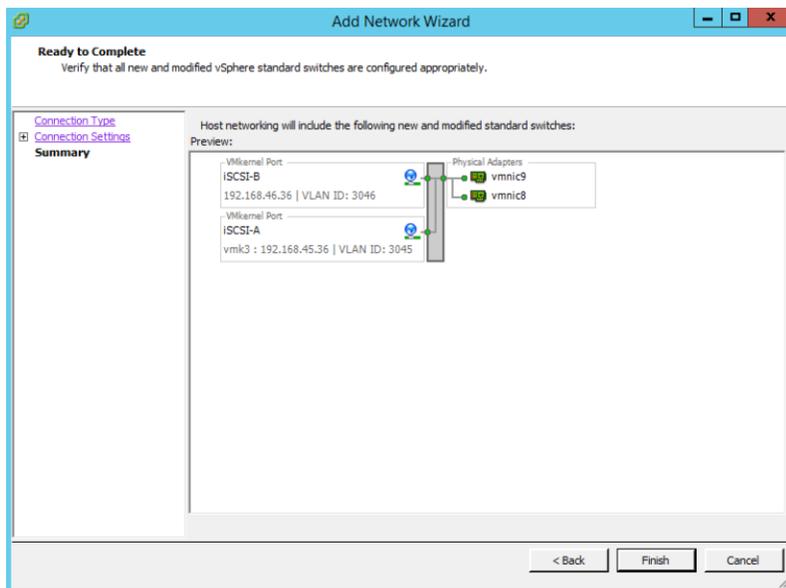
- In Cisco UCS Manager, Expand Servers > Service Profiles > root > Sub-Organizations, go to the HX sub-organization just created, verify the iSCSI vNICs on all HX servers. Click one vNIC, view the properties of that iSCSI adapter. Make sure Jumbo MTU 9000 is set.



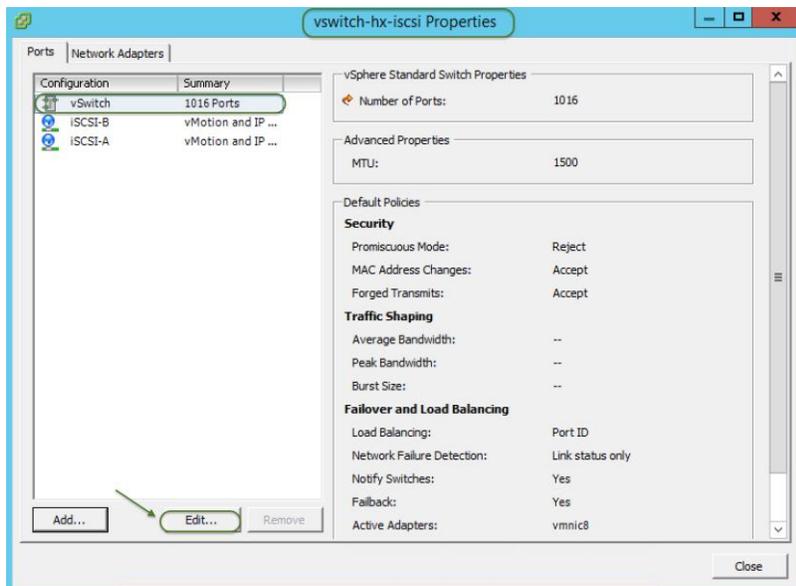
- Set up the networking for the vSphere iSCSI switch. Login to vCenter and select the first node of the HX cluster in the left screen, then on the right screen select the Configuration tab, select Networking in the hardware pane, then scroll to the iSCSI switch. Click Properties.



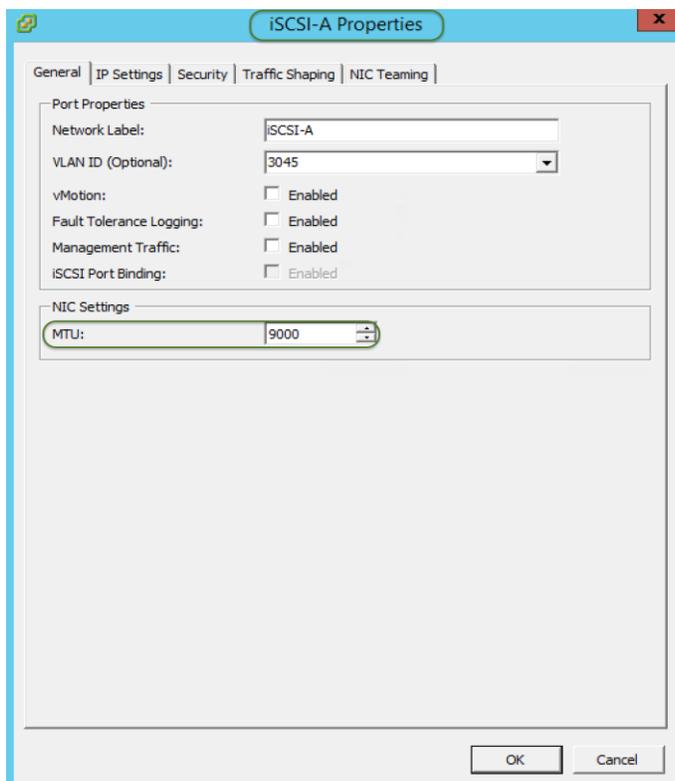
7. Click Add.
8. Select VMkernel and click Next.
9. Name iSCSI-A for the Network Label and input iSCSI VLAN ID for the A Fabric, then click Next.
10. Add the IP address for subnet for Fabric-A and click Next.
11. Click Finish to complete addition of iSCSI VMkernel port for A Fabric.
12. Repeat Steps 7-11 to add VMkernel Port for iSCSI-B.



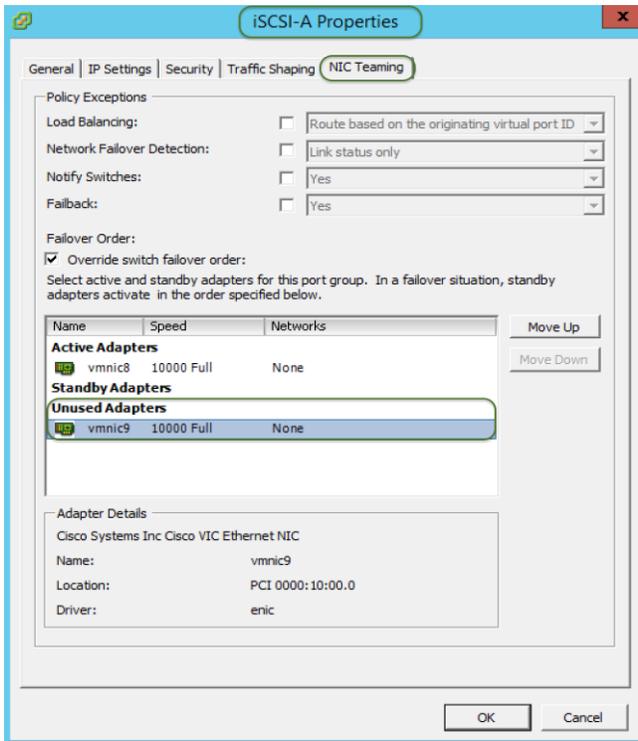
13. Back to the vSwitch Properties page, highlight the vSwitch and click Edit.



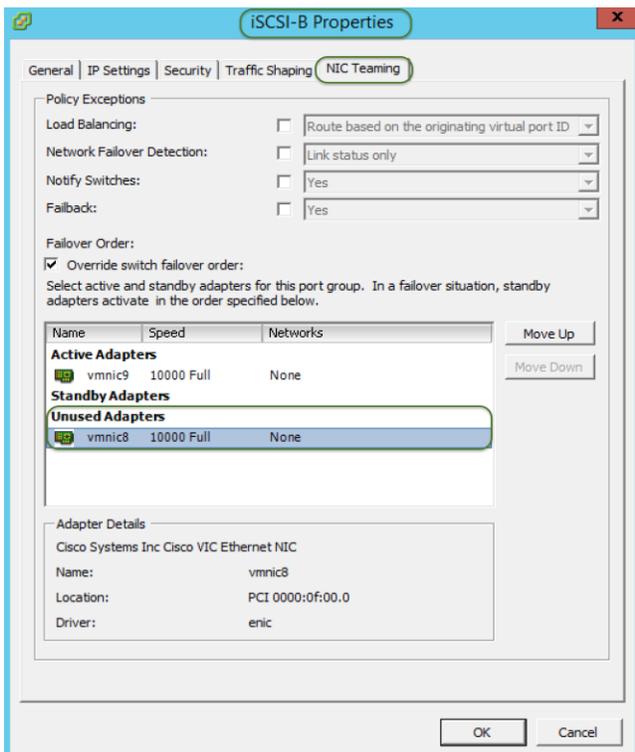
14. Change MTU for vSwitch to 9000.
15. Select the NIC Teaming tab and make both adapters active by moving the standby adapter up. Click OK.
16. Highlight the iSCSI-A VMkernel port and click Edit in the vSwitch Properties page.
17. Change the port MTU to 9000.



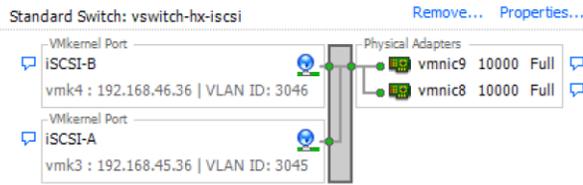
18. Select the NIC Teaming tab. Choose the option of Override switch failover order, highlight vmnic8 and move it to Unused Adapters as this adapter is for the iSCSI-B connection. Click OK.



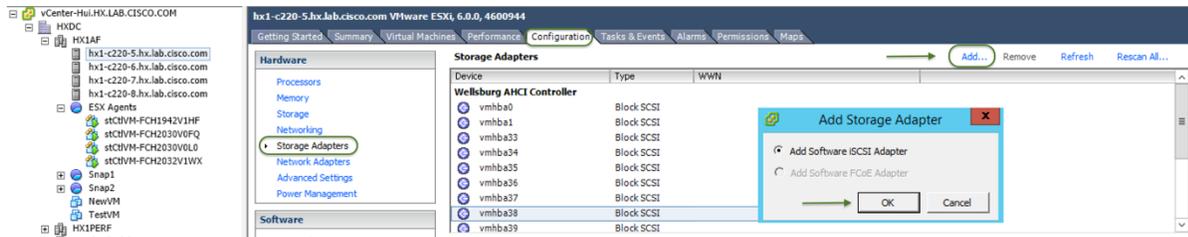
19. Highlight the iSCSI-B VMkernel port and click Edit.
20. Change the port MTU to 9000.
21. Select the NIC Teaming tab. Select the Override switch failover order, highlight vmnic8 and move it to Unused Adapters as this adapter is for the iSCSI-A connection. Click OK.



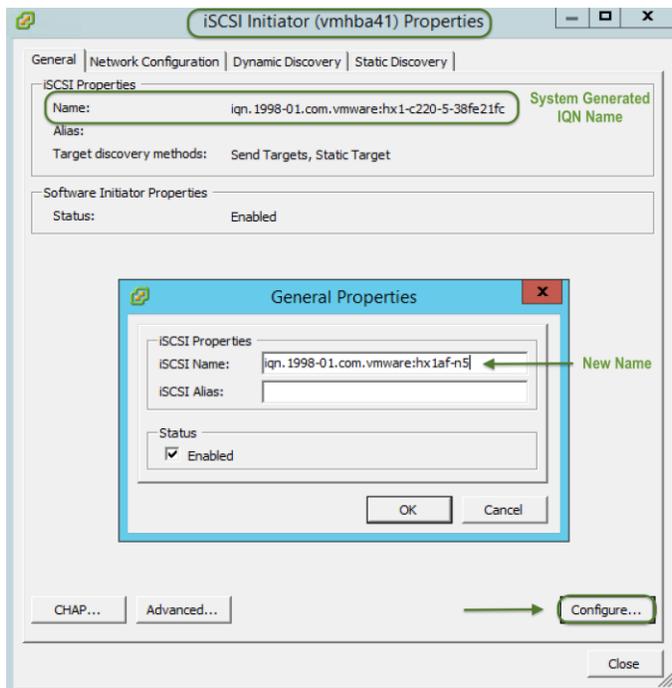
- Click Close and review the iSCSI vSwitch. Now you should have two IP addresses used in the vSwitch on separate VLANs.



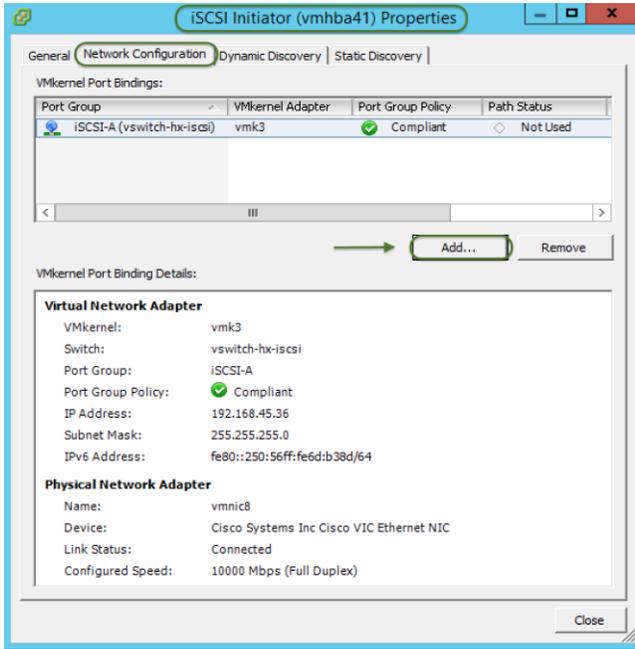
- Repeat Steps 6-22 to configure the iSCSI vSwitch for the other HX nodes in the cluster.
- Add the software iSCSI adapters on HX hosts. Select the first node of the HX cluster in the left screen, then on the right screen select the Configuration tab, select Storage Adapters in the hardware pane and click Add, then click OK to Add Software iSCSI Adapters, and then click OK again.



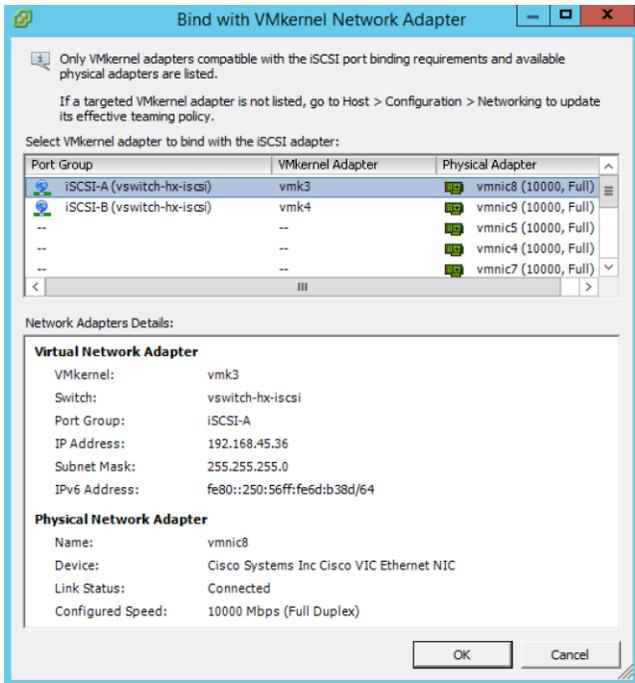
- Scroll down and right-click the newly created software initiator, right-click and select Properties.
- Click Configure to change the iSCSI IQN name to a customized name.



- Click the Network Configuration tab and click Add to bind the VMkernel Adapters to the software iSCSI adapter.



28. Select iSCSI-A and click OK.



29. Click Add again and select iSCSI-B and click OK.

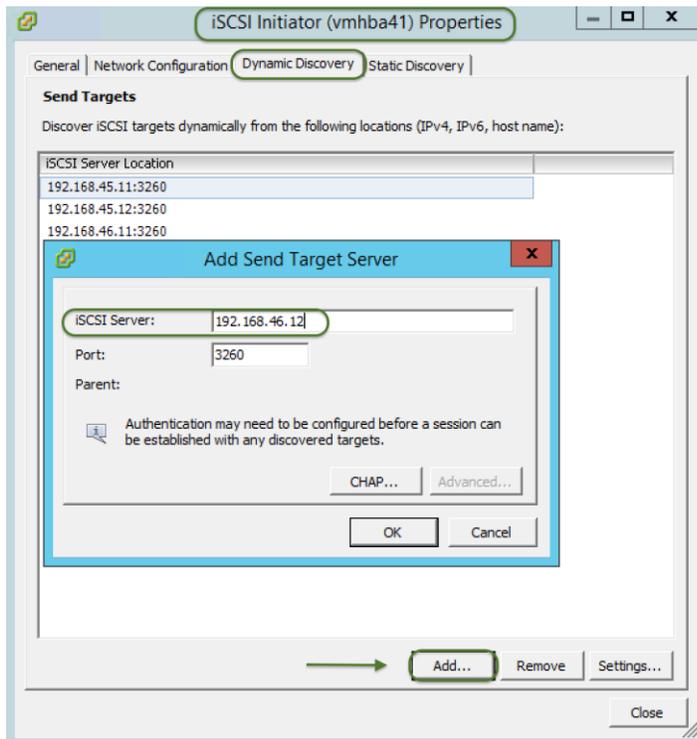
30. Copy and record the initiator name, IP addresses of iSCSI-A and iSCSI-B VMkernel ports to the following table. Save these values for later use to add to the initiator group created on the storage array.

**Table 52 HX iSCSI Initiators**

Items	Fabric A	Fabric B
-------	----------	----------

Items	Fabric A	Fabric B	
iSCSI VLAN ID			
HX Hosts	IP Address-A	IP Address-B	iSCSI IQN Name
HX Server #1 iSCSI Initiator			
HX Server #2 iSCSI Initiator			
HX Server #3 iSCSI Initiator			
HX Server #4 iSCSI Initiator			
HX Server #5 iSCSI Initiator			
HX Server #6 iSCSI Initiator			
HX Server #7 iSCSI Initiator			
HX Server #8 iSCSI Initiator			

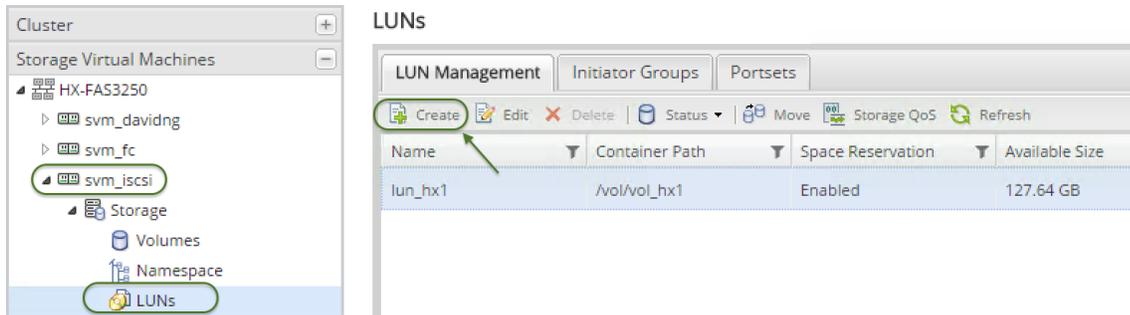
31. Click the Dynamic Discovery tab and click Add and enter the first IP address that you recorded from your storage device network interface. Click OK. Click Add again until all the interfaces for your storage controllers are entered.



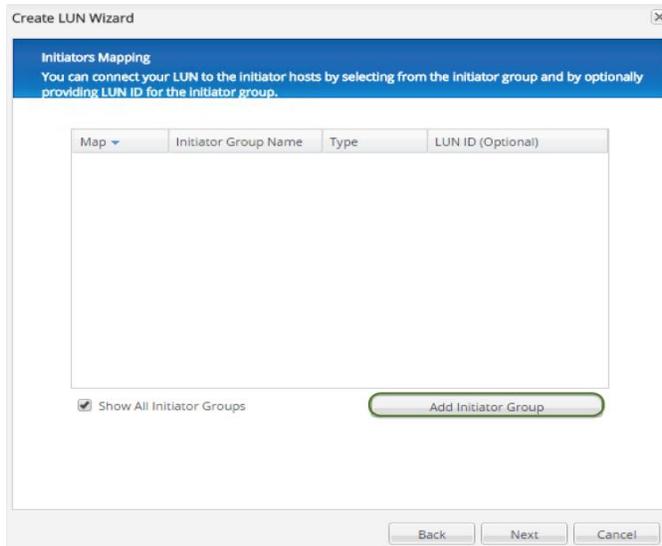
32. Click Close. You do not need to rescan the host bus adapter at this point, so choose No to the scan popup.
33. Repeat Steps 24-32 adding the software iSCSI adapters for the remaining HX nodes.

34. Now create iSCSI initiator groups and then create an iSCSI LUN on the storage system and map it to the HX system. In this example, we are using NetApp OnCommand System Manager GUI to create a LUN on a FAS3250 array. Please consult your storage documentation to accomplish the same tasks. It is assumed you have already configured your iSCSI storage as shown in the CVD.
35. Open NetApp OnCommand System Manager GUI from the web browser, select the pre-configured iSCSI Storage Virtual Machine, expand Storage, then LUNs; from the right pane, click Create. This will open Create LUN wizard.

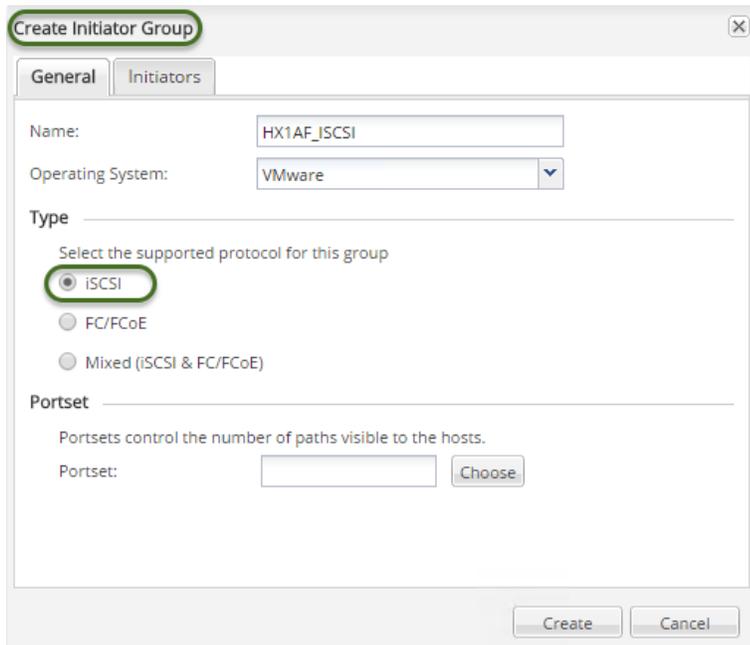
### NetApp OnCommand System Manager



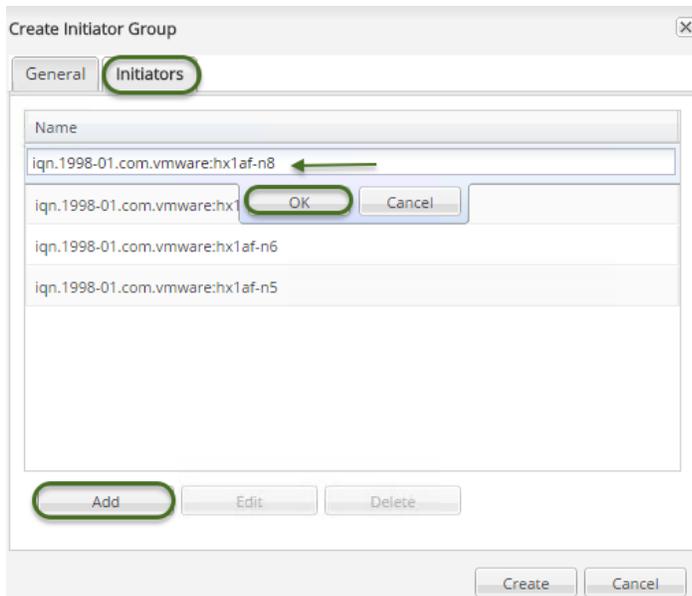
36. Click Next on the General Properties page, enter the LUN Name, Type and Size. Click Next.
37. Check “Select an existing volume or qtree for this LUN”, browse and select an existing volume, then click Next.
38. On Initiators Mapping page, select Add Initiator Group.



39. In Create Initiator Group wizard, on the General tab, enter Name, Operation System, and select Type of iSCSI for the Initiator Group to be created.

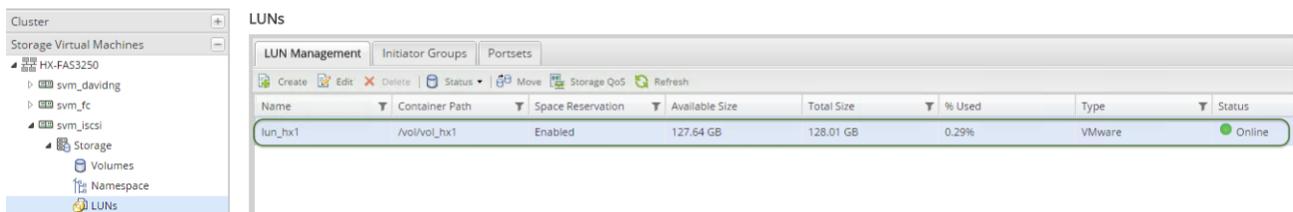


40. On Initiators tab, click Add then enter the iSCSI IQN Name of the first HX host (copy from Table 52 ), click OK.

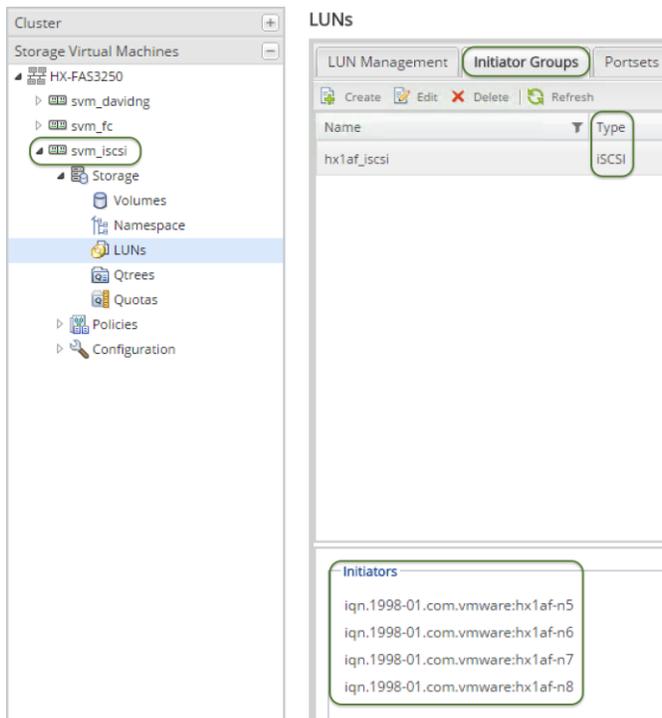


41. Repeat Step 40 until the IQN names of all HX iSCSI adapters are added. Select Create to create the Initiator Group.

42. The Create Initiator Group Wizard closes and reverts to the Initiators Mapping page of the Create LUN wizard. Select the HX initiator group that is just created, click Next three times then click Finish to complete the LUN creation.



43. Check the iSCSI initiators mapped to this LUN.

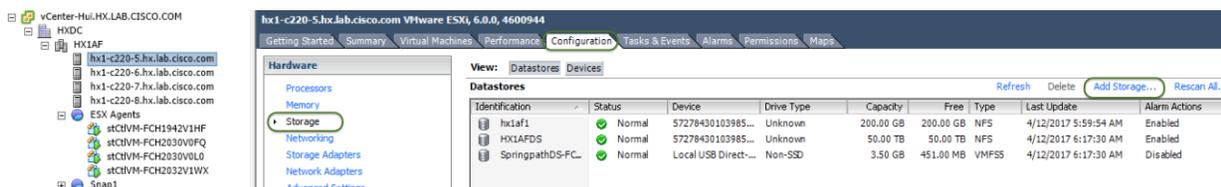


44. With a mapped LUN, you can rescan the iSCSI software initiator. Login to the vCenter again, in the configuration tab, right-click the iSCSI software adapter and click Rescan or click Rescan All at the top of the pane (do this for each host).

45. The iSCSI disk will show up in the details pane.



46. Add the disk to the cluster by selecting Storage in the Hardware pane, then Add Storage in the Configuration tab.



47. Leave Disk/LUN selected and click Next.

48. Now the NetApp iSCSI LUN will be detected. Highlight the disk and click Next, and then click Next again.

49. Enter the new Datastore name and click Next then Finish. A new iSCSI datastore for the HX cluster will be created.

The screenshot displays the vCenter interface for a VM named 'hx1-c220-5-hx.lab.cisco.com'. The 'Storage' tab is active, showing a list of datastores. The 'HXIAF-ISCSI-NTP1' datastore is selected, and its details are shown below. The datastore is a VMFSS type with a capacity of 127.75 GB and 126.80 GB free. The file system is VMFS 5.61 with a block size of 1 MB. The storage I/O control is disabled.

Identification	Status	Device	Drive Ty...	Capacity	Free	Type	Last Update
HXIAF_FC_NTP1	Normal	NETAPP Fibre Channel Disk (naa.600a09804d...	Non-SSD	119.75 G	118.80 GB	VMFSS	4/14/2017 1:51:53 PM
hx1af1	Normal	5727843010398535752-76799595100647104...	Unknown	200.00 G	200.00 GB	NFS	4/12/2017 5:59:54 AM
HXIAFDS	Normal	5727843010398535752-76799595100647104...	Unknown	50.00 TB	50.00 TB	NFS	4/17/2017 11:49:08 AM
HXIAF-ISCSI-NTP1	Normal	NETAPP ISCSI Disk (naa.600a09804d542d743...	Non-SSD	127.75 G	126.80 GB	VMFSS	4/17/2017 11:49:08 AM
SpringpathDS-FC...	Normal	Local USB Direct-Access (mpx.vmba32:C0:T0...	Non-SSD	3.50 GB	451.00 MB	VMFSS	4/12/2017 6:17:30 AM

50. You can now create VM's on this new datastore and migrate data between HX and the iSCSI datastore.

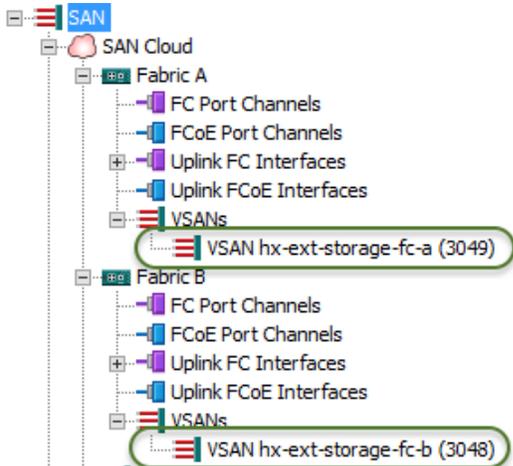
## Connecting to Fibre Channel Storage

The HX installer can guide you through the process of setting up your HX cluster allowing you to leverage existing third-party storage via the Fibre Channel protocol. It will automatically configure Cisco UCS profiles, and HX cluster nodes with vHBAs, proper VSAN, and WWPN assignments, simplifying the setup. The procedure is described [here](#) in this CVD. It is assumed that the third-party storage system is already configured per a Cisco Validated Design and all networking configuration, including Fibre Channel for connecting via the upstream switches, is completed as well. In this example, you will be using Cisco MDS Fibre Channel switches that are connected to the Cisco UCS Fabric Interconnects, which are configured with Fibre Channel unified ports in End Host mode. Changing the identity of unified ports on a Cisco UCS Fabric Interconnect requires that the FIs are rebooted, so this task should be completed prior to the installation of the HyperFlex cluster(s). The third-party storage is connected to the MDS switches.

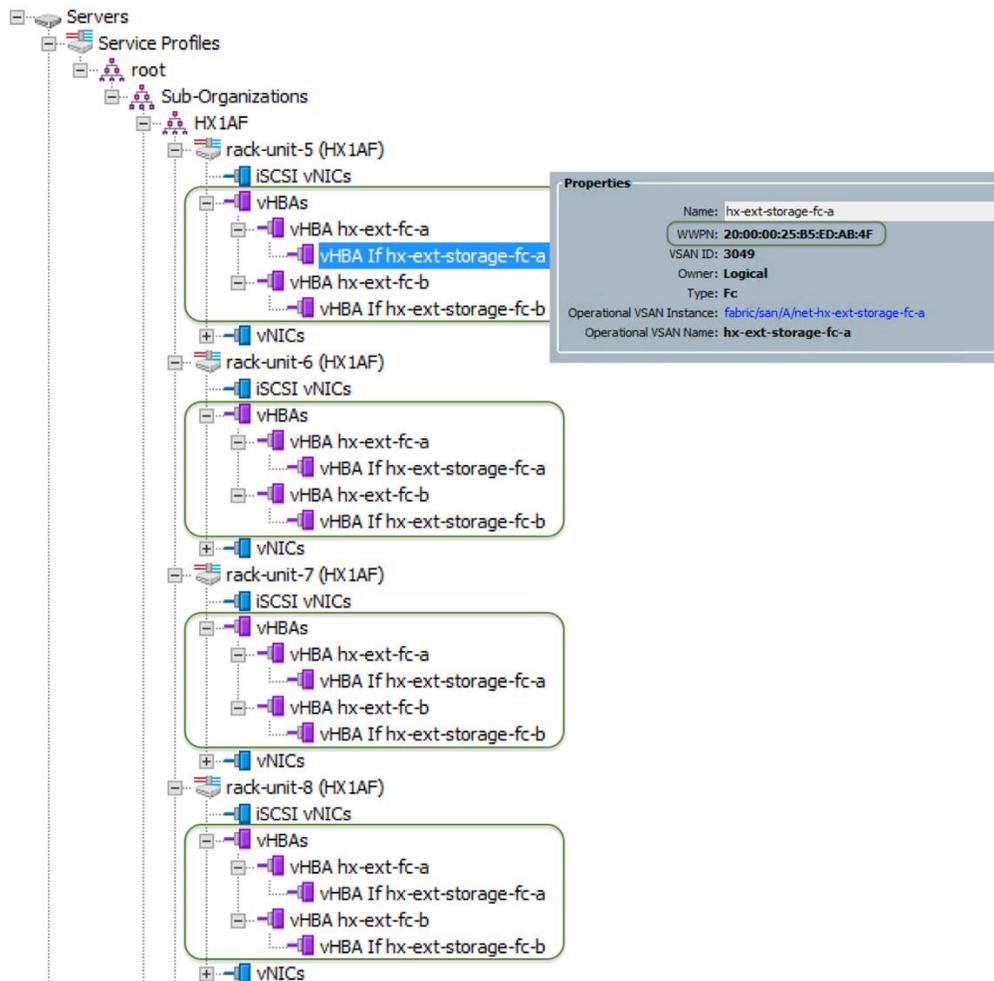


**Note:** It is required that you obtain the VSAN IDs being used in your current environment for the storage device that is already configured. This can be obtained from the SAN tab in Cisco UCS Manager, or from the upstream Fibre Channel switches.

1. Follow [these steps](#) for the HX cluster installation using the same VSAN IDs obtained from Step 1 for both Fabric A and B. Upon completion of HX install, two VSANs and two vHBAs (one for Fabric A and one for Fabric B) for each HX host will be created.
2. Open Cisco UCS Manager, Expand SAN > SAN Cloud > Fabric A > VSANs, then Fabric B > VSANs, verify the right VSANs are generated:



3. In Cisco UCS Manager, Expand Servers > Service Profiles > root > Sub-Organizations, go to the HX sub-organization you just created, verify vHBAs on all HX servers:

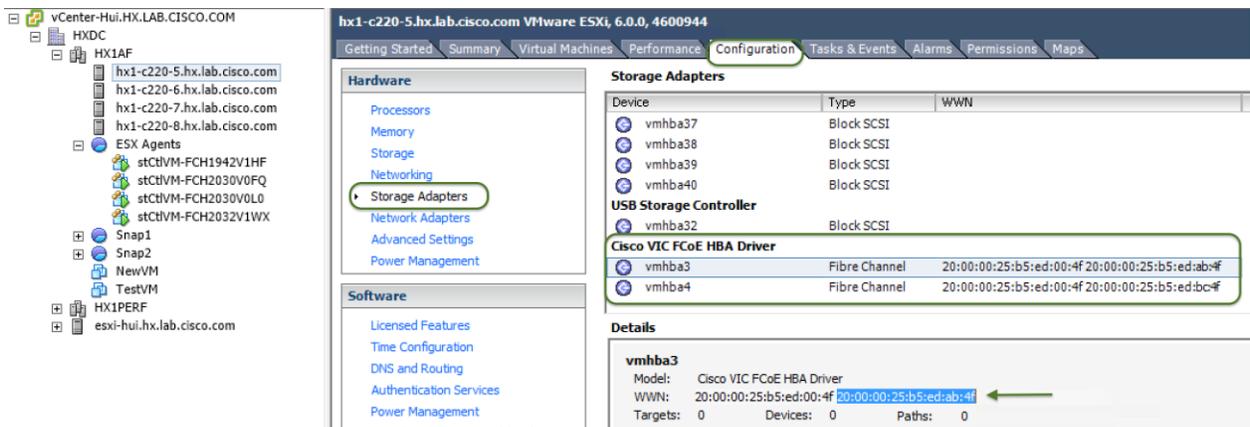


4. Record all the WWPN's for each HX node in the following table. These values are needed later for the zone configuration on the FC switches. You can copy the WWPN value by clicking on the vHBA in Cisco UCS Manager and the in the right pane, right-clicking the WWPN to copy.

**Table 53 WWPNs on HX Hosts**

Items		Fabric A	Fabric B
HX Server #1	WWPN		
	Alias		
HX Server #2	WWPN		
	Alias		
HX Server #3	WWPN		
	Alias		
HX Server #4	WWPN		
	Alias		
HX Server #5	WWPN		
	Alias		
HX Server #6	WWPN		
	Alias		
HX Server #7	WWPN		
	Alias		
HX Server #8	WWPN		
	Alias		

- Alternatively, you can copy the WWPN value on the ESXi host in vCenter on the Configuration tab > Storage Adapters > Cisco VIC FCoE HBA Driver > <<vmhba>>.



- The WWPNs for the storage ports will also be recorded. These values are needed later for zone configuration on the FC switches. You can get that information from your storage device’s management tool.

**Table 54 Storage WWPNs**

Items	Fabric A	Fabric B

Storage Device Port #1	WWPN		
	Alias		
Storage Device Port #2	WWPN		
	Alias		
Storage Device Port #3	WWPN		
	Alias		
Storage Device Port #4	WWPN		
	Alias		

7. Login to the MDS switch for A Fabric (MDS A), verify all HX vHBAs for A fabric have login to the name server and verify they are in the same VSAN as the target storage ports. Example:

```
HX1-C25-MDSA(config-vsan-db)# show flogi database vsan 3049
```

```
-----
INTERFACE          VSAN   FCID          PORT NAME          NODE NAME
-----
fc1/1              3049   0xba0000     20:1f:8c:60:4f:8d:dc:c0 2b:e9:8c:60:4f:8d:dc:c1
fc1/1              3049   0xba0001     20:00:00:25:b5:ed:ab:4f 20:00:00:25:b5:ed:00:4f
fc1/1              3049   0xba0002     20:00:00:25:b5:ed:ab:5f 20:00:00:25:b5:ed:00:5f
fc1/1              3049   0xba0003     20:00:00:25:b5:ed:ab:2f 20:00:00:25:b5:ed:00:2f
fc1/1              3049   0xba0004     20:00:00:25:b5:ed:ab:3f 20:00:00:25:b5:ed:00:3f
fc1/49             3049   0xba0020     50:0a:09:85:8d:b2:b9:0c 50:0a:09:80:8d:b2:b9:0c
fc1/49             3049   0xba0021     20:01:00:a0:98:1e:9c:9c 20:00:00:a0:98:1e:9c:9c
```

8. Complete the following steps to create the WWPN aliases using the values from the table. Example:

```
configure terminal
device-alias database
device-alias name HX1AF-N5a pwwn 20:00:00:25:b5:ed:ab:4f
device-alias name HX1AF-N6a pwwn 20:00:00:25:b5:ed:ab:5f
device-alias name HX1AF-N7a pwwn 20:00:00:25:b5:ed:ab:2f
device-alias name HX1AF-N8a pwwn 20:00:00:25:b5:ed:ab:3f
device-alias name FAS3250-010c pwwn 20:01:00:a0:98:1e:9c:9c
device-alias commit
```

9. Create the zones and add device-alias members (or PWWN members) for the HX servers. Example:

```
zone name HX1AF-N5a vsan 3049
member device-alias HX1AF-N5a
member device-alias FAS3250-010c
exit
```

```
zone name HX1AF-N6a vsan 3049
member device-alias HX1AF-N6a
member device-alias FAS3250-010c
exit
```

```
zone name HX1AF-N7a vsan 3049
member device-alias HX1AF-N7a
member device-alias FAS3250-010c
exit
```

```
zone name HX1AF-N8a vsan 3049
member device-alias HX1AF-N8a
member device-alias FAS3250-010c
exit
```

10. Create a zoneset and add the zones. Example:

```
zoneset name HX1AF-a vsan 3049
member HX1AF-N5a
member HX1AF-N6a
member HX1AF-N7a
member HX1AF-N8a
exit
```

11. Activate the zoneset. Example:

```
zoneset activate name HX1AF-a vsan 3049
```

12. Validate the active zoneset and verify that all HX vHBAs and the target storage ports are logged into the switch (indicated by the \* next to the devices). Example:

```
HX1-C25-MDSA(config)# show zoneset active vsan 3049
zoneset name HX1AF-a vsan 3049
```

```

zone name HX1AF-N5a vsan 3049

* fcid 0xba0001 [pwwn 20:00:00:25:b5:ed:ab:4f] [HX1AF-N5a]

* fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]

zone name HX1AF-N6a vsan 3049

* fcid 0xba0002 [pwwn 20:00:00:25:b5:ed:ab:5f] [HX1AF-N6a]

* fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]

zone name HX1AF-N7a vsan 3049

* fcid 0xba0003 [pwwn 20:00:00:25:b5:ed:ab:2f] [HX1AF-N7a]

* fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]

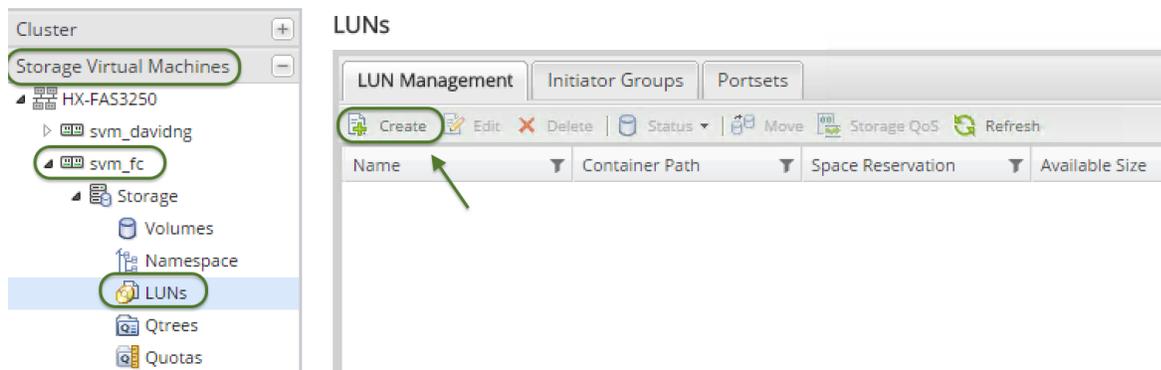
zone name HX1AF-N8a vsan 3049

* fcid 0xba0004 [pwwn 20:00:00:25:b5:ed:ab:3f] [HX1AF-N8a]

* fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]

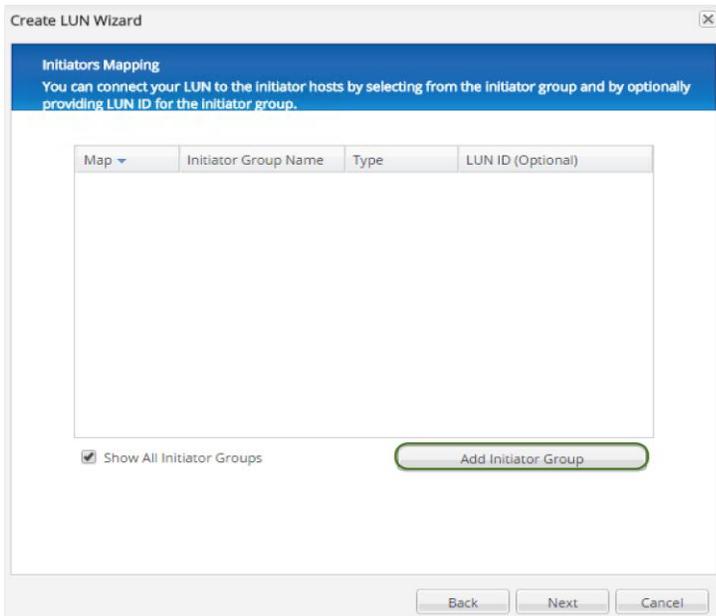
```

13. Login to the MDS switch for the B fabric (MDS B) and complete steps 7-12 to create and activate the FC zones on the B side FC fabric.
14. Create initiator groups and then create a LUN on the storage system and map it to the HX system. In this example, we are using NetApp OnCommand System Manager GUI to create a LUN on a FAS3250 array. Please consult your storage documentation to accomplish the same tasks. It is assumed you have pre-existing FC storage configurations on an array as shown in this CVD.
15. Open NetApp OnCommand System Manager GUI from the web browser, select the pre-configured FC Storage Virtual Machine, expand Storage, then LUNs; from the right pane, click Create. This opens the Create LUN wizard.

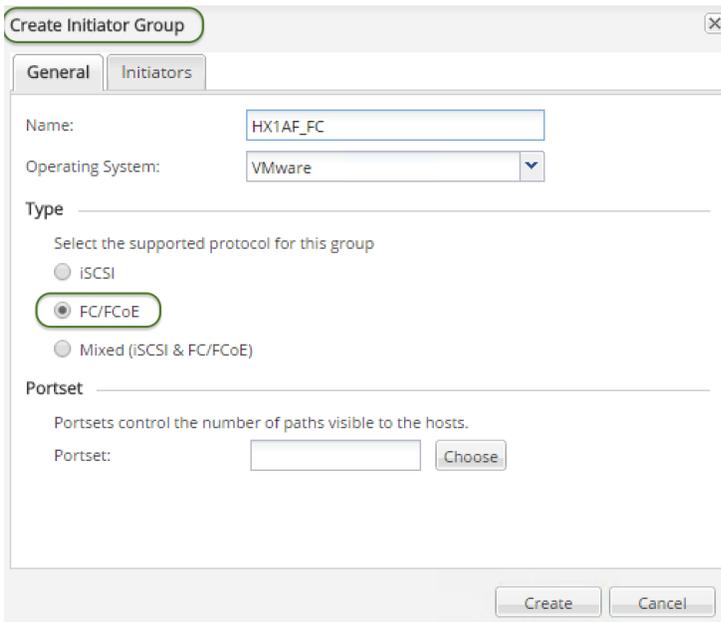


16. Click Next. In General Properties page, enter LUN Name, Type and Size. Click Next.
17. Check “Select an existing volume or qtree for this LUN” , browse and select an existing volume, then click Next.

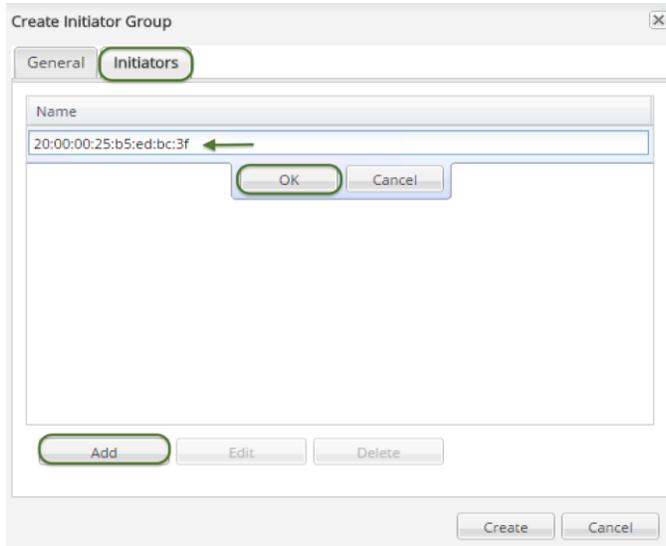
18. On Initiators Mapping page, select Add Initiator Group.



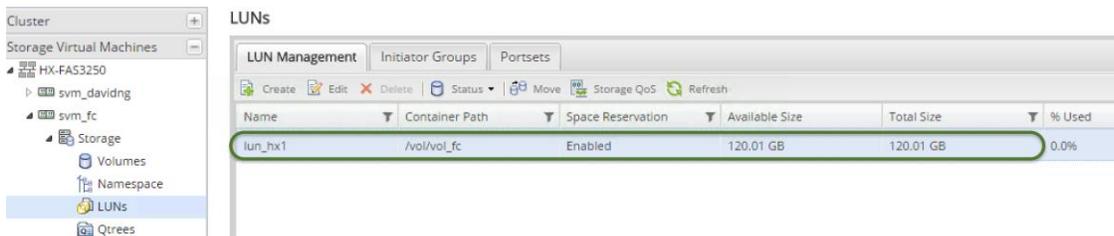
19. In Create Initiator Group wizard, on General tab, enter Name, Operation System, and select Type of FC/FCoE for the Initiator Group to be created.



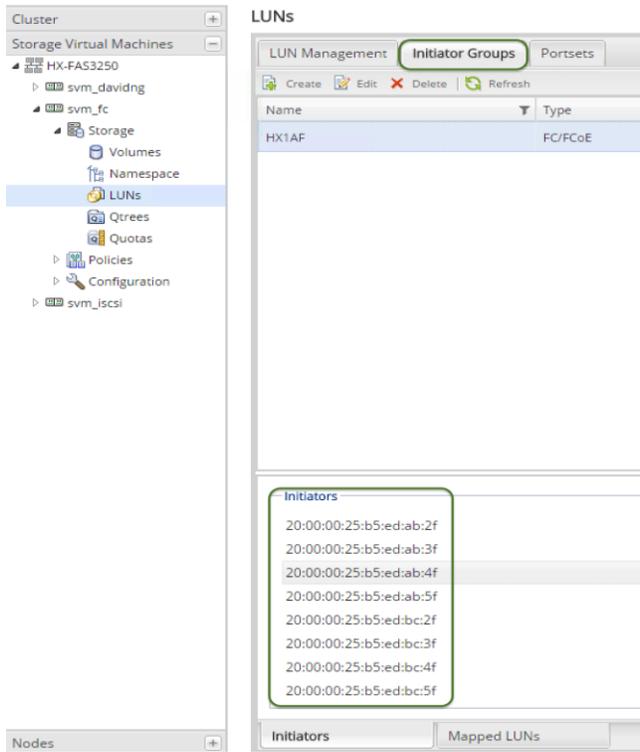
20. On Initiators tab, click Add then enter the WWPN of the first HX vHBA, click OK.



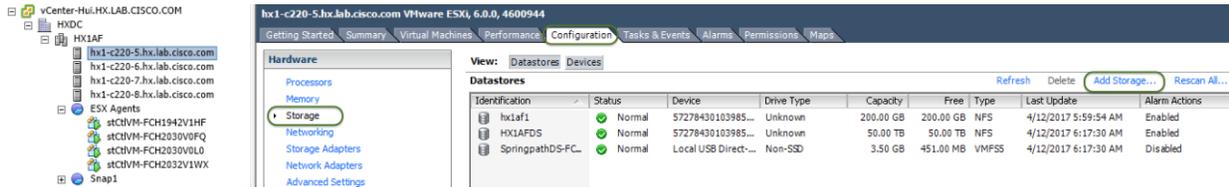
21. Repeat Step 21 until the WWPNs of all HX vHBAs (on both Fabric A and B) are added. Select Create to create the Initiator Group.
22. The Add Initiator Group Wizard exits back to Initiators Mapping page of the Create LUN wizard. Select the HX initiator group that is just created, click Next three times then click Finish to complete the LUN creation.



23. Check the initiators mapped to this LUN.

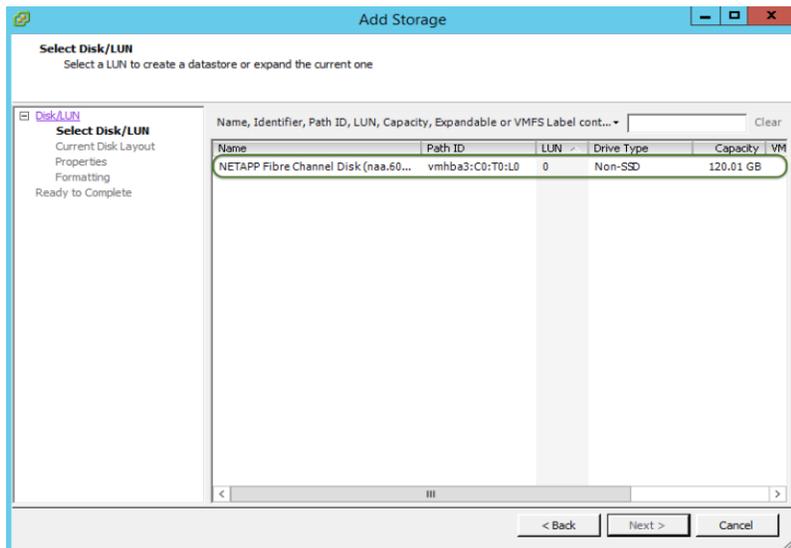


24. Return to vCenter and from the Configuration tab, select Storage, then Add Storage.

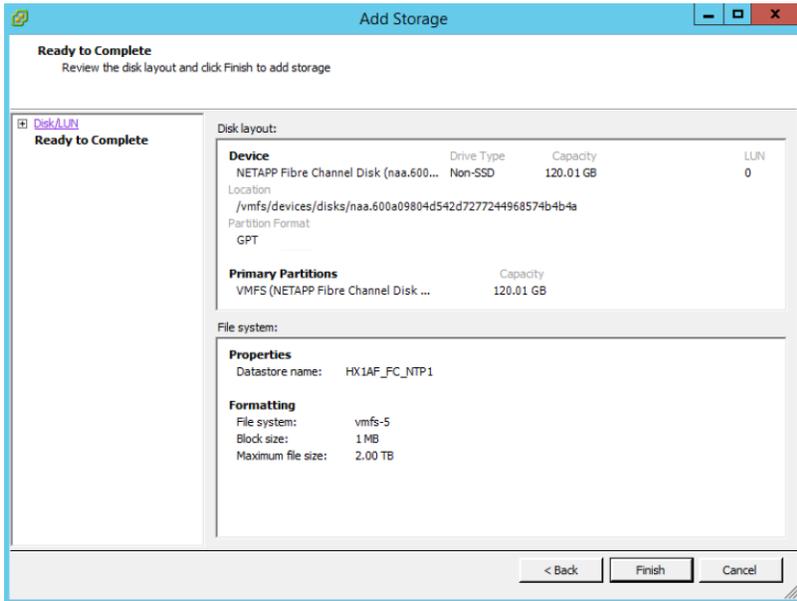


25. Leave Disk/LUN selected and click Next.

26. The NetApp Fibre Channel LUN just created will be detected. Highlight the disk and click Next, then click Next again.



27. Enter the Name of the Datastore and click Next.
28. Click Next for maximum available space as desired, then click Finish.



29. You can now review your datastores in the configuration tab, and perform storage migration of any VM's if necessary.

View: **Datstores** Devices

Refresh Delete Add Storage... Rescan All...

Identification	Status	Device	Drive Type	Capacity	Free	Type	Last Update	Alarm Actions
HX1AF_FC_NTP1	Normal	NETAPP Fibre Ch...	Non-SSD	119.75 GB	118.80 GB	VMFSS	4/14/2017 1:51:53 PM	Enabled
hx1af1	Normal	57278430103985...	Unknown	200.00 GB	200.00 GB	NFS	4/12/2017 5:59:54 AM	Enabled
HX1AFDS	Normal	57278430103985...	Unknown	50.00 TB	50.00 TB	NFS	4/14/2017 1:51:38 PM	Enabled
SpringpathDS-FC...	Normal	Local USB Direct...	Non-SSD	3.50 GB	451.00 MB	VMFSS	4/12/2017 6:17:30 AM	Disabled

## F: Adding HX to an Existing Cisco UCS Domain

For a scenario where HX nodes are added to an existing Cisco UCS domain, extreme caution is advised, as the HX installer will overwrite any conflicting configuration in the existing Cisco UCS domain, in particular the QoS system classes. A Cisco UCS firmware upgrade or changes to the configuration on the upstream switches may also be required. All of these changes can be disruptive to the existing systems and workloads, and need to be carefully planned and implemented within a maintenance window. It is recommended that you contact Cisco TAC, or your Cisco sales engineer support team for assistance when you need to connect HX nodes to an existing Cisco UCS domain.

## About the Authors

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Brian is an IT industry veteran with over 19 years of experience deploying server, network, and storage infrastructures for companies around the world. During his tenure at Cisco, he has been a lead Advanced Services Solutions Architect for Microsoft solutions, virtualization, and SAP Hana on Cisco UCS. Currently his focus is on Cisco's portfolio of Software Defined Storage (SDS) and Hyperconverged Infrastructure solutions. Brian has earned multiple certifications from Microsoft, Cisco, and VMware.

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Hui is a network and storage veteran with over 15 years of experience on Fibre Channel-based storage area networking, the LAN/SAN convergence systems, and how to build end-to-end; from the server to storage, and solutions in the data center. Currently he focuses on Cisco's Software Defined Storage (SDS) and Hyperconverged Infrastructure (HCI) solutions. Hui is also a seasoned CCIE.

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Jeff has over 20 years of experience in both Information Systems and Application Development dealing in Data Center Management, Backup, and Virtualization Optimization related technologies. Jeff works on design and test a wide variety of enterprise solutions encompassing Cisco, VMware, Hyper-V, SQL, and Microsoft Exchange. Jeff is a Microsoft Certified System Engineer with multiple patents filed in the Datacenter Solutions space.