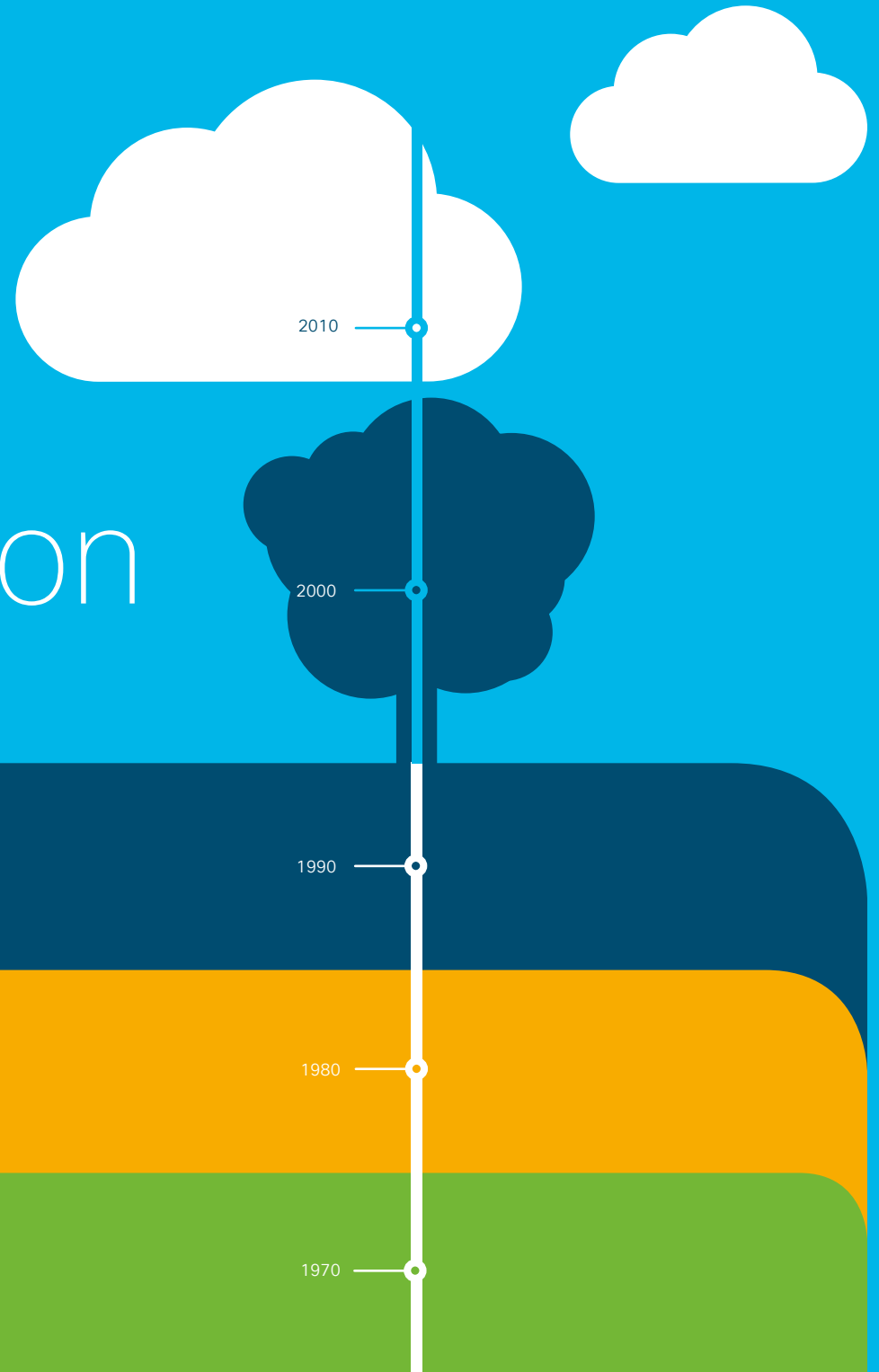




From mainframe to multicloud and intent based

Compute Evolution

A brief guide to business computing infrastructure



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Chapter 1

Timeline for computing evolution

The past decade has seen three evolutionary waves in computing infrastructure.

The first wave saw the shift from proprietary mainframes to x86-based servers, based on premises and managed by internal IT teams.

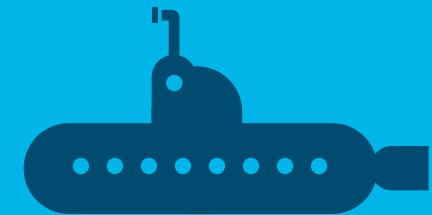
wave one

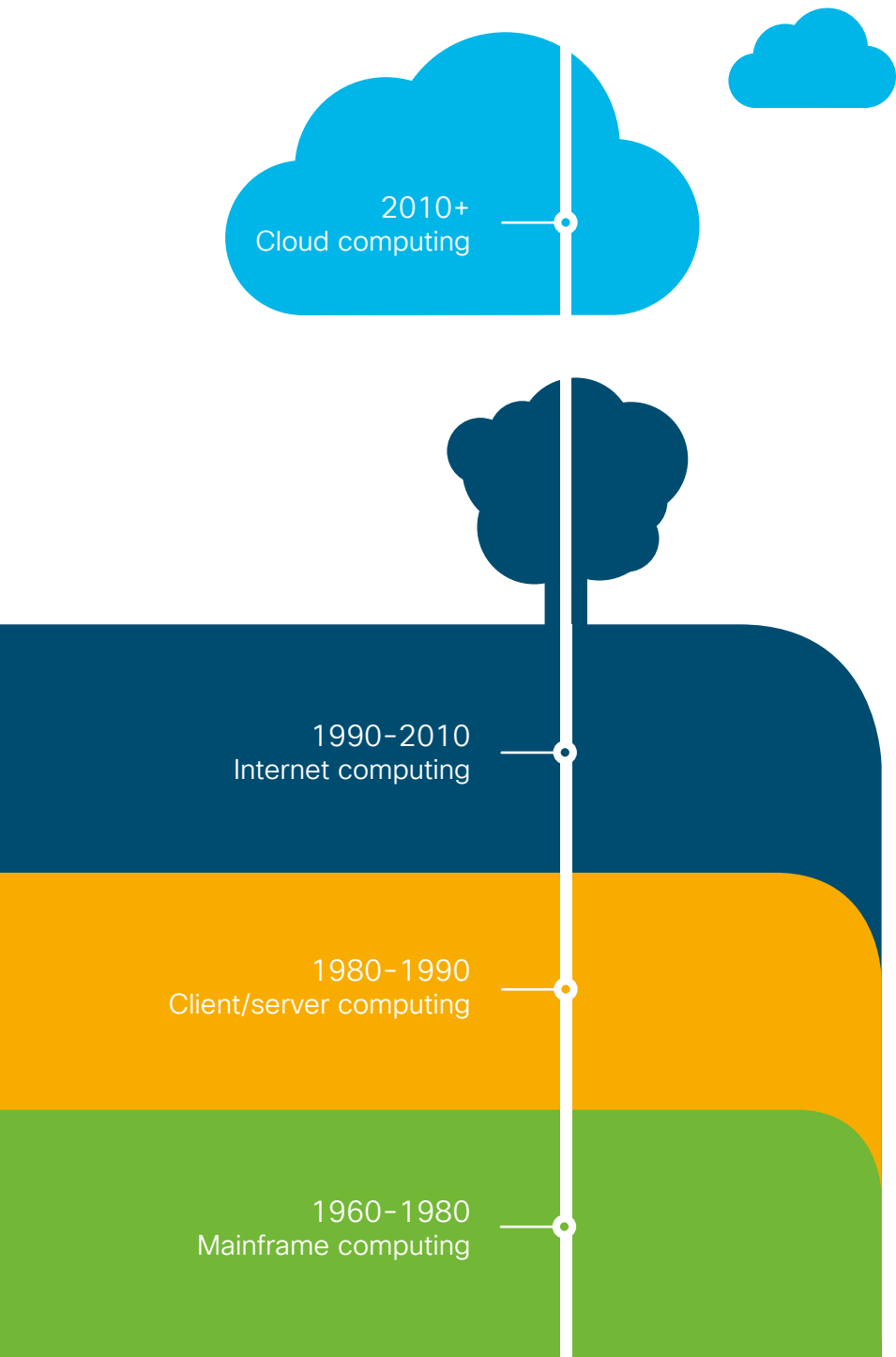
A second wave saw widespread virtualisation of the infrastructure that supported applications. This allowed for improved use of resources and mobility of workloads across pools of physical infrastructure.

wave two

The third wave finds us in the present, where we are seeing the move to cloud, hybrid cloud and cloud-native. The latter describes applications born in the cloud.

wave three





A brief history of business computing

The mainframe era gave rise to computing as a business resource.

This phase lasted about 20 years before giving way to client/server computing. As companies began to locate more employees in branch offices, we saw the emergence of internet computing.

The most recent evolutionary wave has been driven by the adoption of cloud computing, which began as a result of businesses purchasing applications using a software as a service (SaaS) model.

As businesses harness the power of cloud in pursuit of digital transformation, workloads are becoming increasingly distributed. Applications are running in public and private clouds, as well as in traditional data centres.

In the following, we explore the evolution of business computing and IT infrastructure. We also look at the options available for addressing the strategic challenges faced in the emerging multicloud world.

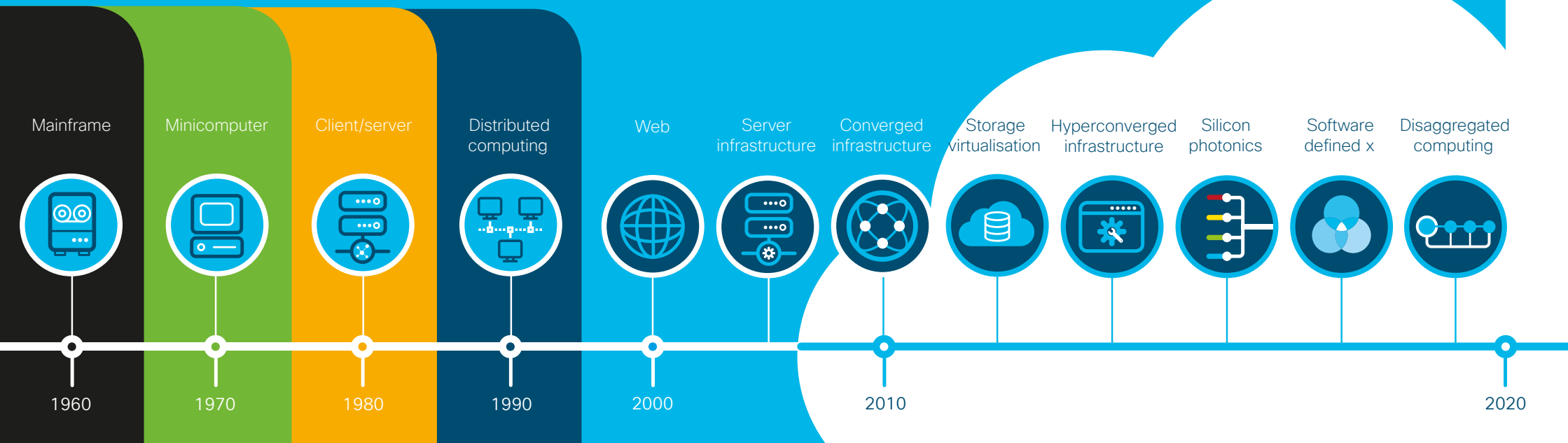
Timeline for computing infrastructure evolution

Dial back the clock 15 years or so and business computing was a relatively simple proposition: Rack mount servers with Operating Systems and applications running on top of them.

The introduction of multicore processors in the mid-2000s drove the need for virtualisation. This in turn spurred the use of centralised storage and the adoption of blades.

Then came cloud computing and a whole new generation of systems optimised for scale out environments. These are commonly referred to as 'multinode'.

More recently we've seen the advent of converged and hyperconverged infrastructure to simplify deployment and operations.



How computing infrastructure stacks up

As the virtualisation of applications became mainstream, many companies have deployed freestanding a-la-carte infrastructure with compute tied to an external storage array. The goal was to optimise resource consolidation and eliminate the silos in the data centre, reducing cost and driving efficiency.

Converged

Converged infrastructure took those same a-la-carte components and delivered them as a pretested solution or appliance to increase the operational effectiveness of those environments. In doing so, converged infrastructure increases reliability and reduces time to value for IT investments.

Hyperconverged

Hyperconverged solutions reorganise the components of converged infrastructure and are combined with software to deliver a pure appliance model. This architecture simplifies operations further.

The use of local disk combined with software virtualisation is a significant departure from the centralised storage environments most companies built previously. Hyperconverged offers the simplicity and speed of an appliance approach. There is a lot of excitement around this technology. It's suitable for specific types of workload – such as desktop and server virtualisation, test & development, and remote office / branch office (ROBO). A broader set of applications is now possible with the availability of all flash arrays.

Scale out

Scale out environments continue the trend of using local disk versus an external storage array for use cases like Big Data and cloud scale. In this model, the applications span across dozens or thousands of nodes. Availability resides in the application instead of the hardware.

Each major compute transition dramatically altered IT, and the cloud will be no different. As businesses shift to a cloud-first model, IT will be impacted in the following ways:

- The cost of computing will be dramatically reduced
- The strategic value of the network will rise
- The interdependency of the network and computing is tighter with each successive wave
- IT management is becoming more software driven

What to consider



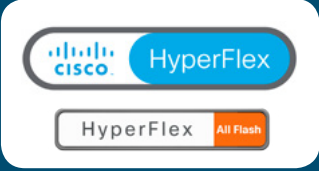





It is important to recognise that scale out architectures are a completely different application environment and so the infrastructure has evolved accordingly. On the compute side, optimised form factors are often employed, along with the use of smaller computing nodes.

Another point of consideration as we look at all of these architectural models is that many companies will have good reason to deploy some or all of these to meet the needs of the various applications and workloads their business requires.

Each of the architectures we see today has unique benefits and limitations. In many cases, these unique infrastructure configurations are a requirement for the applications they support.

The question is:

What does your data centre look like when all of these are present – nightmare or nirvana?

	Freestanding infrastructure	Converged infrastructure	Hyperconverged	Scale out
Applications				
Infrastructure				
Attributes	A-la-carte design servers, networking, SAN	Pre-engineered with app sizing Platform-level automation Flexible resource ratios	Appliance model Fixed resource ratios Storage virtualisation	Bare metal Disk-optimised rack mount servers

Chapter 2

Welcome to the multcloud world

All companies today are battling with unprecedented competitive pressures. In order to succeed – or even survive – you must rapidly adapt to constantly changing environments. It's the same scenario in every industry and sector. What does this mean for your IT leaders? Transformation, on all fronts.



The very factors driving digital transformation in businesses are pressuring IT organisations themselves to transform.



Transformation on all fronts

Digital transformation is defined as the process of creating value, growth, and competitive advantage through new digital offerings, business models, and business relationships.

The very factors driving digital transformation in businesses are pressuring IT organisations themselves to transform. Customer expectations have increased. Your business will live and die by the applications you provide to your customers and employees. A smartphone is the modern bank branch. The palm of your hand is replacing traditional brick and mortar stores. Access without delay or interruption, 24/7, is the new normal.

If your customers can't get what they want, when they want it, they go elsewhere. The cloud journey and infrastructure modernisation are integral parts of IT transformation. Public cloud is a mature business model for many companies, offering greater agility, lower operational costs and the ability to meet unpredictable demand. But that means the IT department must manage a whole new dimension of IT infrastructure over which it has little or no direct control, while also maintaining still critical private cloud and data centre responsibilities.

Transformation on all fronts

- Transformation comes in many guises
- Many businesses are operating in a multicloud environment
- IT teams must manage a whole new dimension of IT infrastructure
- Key priorities are simplicity, agility, pervasive visibility and comprehensive security

Disruption in 3 key areas

Digital transformation is driving disruption in 3 key areas:

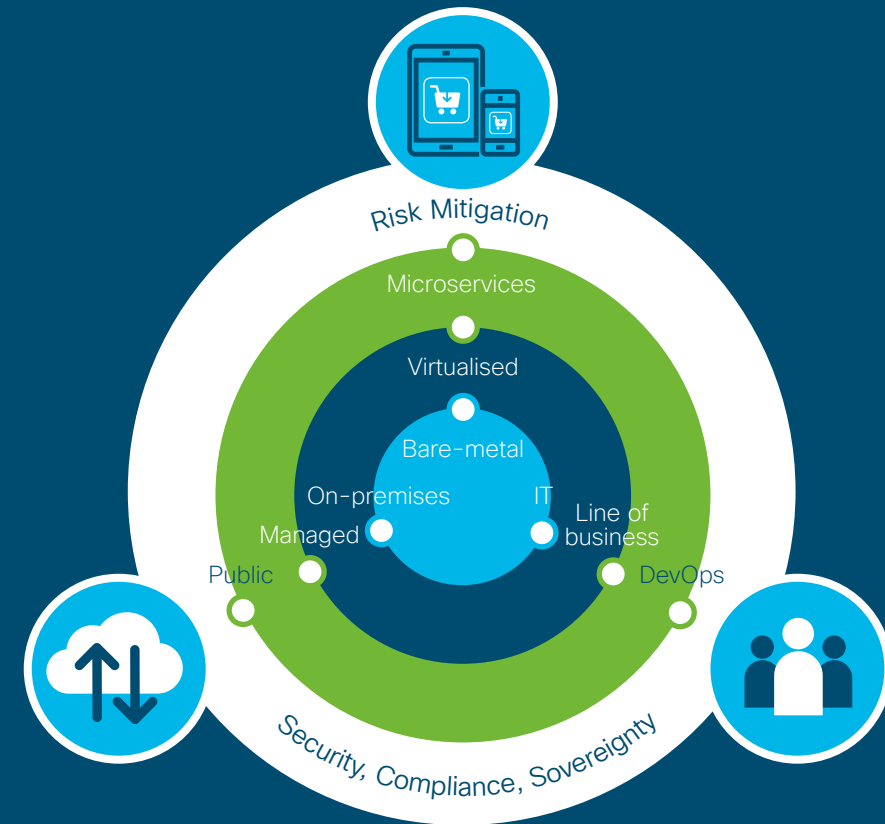
Application evolution - Modern apps are fundamentally becoming less monolithic and data centre dependent. They're mobile-enabled and hyperscale in architecture. This is creating an explosion in new end points that IT has to account for in terms of management and security.

Infrastructure management - organisations are increasingly user-centric in terms of technology adoption, purchase and deployment. Lines of business (LoBs), application developers, DevOps teams and others increasingly wield significant influence over technology decisions.

Application Location - IT teams must now manage users, applications and workloads across public, managed and private cloud environments.

Previously, IT teams could support and manage all users and applications safely behind the confines of the on-premises data centre. The big challenge for them today is that this is an "and" problem. While monolithic apps like Microsoft, SAP and Oracle are not going anywhere, IT teams have to prepare for the onslaught of modern, next generation apps delivered over containers.

As a result, IT teams must support all on-premises data centres while harnessing the agility and simplicity of private cloud and public cloud options.



IT teams have to prepare for the onslaught of modern, next generation apps delivered over containers.

Cloud the critical catalyst

As IT shifts to an as-a-service model, cloud computing becomes the critical catalyst.

Cloud opens up new worlds to companies, enabling applications and functionality to be drawn from multiple sources, whether they are public cloud-based resources, private cloud resources, or traditional internal data centres. But IT and business executives must strike the right balance between public and on-premises resources, and adapt that balance as business requirements change.

To explore how companies are progressing on this journey, Forbes Insights, in partnership with Cisco, conducted a survey of 302 top IT executives from across the globe.

Break-even point

In seeking to identify the “break-even” point between on-premises solutions and public cloud, as well as where the greatest overall value may be achieved, the survey revealed private and public clouds are largely on an equal footing.

The costs tend to even out between public and private clouds, and the Forbes’ survey suggests executives are comfortable with the security that is available with public cloud implementations.

They also gave high ratings to the levels of service they are seeing from public cloud. However, it’s worth noting that while the service level agreement (SLA) for a virtual machine (VM) and a small number of other services from a public cloud might be adequate, the SLA (if one is provided) will not match that of a private cloud.

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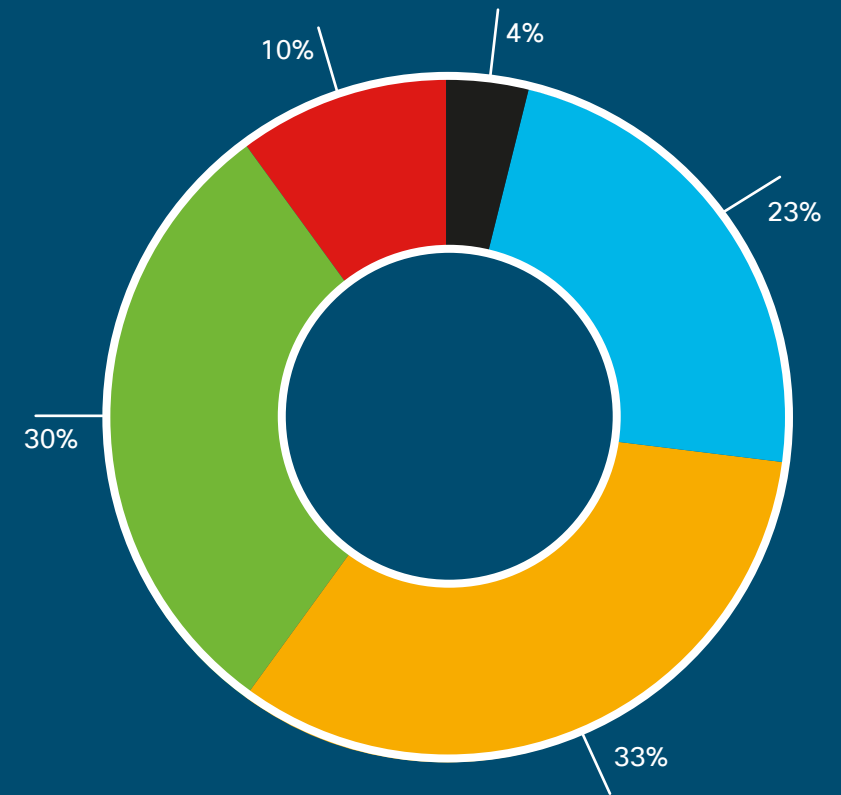
Cloud the critical catalyst

In the Forbes Insights survey, a majority of executives indicated they're employing a mix of public and private services. Hybrid or private cloud were the preferred options going forward.

Overall, the survey found 91% of executives plan to increase use of private cloud over the next two years. The point at which respondents would consider transitioning their public cloud services to an on-premises data centre are shown below.

- When OPEX + CAPEX for on premises is more than x3 greater than OPEX for public cloud services
- When OPEX + CAPEX for on premises is x3 greater than OPEX for public cloud services
- When OPEX + CAPEX for on premises is x2 greater than OPEX for public cloud services
- When OPEX + CAPEX for on premises is equal to OPEX for public cloud services
- When OPEX + CAPEX for on premises is less than OPEX for public cloud services

Source: Forbes Insights. Note: Does not add to 100% due to rounding.



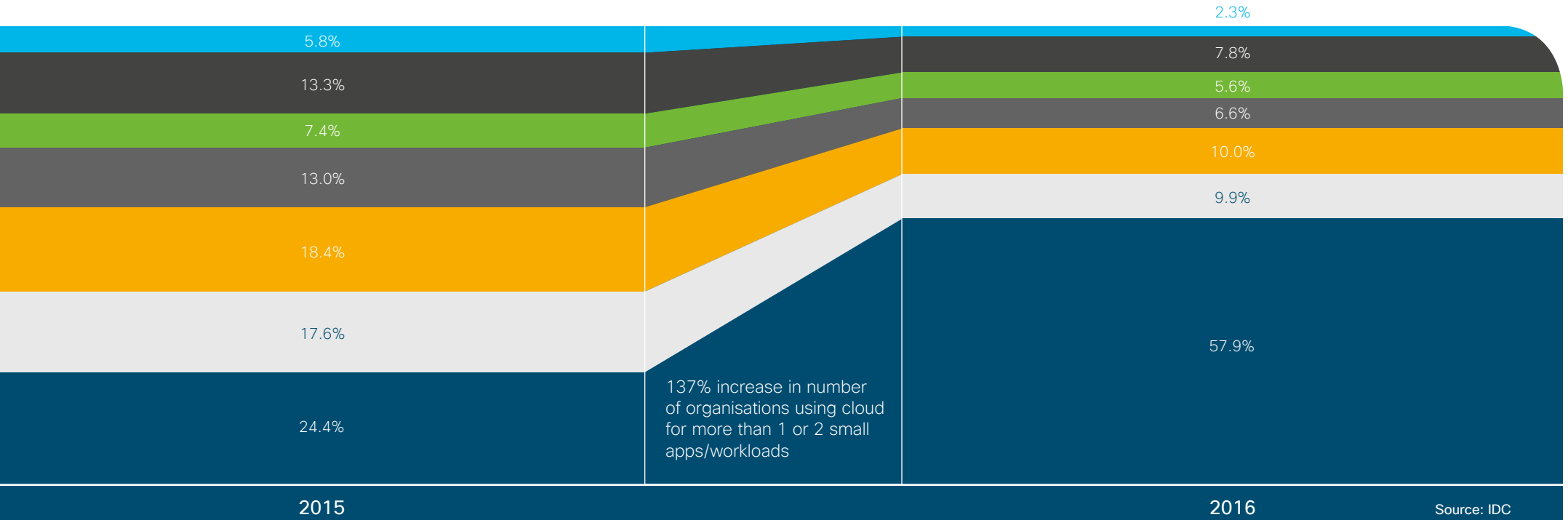
IT budgets shift

In its last CloudView Survey, IDC identified an increase of 137% in the number of companies using cloud for more than one or two workloads (during the period 2015-2016).

IDC reported that cloud computing had become an integral element of any successful digital transformation strategy, with IT budgets shifting toward cloud. More than half of companies' IT infrastructure and software investments are expected to be cloud based (private and public) by 2018, with cloud accounting for 60-70% of IT spend by 2020.

- More than one or two small apps/workloads
- 1 or 2 small apps/workloads
- Firm plans
- Evaluating
- Educating
- Not interested
- Don't know

Cloud adoption trends: 2015 versus 2016



IT budgets shift

Those embracing cloud see a multicloud world. IDC's CloudView Survey confirmed strong interest in private cloud and public cloud, with a growing percentage of respondents embracing both.

As a result, workloads are increasingly distributed – some being traditional and on-premises, some residing in hosted private clouds, and some migrating to public clouds.

Different clouds for different crowds

The public cloud tends to claim many application workloads, email, enterprise social networks and data-oriented workloads.

The private cloud typically attracts enterprise resource planning (ERP) and supply chain logistics, while conventional data centres in the main continue to host human resource (HR) applications and traditional data-oriented workloads such as enterprise content management (ECM) and data integration.

According to IDC, digital transformation and cloud are having a hugely disruptive impact on the evolution of applications and where they reside, and on infrastructure management.

Application environments are evolving, with an expanding mix of bare metal, virtualised and containerised applications.

Meanwhile, applications are becoming more distributed, more mobile and more like those associated with hyperscale environments. The rise of containers and microservices presents a number of infrastructure challenges, including the need to manage, network, and secure a proliferation of endpoints.

Enterprises implicitly understand that organisations that fail to embrace and execute on digital transformation risk significant consequences, including long-term business irrelevance.

IDC

Chapter 3

Meet the computing challenge

IT's challenge is to support legacy applications in on-premises data centres while achieving agility and simplicity through support of applications resident in public and private clouds.

The strain is growing as data centres age while an ever broader range of applications must coexist. Whether it's legacy, web, and collaboration, or business-critical applications, test and development sandboxes, or desktop virtualisation.



Devising a strategy

3 key pillars of the Cisco data centre

To develop, deploy and run business-essential applications & workloads quickly, securely, and reliably, you need a data centre that is:



Constantly learning

to continuously capture the “intent” of what your users and your apps need from every data centre across your entire multicloud domain. Intent enables automation, as the infrastructure provisions in lock-step with apps as they grow, shrink, or move during their lifecycle.



Constantly adapting

to continuously interpret the ‘who, what, when, where and how’ of every application transaction and end-user experience, as well as infrastructure utilisation. This forms “context” not only as a real-time snapshot, but also as aggregated insights over time through machine-learning techniques.



Constantly protecting

to form a close-loop process that results in an “intuitive” infrastructure across the multicloud domain. This infrastructure learns, adapts, and protects more effectively over time – i.e. it gets smarter with more use – making it possible for IT to manage both traditional and cloud-native apps with consistent security.

To date many companies have had data centres built in silos of infrastructure and associated technical operations supporting distinct applications. This environment, whilst often reliable and 'enterprise-class', is now too static and rigid to support the growing and changing demands of business today.

Manual processes and human intervention are too time-consuming, costly and error-prone for IT functions to scale the way they need to moving forward. Aging infrastructures and technologies will inevitably struggle to cope and, when coupled with an ever-increasing range of applications to be delivered and supported, the strain continues to grow.

Data centres are now less about single physical locations and much more about accessing and consuming applications and services from multiple sources. When coupled with cloud and business transformation imperatives, many companies are finding themselves at the centre of a perfect storm.

A familiar picture?

Operational: We are entering a phase where resources are not viewed at server level but at a stack level. Without a common operating model across the different architectures, this shift has the potential to increase operational complexity and decrease IT's ability to deliver with speed.

People: Operating each of these environments will often require specialisation that runs counter to the trends most organisations are trying to accelerate, which is toward broader skill sets and common process flows. From a compliance and security perspective, these silos can also represent risks as each environment may have different capabilities and associated toolsets.

Financial: These silos represent not only an operational burden, but also poor return on assets and equity. All the trapped resources and operational overhead are a tax or 'technical debt' subtracting a % of the value of each dollar spent on IT.

In the example shown below you have extra resources in freestanding infrastructure and hyperconverged silos, but are unable to share those resources with the scale out environment, which is running out of resources.

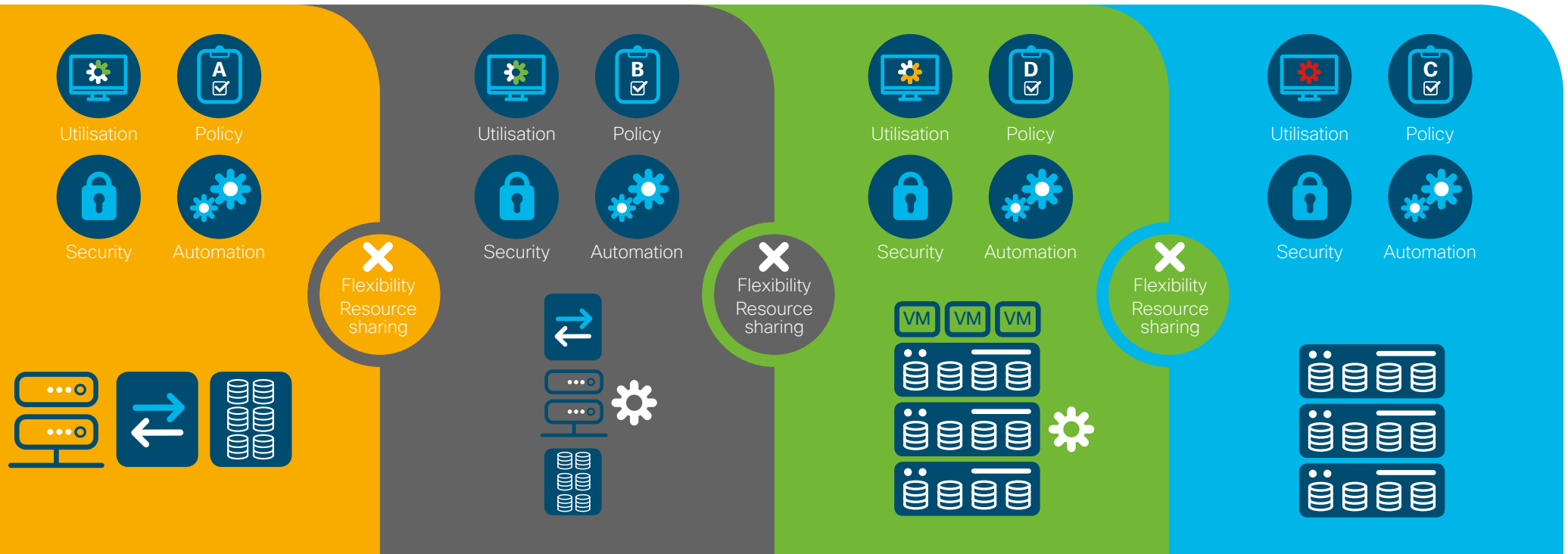
The challenge is not only picking a solution that works, but also finding the best way to automate across those solutions and share resources across these types of environments.

Freestanding infrastructure

Integrated infrastructure

Hyperconverged

Scale out



Make the right Infrastructure decisions

Wouldn't it be nice to be able to execute against incremental projects by improving capital efficiency through making the right infrastructure decisions?

Infrastructure still matters, regardless of what type of infrastructure an application dictates. Scale out versus hyperconverged versus converged infrastructure – they should be represented as a policy delivered across a single operating model. Using an object based, policy defined approach extends the operating model from the data centre out to the edge or into the cloud.

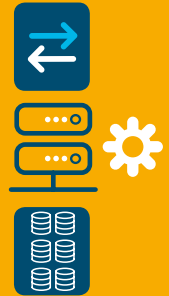
This also has significant implications in the areas of security and risk mitigation:

- Common security model improving your compliance and audit capability
- Reduction in concentration risk
- Reduction in human capital required from an operational perspective, which means a company can shift human capital from keeping the lights on to innovation and new projects

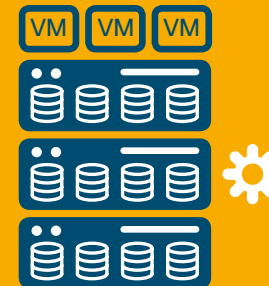
One system, one operating model



Freestanding infrastructure



Converged infrastructure



Hyperconverged



Scale out

One system for all workloads

Part of the Cisco Data Centre solution.

Cisco's object based, policy defined approach began with the launch of the Unified Computing System (UCS) in 2009. Cisco UCS is built to provide one operating environment across many architectures, regardless of the form factor, rack or blade; and regardless of the mode of operation you are using to deliver services.

The UCS portfolio spans all workload requirements and operating environments:

- Scale out / scale up
- Bare metal, virtualised, cloud, and containers
- Component, converged, and hyperconverged

All with common management – consistent, policy driven infrastructure. No operational or technology silos to accomplish what you need.

The singular elegance of UCS arises from the way management functionality is removed from individual elements (servers, networking, storage) and centralised in the fabric.

With the launch of Cisco Intersight, we've taken this centralised management and policy control engine and moved it to the cloud. You can now scale capacity without additional capex investment in infrastructure to manage infrastructure.

Using Intersight's artificial intelligence (AI)-infused, cloud-management tools you get deep insights into the state of your infrastructure. You will be able to identify issues before they become major problems and benefit from faster root cause identification.

[Explore the benefits of Cisco Intersight](#)

UCS: Common platform for workloads and locations

The Cisco Data Centre: Powered by intent. Informed by context. Delivered across multicloud.

HyperFlex Edge
UCS Mini e-Series



ROBO

Fifth Generation UCS



Mainstream computing

UCS Integrated
Infrastructure Solutions



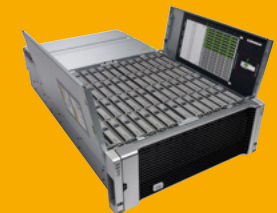
Converged infrastructure

HyperFlex Systems



Hyperconverged infrastructure

C-Series Rack Servers
UCS C3000 Series



Scale out

Edge

Cisco Intersight cloud management

Cloud

Chapter 4

Move with intent

Apps run your business. They also run across the entire multicloud domain including your private data centres, clouds, public cloud and SaaS offerings.

With the rate of change, diversity and exponential complexity within your apps, users, devices and the ever-expanding attack surface, you cannot keep pace. You need a solution that understands the “intent” of your apps, your business, and you.

The Cisco Data Centre empowers you with the flexibility to run any traditional or cloud-native application across any environment: on-premises, managed or public clouds. Built with industry-leading products and solutions, the architecture ties analytics, automation, and policy-driven security to provide you with the best aspects of data centres and multicloud.

Transform your data centre for a multicloud world with Cisco. We will help you understand how to align your business and technology objectives, while efficiently managing performance and cost structures.

[Learn more here](#)

[Chat with a Cisco specialist](#)



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