Smarter IBM Data Center for Smarter Planet

Car Mitar-Veljko
IBM Hrvatska
Experience Today the Network of Tomorrow

Welcome to the Human Network.

Cisco Expo 2009
Cavtat, Hotel Croatia
01. - 03. travanj 2009
IBM Network Integration Services for Data Center Networks

- **IBM Network Integration Services for data center networks provide design and implementation services to prepare the network infrastructure to support important data center initiatives such as consolidation, virtualization, and energy savings.**

- IBM can provide clients with a comprehensive solution designed to support today's high-availability, high-performance, security, resiliency, scalability and manageability requirements. IBM can help clients architect, design, integrate and deploy a standards-based networking infrastructure, providing the following services:
  - Architecture and design or validation of a client’s existing architecture and design
  - Integration with IBM or other servers, storage systems and existing networking infrastructure
  - Ordering support, procurement and site preparation
  - Configuration, implementation, network cabling and system testing of network connectivity, routers, switches, acceleration devices and high-availability
  - IP server connections
  - Project management.

- In IBM Network Integration Services engagements, IBM personnel use a combination of methodologies, tools, processes and training services to support the architecture, design, integration and deployment of data center networks. The network methodology employed by IBM has been successfully used and refined in hundreds of client engagements over the past ten years. In addition, IBM serves clients across geographies and in virtually every industry by providing highly trained and experienced solution specialists who can expertly manage even the most complex implementations.
Network Integration Services

Network Integration Services provide clients with

*comprehensive end-to-end technical network solutions*

designed to assist clients in deploying reliable, standards-based network infrastructures

**This service consists of:**

- **Architecture, design, integration and deployment** services for clients that require flexible, robust, and resilient network infrastructures

- **Solutions** that address complex network implementations, upgrades, refreshes, expansions, optimization, virtualization, and consolidations involving routers, switches, appliances, other networking equipment, servers, storage and cabling
IBM Data Center Networking Services

**Data Center Networking Services include:**

- Understanding the strategy that is driving changes to the data center
- Determining the networking requirements
- Comparing the current networking environment and support structure to the new requirements
- Developing a data center network architecture and design to meet business and functional requirements

<table>
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<tr>
<th>Strategy</th>
<th>Architecture</th>
<th>Design</th>
<th>Integration</th>
<th>Deployment</th>
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- Selecting vendors and components and prepare a detailed design
- Creating a roadmap for migration
- Carrying out procurement, logistics and site preparation
- Configuring, installing and testing the network
- Providing on-going maintenance support
Business drivers

Business issues driving the need to upgrade or deploy a new data center network infrastructure:

- Looking for operational cost controls and containment through server and storage consolidation, data center consolidation or data center relocation
- Plan to implement server and storage virtualization to increase device utilization
- Plan to implement centralized application delivery to reduce server sprawl and meet regulatory requirements
- Plan to move to a new data center space
- Plan to add backup or redundant data center(s)
Enterprise Data Center Evolution

Past
- Centralized – Mainframe centric
- Shared
- Limited applications
- Limited access
- Unresponsive

Current
- Distributed
- Dedicated infrastructure
- Explosion of applications
- Ubiquitous access
- Fragmented islands of computing
- Inefficient

New
- Re-centralization
- Shared infrastructure
- Transparent delivery of services
- Ubiquitous access with high bandwidth, low latency
- Efficient, dynamic and responsive
- Virtualization
- Web 2.0
- Network
- Enterprise Data Center
- New Enterprise Data Center
- Real-time data streams
- Enterprise data centers
- Data centers
Why are clients taking action now?

Multiple forces are driving a transformation of the data center

- Operational issues have IT at a break point
- Accelerated pace of business and technology innovations
- Costs & Service Delivery
- Business Resiliency & Security
- Energy Requirements
- Consolidation
- Virtualization
- Mobility
- SOA
- Software as a service
As the different areas evolve, the data center network must respond to support the changing connectivity requirements

- Consolidation and virtualization of server and storage resources will increase the performance demands on the data center network
- Centralized application delivery will increase the bandwidth demands on the wide area network
- Remote and mobile application access will drive the need for heightened user and device security
- Dynamic resource allocation (server, storage and data) will drive the need for dynamic network support
- A common management view that includes the network, built on open standards to centrally provision the virtualized resources
Why are clients taking action now?

- **Data Center Operational Cost Take-out**
  - Consolidating data center locations and servers to reduce costs
  - Server and storage virtualization to increase device utilization
  - IT cost savings that can be applied to projects that directly impact the core business.
  - Reduced cost of operations = competitive advantage

- **Operational Efficiency**
  - A more standardized and unified network, which can be easier to manage and maintain going forward
  - A single network capable of supporting data and voice allowing for the subsequent streamlining of telephony moves, adds, and changes
  - Operational efficiencies = competitive advantage

- **Responding to Marketplace Realities**
  - A more fully capable network to support business reinvention, diversification and new revenue streams
  - A single network capable of supporting integrated data, voice and video and wired and wireless communications to support customers, supply chain partners and employees
  - Business model reinvention = competitive advantage
Value Propositions

Data center network services from IBM help clients to:

- Improve an inefficient networking infrastructure
- Prepare the networking infrastructure for the addition of new technologies: hosted application delivery, application performance optimization
- Rationalize the networking infrastructure following mergers, acquisitions or years of decentralized decision making or distributed computing
- Improve business resiliency through distributed environment and standards based solutions
- Design the appropriate level of network performance, availability and future capability based on the client’s business and IT requirements
  - IBM’s data center network reference architecture provides a comprehensive design base built upon “de facto” industry standards and the collective IBM experience
- Implement the design changes to the network with minimal risk to on-going business
  - IBM’s structured delivery methodology, skilled networking personnel, project management expertise and deep experience can help mitigate the risk of unanticipated outages and increase the likelihood that the implementation project is completed on time and on budget
What is unique about services from IBM?

- Deep experience in design and deployment of data center solutions
- Experience in deploying very large-scale solutions
- Proven global delivery method and IBM Reference Architecture
- Ability to offer end-to-end infrastructure solutions
- Delivers strategic and operational resilience and security with its services
- Analyst-recognized marketplace leadership in network consulting
- Partnership and integration with leading solution vendors
- IBM’s geographic reach
  - Sales and support operations in over 160 countries
Data center network services are delivered using a methodology that is proven by over 10 years of global usage

The IBM Unified Method Framework provides a single, consistent method and enables a common language among IBM practitioners around the world delivering business solutions.

- Exploits IBM’s reference architecture, intellectual capital and knowledgebase
- Leverages IBM core business and technical competencies
- Access to global team of commonly trained and skilled professionals
- Successful project execution by following common methodology
IBM Strengths – Services

A global community of industry recognized experts and specialists

IDC has named IBM Global Services as the top market share leader in network consulting and integration services revenue each year since 1996.¹

IBM projects are governed by the industry’s leading and most comprehensive engagement methodology: the IBM Global Services Method.

IBM has a proven competency in designing and deploying large-scale, geographically dispersed mission-critical solutions.

Our internal experience in pioneering the DC is directly benefiting our clients.

IBM has gained significant operational experience, built a strong professional skill base, and developed a substantial amount of intellectual property for network architecture, implementation and operation.
IBM reusable intellectual capital

- Sales material
- Proposal material
- Services delivery material
IBM Reference Architecture

Provides a consistent IBM point of view
- Defines the full scope of data center networks
- Communicates to our clients the IBM thought leadership
- Provides input to IBM services and product development

Yields efficiency and quality delivery
- Aligns business drivers and pain points with the solution
- Improves quality and consistency of services delivery
- Reduces engagement costs by reducing time required to build client solution
- Improves skills

Architecture delivered as a reusable model vs. ‘marketecture’
With whom do we partner?

IBM does not manufacture network equipment:
- Switches
- Routers
- WAN acceleration
- Security / VPN

We partner with the industry leaders:
- Cisco
To become an innovative leader with a true competitive advantage, you need a reliable, secure, scaleable, available network—and that means an intelligent network, based on established Cisco Technology and IBM Know-how (Approx 80% of Enterprises are IBM and Cisco customers)
Cisco and IBM Relationship Today

Industry and Horizontal Solutions
- Banking and Insurance
- Retail
- Public Sector
- Energy & Utilities
- Automotive
- SMB
- IPTV
- Unified Communications
- Data Center Solution
- Integrated Security Solutions
- Wireless Offerings
- Storage Offerings

Technology Collaboration
- Software and Hardware
- Tivoli, WebSphere, Lotus, Information Management, and Rational
- System x, System p Servers, SAN Directors
- BladeCenter, Linux, Virtualization Mgmt, Microelectronics —ASICs

Senior Leadership Support
- CEO Meetings
- Senior Executive Sponsorships WW
- Sharing of visions and strategies

Channels and Marketing
- Cisco Channel Incentive Programs
- Cisco Certification Programs
- Regional Account Planning
- WW Marketing Planning and Campaigns

Demo Capabilities
- 300+ Joint Competency Centers
- UC innovation facilities WW
- Retail and FSS Exec Briefing Centers

IBM Global Services
- Robust portfolio of service offerings for Cisco (assess, design, install, manage)

Together, IBM and Cisco provide an unmatched, holistic approach to the market and our mutual customers
Case study: Implementing Catalyst 6500 with VSS in Data Center
Abstract
Implementing Catalyst 6500 with VSS in Data Center

- Customer:
  Fast growing bank with even faster growing server connectivity requirements

- Requirements:
  High port density, high availability, EtherChannel to the server

- Solution:
  VSS based on high availability Catalyst 6500 switches with multichassis EtherChannel

- Background:
  Positive previous experience with Catalyst 3750 switch clusters for server access
  More robust and feature rich platform was needed
Requirements

- Task was to design datacenter network for:
  - High availability
  - High scalability
  - Simplicity
  - Support for heterogenous server architectures

- Additional considerations were:
  - Raw performance in terms of throughput was of lower priority
  - Disaster recovery architecture is planned to use Layer 2 connectivity with DWDM/dark fiber
  - Regarding disaster recovery there is no primary or backup site, both sites are equal.

- Supported server architectures:
  - Various Intel based, most with dual NICs
  - IBM Blade center with built in Cisco CIGESM switches
  - IBM pSeries (AIX)
  - IBM iSeries
  - Sun
  - Other appliance-like servers (such as Cisco ACS-SE, Reuters)
Solution

Design choices were quickly drawn from requirements

- **Requirements**
  - Task was to design datacenter network for:
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    - Simplicity
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- **Design choices**
  - Platform selection:
    - Cisco Catalyst 6500
  - Network Architecture
    - Simple Layer 2 switched network, all routing is handled by collapsed core
  - Server attachments
    - Most servers as well as Blade Center support Etherchannel, so preferred connectivity is Etherchannel

- **Cisco Catalyst 6500 VSS was chosen because:**
  - Platform with most high availability features, high scalability
  - Customer is already using 6500 in network core
  - Multichassis Etherchannel
  - VSS is used in its simplest form and minimal hardware
Solution cont’d
Basic solution diagram

Core
VSS
Datacenter
Cat4948
Blade switches
Datacenter
Access
Servers
Solution cont’d

Key benefits:
- Minimal number of devices to manage
- Simple spanning-tree topology, almost loop-free

Components used:
- Bare minimum required for VSS
- IOS 12.2(33)SXI
- C6506 chassis
- Sup720-10G 3C
- WS-X6748 line card

Open issues:
- Handling of dual active
- Full testing of server attachment scenarios
Virtual Switching System
Virtual Switching System 1440 (VSS)

- Virtual Switching System consists of two Cisco Catalyst 6500 Series defined as members of the same virtual switch domain
- Single control plane with dual active forwarding planes
- Design to increase forwarding capacity while increasing availability by eliminating STP loops
- Reduced operational complexity by simplifying configuration
Virtual Switching System
Hardware and Software Requirements

- **Software Support**
  - Native and modular Cisco IOS are supported
  - Minimum IOS required is 12.2(33)SXH1, however current recommendation is 12.2(33)SXH2(a)

- **Supervisor—VS-S720-10G-3C/XL**
  - PFC3C/XL contains new hardware support to forward traffic across multiple physical chassis and lookup enhancements

- **Virtual switch link**
  - VS header encapsulation requires new port ASIC
  - VS-S720-10G-3C/XL Supervisor 10G port or WS-X6708-10G-3C/XL
  - 10 Gigabit Ethernet only
Virtual Switching System
Hardware Requirements

- Supported line cards
  WS-X67xx-series DFC (3C and 3CXL) or CFC (non-DFC) cards are required
  Any other type of card will be powered down during VSS initialization phase

- Supported service modules
  NAM/FWSM/IDSM/ACE 10/20 and WISM
Virtual Switching System
Dual Active Forwarding Planes

- Virtual Switch operates with a single active supervisor from a control plane perspective but with dual active forwarding plane
- Supervisor ports and all the line card in both chassis including Distributed Forwarding Engines (DFCs) are actively forwarding

VSS-Router#show switch virtual redundancy
  My Switch Id = 1
  Peer Switch Id = 2

Switch 1 Slot 5 Processor Information:
-----------------------------------------------
  Current Software state = ACTIVE
  Configuration register = 0x2
  Fabric State = ACTIVE
  Control Plane State = ACTIVE

Switch 2 Slot 5 Processor Information:
-----------------------------------------------
  Current Software state = STANDBY HOT (switchover target)
  Configuration register = 0x2
  Fabric State = ACTIVE
  Control Plane State = STANDBY
Virtual Switching System
VSL—Virtual Switch Link

- VSL (Virtual Switch Link) provides two functions
  - Control plane extension and enables synchronization of protocol states and table
  - Data forwarding when needed
- VSL is treated as system links thus many user level protocol and capabilities are restricted e.g., IP address, flow control, QoS, etc.
- VSL can only be defined with 10 Gig port on either Sup720-10G or WS-X6708
- VSL is defined by unique port-channel interface on each switch; recommended to use port from diverse line card/Supervisor

```
Switch 1
interface Port-channel1
  description VSL Link from Switch 1
  no switchport
  no ip address
  switch virtual link 1
  mls qos trust cos
  no mls qos channel-consistency

Switch 2
interface Port-channel2
  description VSL Link from Switch 2
  no switchport
  no ip address
  switch virtual link 2
  mls qos trust cos
  no mls qos channel-consistency
```
Virtual Switching System
Role Resolution Protocol (RRP)

- RRP also runs on each individual link of the VSL
- Determines whether hardware and software versions allow a virtual switch to form
- Determines which chassis will become Active or Hot Standby from a control plane perspective

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<table>
<thead>
<tr>
<th>Switch Number</th>
<th>Switch Status Oper(Conf)</th>
<th>Preempt Oper(Conf)</th>
<th>Priority Oper(Conf)</th>
<th>Role</th>
<th>Session ID Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCAL 1</td>
<td>UP</td>
<td>FALSE(N)</td>
<td>110(110)</td>
<td>ACTIVE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>REMOTE 2</td>
<td>UP</td>
<td>FALSE(N)</td>
<td>100(100)</td>
<td>STANDBY</td>
<td>9924</td>
<td>7656</td>
</tr>
</tbody>
</table>
Virtual Switching System
Virtual Switch Domain

- Domain ID is used to identify that two switches are intended to be part of the same VSS pair
- Domain ID enables multiple virtual switch pairs connected in hierarchical manner
- Only one VSS pair can participate in one domain
- Domain ID is a value between 1 and 255

```
cr2-6500-vss#sh run
...
switch virtual domain 10
switch mode virtual
switch 1 priority 110
switch 2 priority 100
```
```
cr2-6500-vss#show switch virtual
Switch mode : Virtual Switch
Virtual switch domain number : 10
Local switch number : 2
Local switch operational role: Virtual Switch Active
Peer switch number : 1
Peer switch operational role : Virtual Switch Standby
```
Virtual Switching System
Multichassis EtherChannel (MEC)

- MEC is an advanced EtherChannel technology extending link aggregation to two separate physical switches
- MEC enables the VSS appear as single logical device to devices connected to VSS, thus significantly simplifying campus topology
- Traditionally spanning VLANs over multiple closets would create STP looped topology, MEC with VSS eliminates these loops in the campus topology
- MEC replaces spanning tree as the means to provide link redundancy and thus doubling bandwidth available from access
- MEC is supported only with VSS
Virtual Switching System
Dual Active

- VSL is the heart of the VSS functionality
- Protecting VSL link bundle is the best practice design
  - Use one port from Supervisor and other from line cards to form a VSL bundle
  - Use diverse fiber path for each VSL links
  - Manage traffic forwarded over VSL link by avoiding single homed devices
- In case of loss of all members of the VSL bundle, the standby supervisor will go active, creating dual active condition
- Dual active leads to
  - Two independent routers with same control plane information e.g. IP address, router ID etc.
  - Error disabling of access-layer due to two STP BPDU sent with different source MAC
- Two mechanism to provide dual active state detection and recovery
  - Enhanced PAgP
  - BFD
Ensuring the availability of the VSL link is a **high** priority. Redundant fiber paths recommended to protect against physical fiber failures.

Deploy ePAgP where possible to get the best convergence. IPBFD will be replaced in next release to have substantially better convergence.

ePAgP can be run either on L2 or L3 MEC.

ePAgP only needs to be run on a single neighbor however, leveraging enhanced PAgP on **all** interfaces will ensure that in the worst case at least **one** switch (assuming that not all cable paths are affected in the failure condition) is connected to both members of the same VSS pair then a path will exist for the recovery.
Core Attachment

- On VSS side, Multichassis EtherChannel is used
- On Core side, regular Etherchannel is used
- Ports in channel are distributed across modules on core side
- EtherChannel interfaces are used in L2 trunk mode because we are using VSS as L2 switching platform only
- L3 is handled in core switches and FWSM
Server Attachment

- 4 distinct scenarios developed
  
  Due to logistic issues scenarios are not yet fully tested

- Single homed servers – low priority
  
  Also servers/devices utilizing other forms of redundancy
  
  Uses Catalyst 4948 access switches

- Single homed servers – high priority
  
  Rare cases only, interim solution

- Dual (multiple) NIC servers – high priority
  
  Servers capable of EtherChannel

- Blade Center with CIGESM
  
  CIGESM is switch derived from Catalyst 2950 and built into IBM Blade Center
  
  Blade Center contains two CIGESM with 4 external Ethernet ports on each CIGESM
Server Attachment 1

- Single homed servers – low priority
  Applicable also to servers with other forms of inherent redundancy

- On VSS side, Multichassis EtherChannel is used

- On Datacenter access side (Cat4948), regular EtherChannel is used

- EtherChannel interfaces are used in L2 trunk mode
Server Attachment 2

- Single homed servers – high priority

- Server attached to port on one of VSS member switches

- Interim solution
  Legacy server HW or OS are not yet capable of some form of dual attachment

- Scenario will be phased out as servers become dual NIC capable
Server Attachment 3

- Dual (multiple) NIC servers – high priority

- On VSS side, Multichassis EtherChannel is used

- Server attached to one port on both of VSS member switches

- Requires interaction with platform specialists to get Etherchannel running
  
  RBA server specialists have some experience with Etherchannel

- Portchannel interfaces can be used in access mode or trunk mode (Logical Partitions, Virtualization)
Server Attachment 4

- Blade Center with CIGESM

- On VSS side, Multichassis EtherChannel is used

- On Blade Center side (CIGESM), regular Etherchannel is used

- EtherChannel interfaces are used in L2 trunk mode

- Link between CIGESMs is tuned not to carry server VLANs

- Blade center/blade servers/CIGESM utilize their own mechanisms for internal server attachment redundancy and failover