Abstract

SAN management today can be a complex task made even more complicated by multiple vendors, various types of software tools and heterogeneous devices. Even as the cost of storage continues to fall, the cost of managing that storage has become an even greater management burden. Management will continue to be a problem if administrators need four or five consoles to manage different storage platforms. As a result, administrators are demanding a single, integrated management pane of glass.

The Storage Management Initiative Specification (SMI-S) addresses these management pain points by defining an open system standard API that links distributed management applications (clients) with device management support (agents). The interface enables applications to manage multivendor SAN environments by allowing storage management systems to identify, classify, monitor and control physical and logical resources. SMI-S will make it possible for a variety of management tools to control and initiate management actions with a variety of storage systems such as tape and disk systems.

In this tutorial, you will learn the joint Hewlett-Packard and Brocade vision for the next generation of storage management and how these companies are developing management software utilizing the SMI-S standard.

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Benefits

- Benefit 1:
  - Learn how SMI-S can provide a standard management interface for managing SANs.
- Benefit 2:
  - Understand how SMI simplifies the management of fabrics, including zoning, and the management of the components in the fabric, including switches, extenders and HBAs.
- Benefit 3:
  - Understand how SMI simplifies the management of storage arrays, including tasks such as volume creation, storage pools, replication and LUN masking and mapping.

SMI-S: Reducing the Complexity of Managing Multivendor, Heterogeneous Storage Environments

John Crandall - Brocade Communications Systems
Steve Jerman - Hewlett-Packard Company

The Authors

Stephen Jerman is a Distinguished Technologist within the Network Storage Solutions Division of Hewlett-Packard. He has been involved with the development of CIM/WBEM as a storage management interface since 1998 and is one of the principle authors of the Storage Management Initiative Specification. Mr. Jerman is chair of DMTF's System and Devices Working Group, where he focuses on storage models. He is a core member of the SNIA Technical Steering Group for SMI-S.

John Crandall is a senior engineer at Brocade and is responsible for ensuring standards integration in the Brocade architecture. He works closely with SNIA and DMTF to develop, drive and promote standards to simplify management of heterogeneous SANs. He was one of the original architects of the Bluefin Specification and is a principal author of SNIA's Storage Management Initiative Specification and a core team member of its steering group. He chairs SNIA's Fibre Channel Technical Work Group, is SNIA's liaison to the DMTF Technical Council and is vice chair of the DMTF System and Device Work Group.

Agenda

- Why SMI-S?
- What is SMI-S?
- Overview of SMI-S at HP
- Overview of SMI-S at Brocade
- Future roadmap.
- Technical Detail

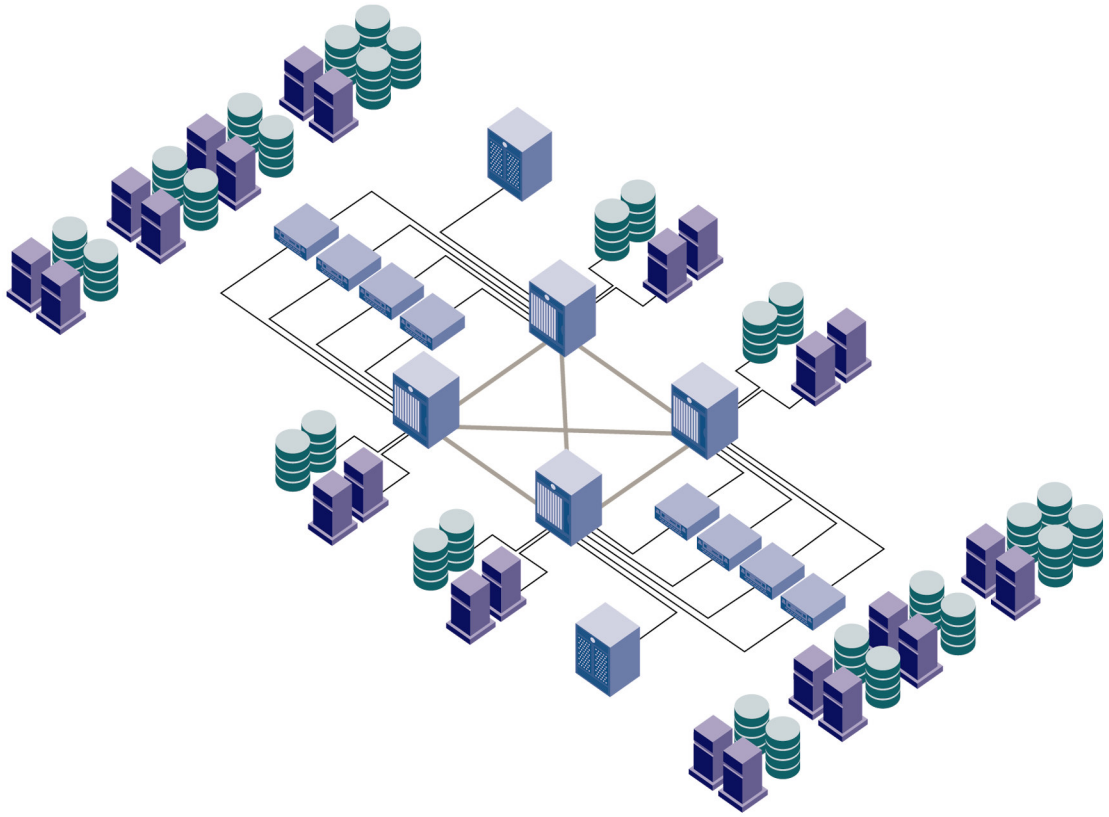
Why SMI-S?

“Yet another standard? You must be joking?!”

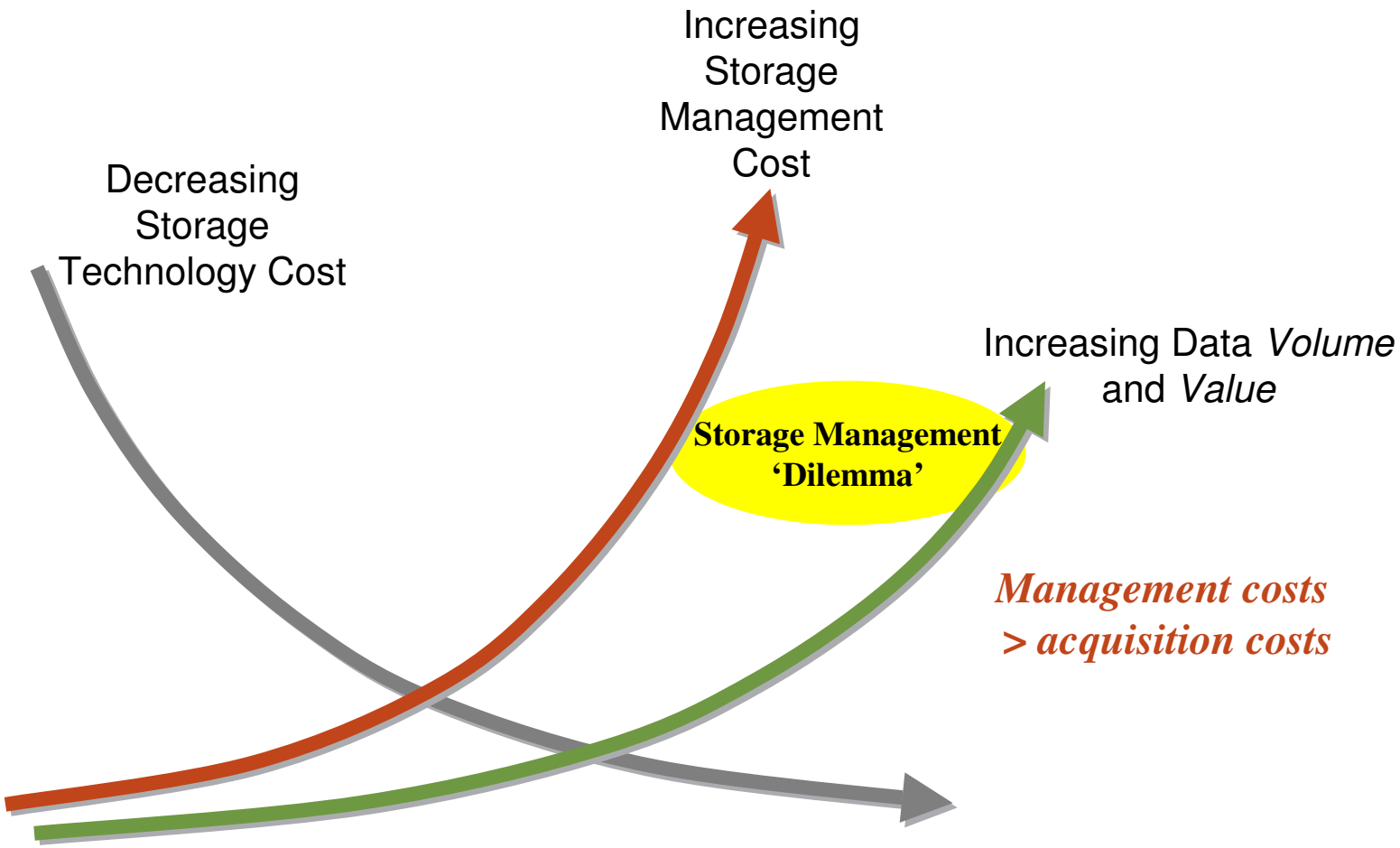
AJ Casamento

Solutioneer, Brocade Communications

The SAN is growing



Why is storage management important?



SMI-S Cost Benefits

Feature	Effect	Result
Loosely Coupled Architecture	Less Strict Interfaces	Lower Support Costs
Third Party Tools	Less proprietary content	Lower Development Costs
Standard Interface	Easier to learn	Lower Development Costs
Industry Standard Documentation	Less Custom Documentation	Lower Production Costs
Conformance Suites	Less Testing	Lower Development Costs
Standard Solution	Parallel Dev and Partner validation/ More Tools	Faster Time to Market Better Image

Storage Management Automation

In the old days, airplanes were a very hands-on activity…

More complex, but easier to use!

Today:

Commercial Aircraft can be monitored… rather than flown

What is SMI-S?

The Storage Networking Industry Association

- The SNIA Mission
  - To ensure that storage networks become efficient, complete, and trusted solutions
- The SNIA Vision
  - ***Accelerate*** new technology development and evolution of standards
  - ***Define*** smart, collaborative, rigorous methods
  - ***Collaborate*** with the IT community to address relevant business issues
  - ***Deliver*** materials, programs and services
  - ***Educate*** and evangelize acceptance among vendors and IT professionals

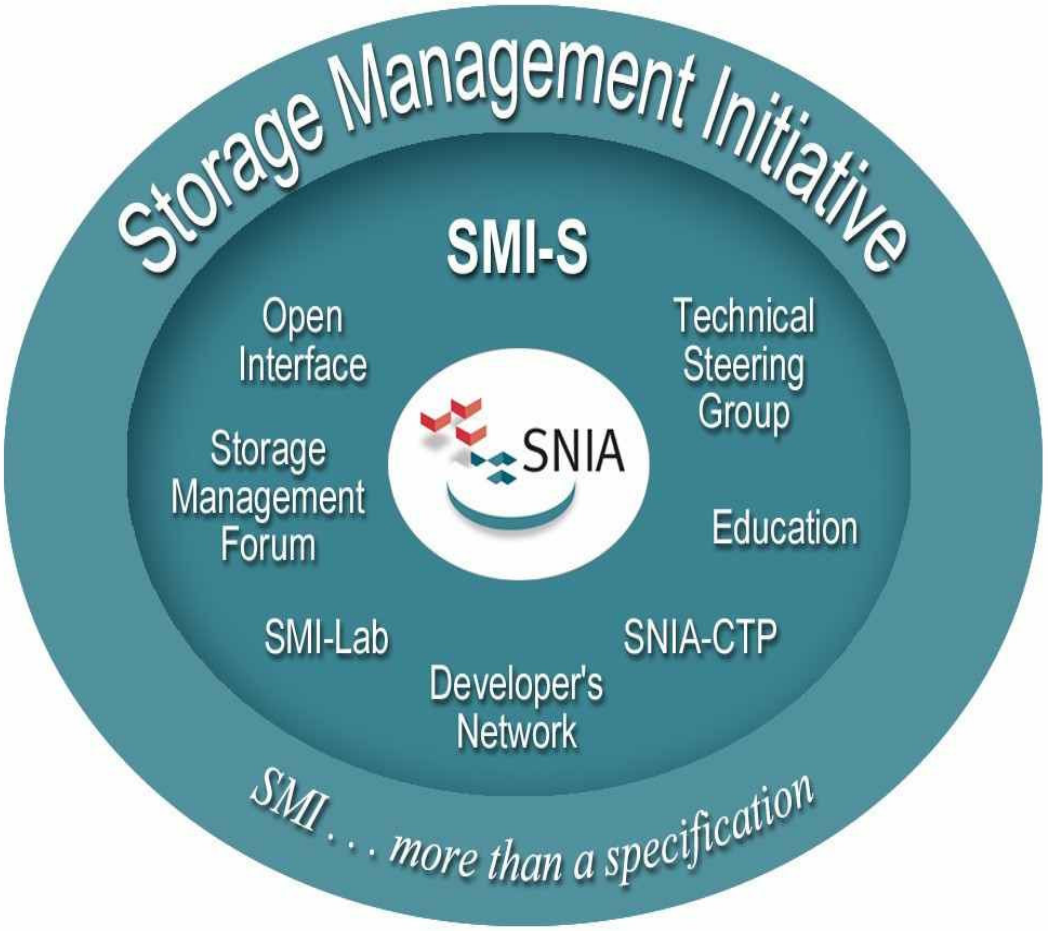
Storage Management Initiative

- What is it?
  - Standard for storage devices & software used to manage devices
  - Owned & developed by Storage Networking Industry Association (SNIA)
  - Overall goal: to provide open & interoperable environment for storage management
    - Provides end users with multi-vendor management
    - Reduces cost barrier towards implementing new storage technologies
  - Storage Management Initiative Specification (SMI-S) version 1.0 released July, 2003
    - Common services defined for user interface, recipes, profiles
  - Goal of SNIA: all storage managed with SMI-S by 2005

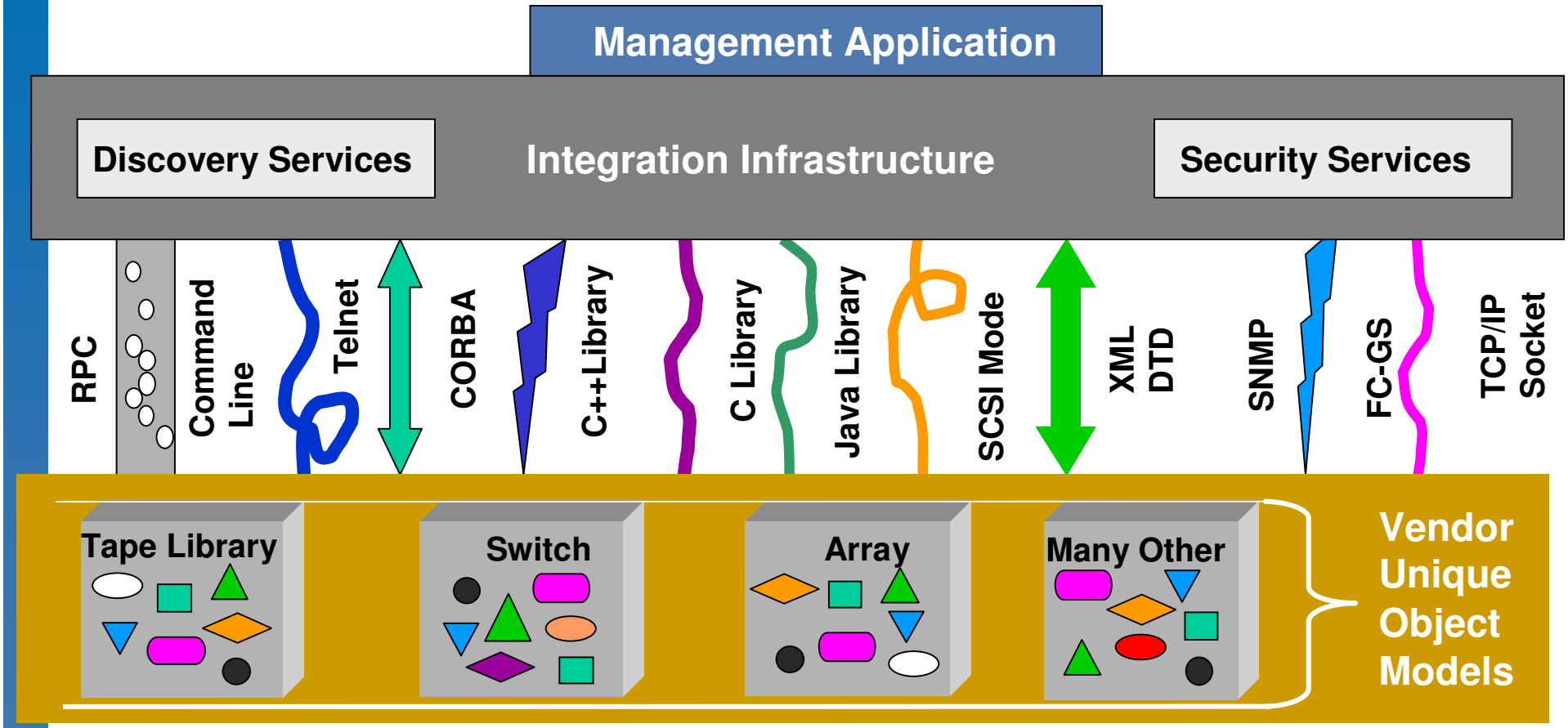
SMI-S Benefits

- Storage Vendors/Integrators
  - Standard eliminates the need for custom integration (proprietary APIs)
  - Faster time to market of new solutions – focus on higher value functionality
  - Streamlines testing matrix
- End-Users
  - Reduces complexity of storage management
  - First steps towards real interoperability rather than power point interoperability
  - SNIA CTP Conformance Testing provides additional assurance that reduces risk in deploying storage management solutions
  - Enables leverage across business solutions
  - Allows implementation of larger storage infrastructures without increasing personnel costs

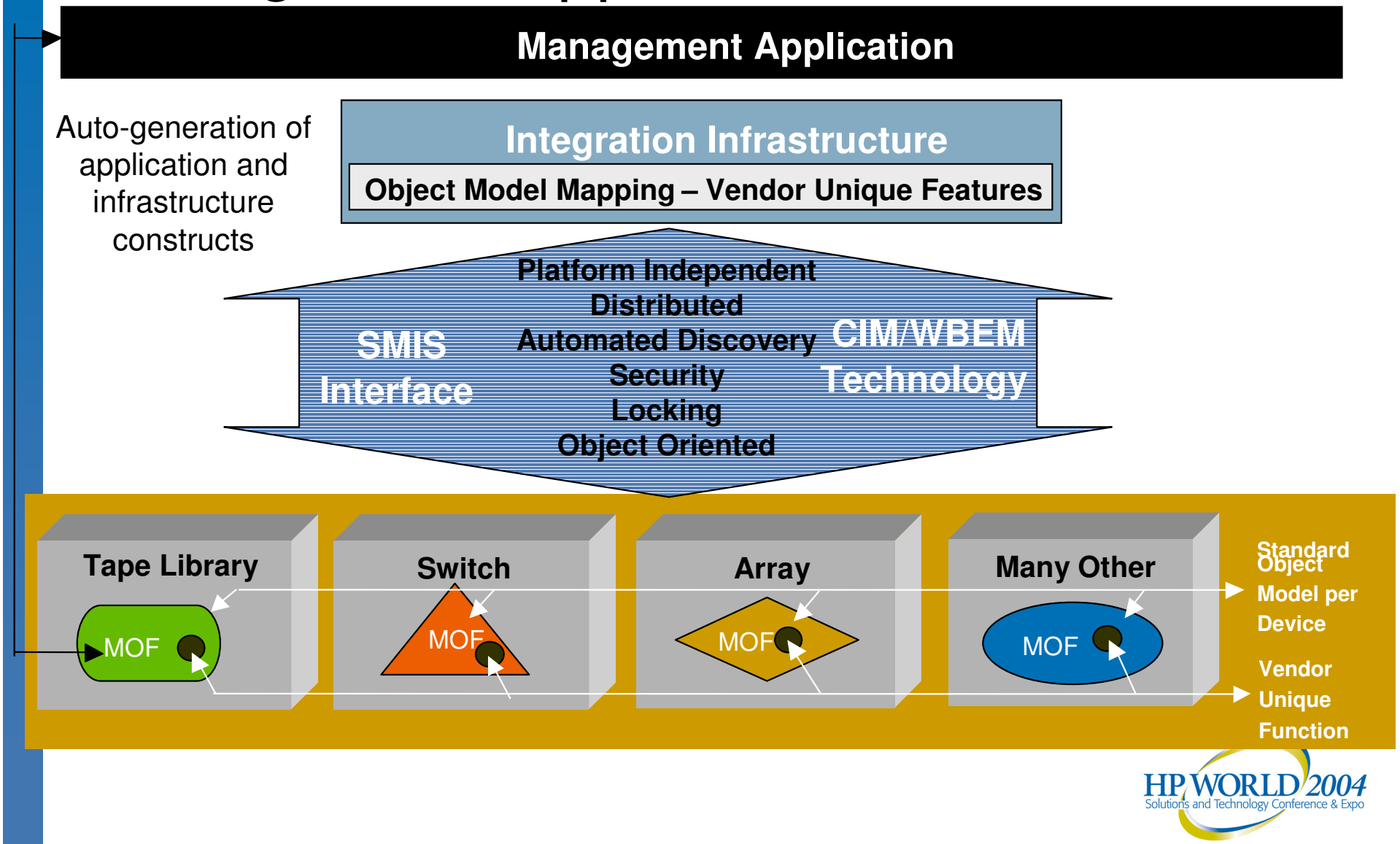
Storage Management Initiative



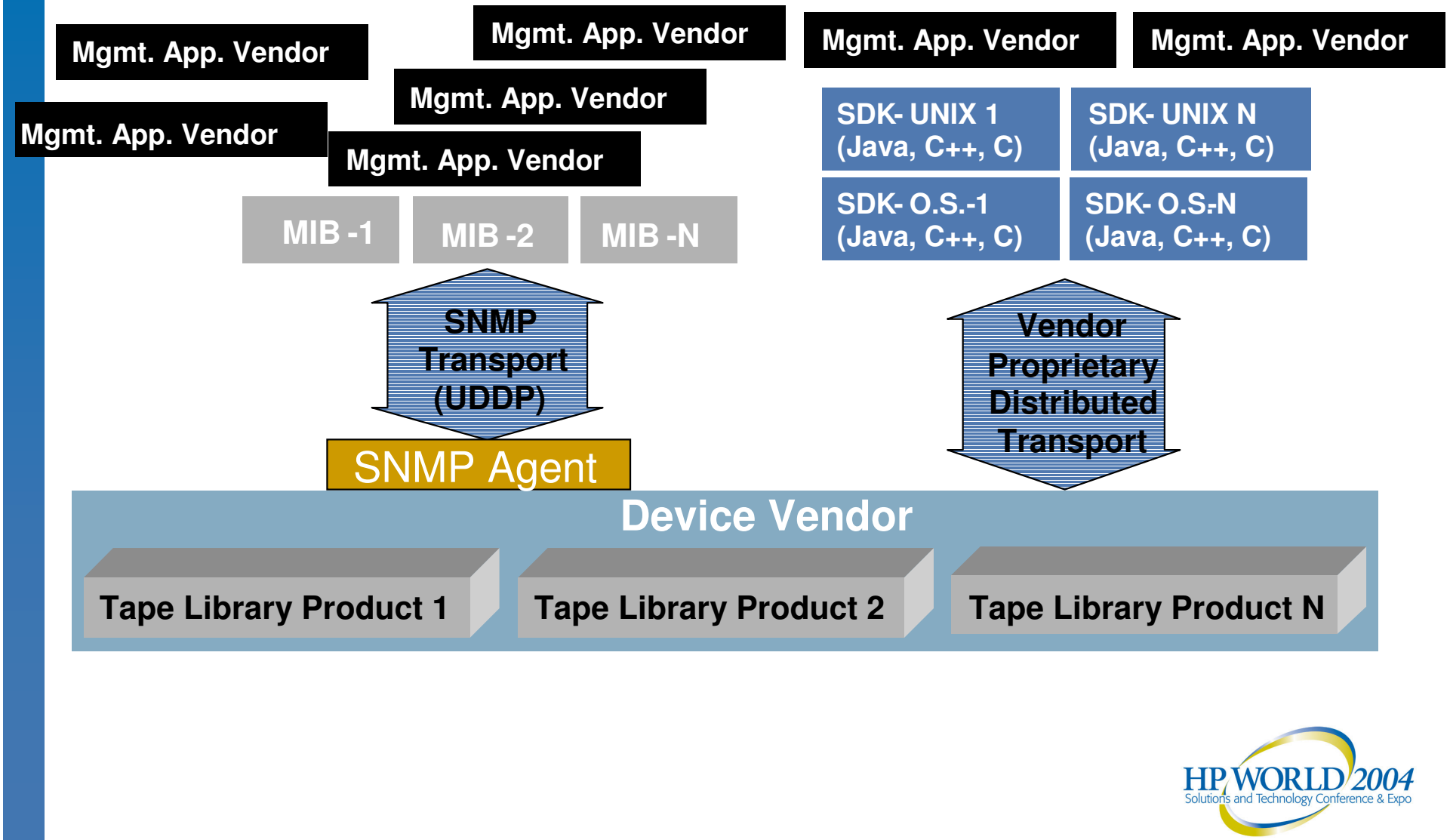
Management App Dilemma



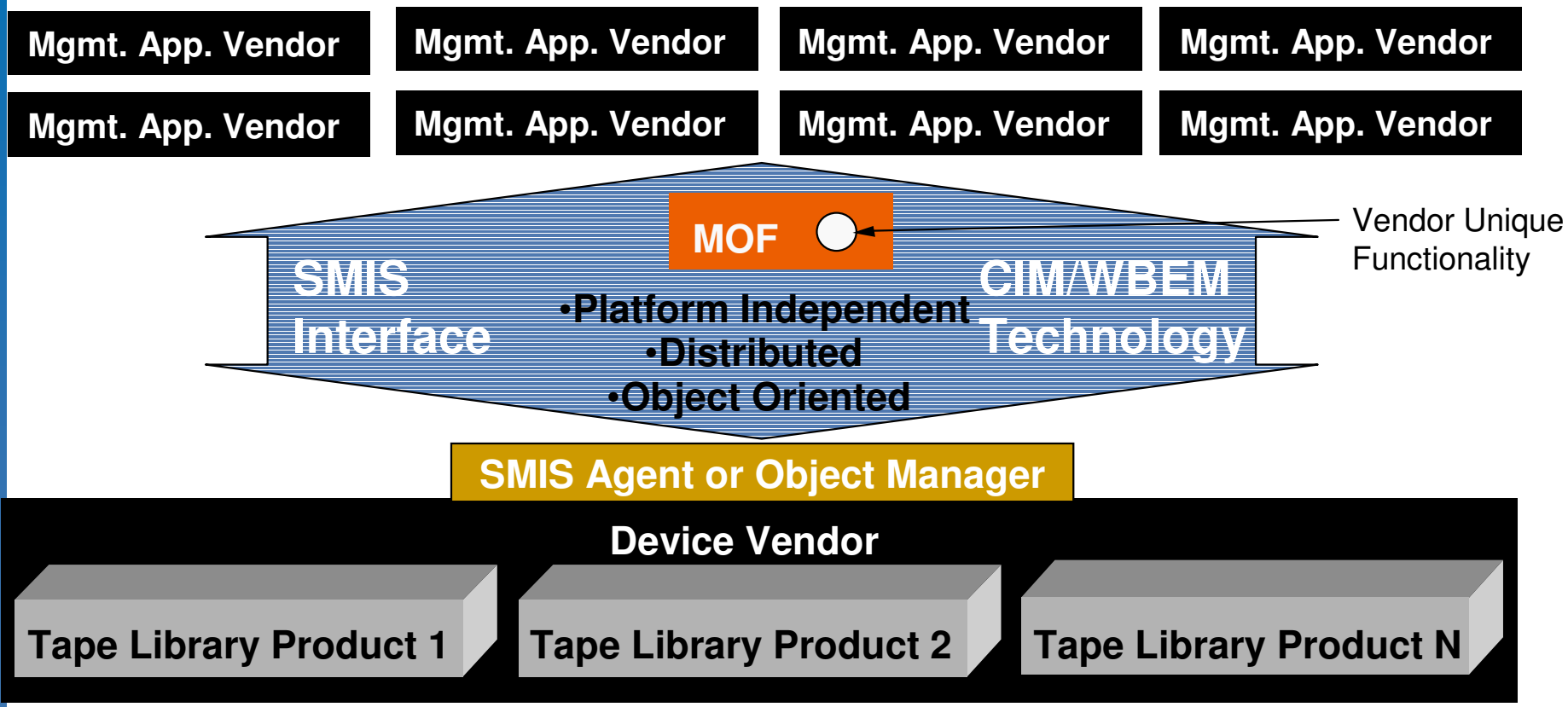
Management App Accelerator



Device Vendor Dilemma

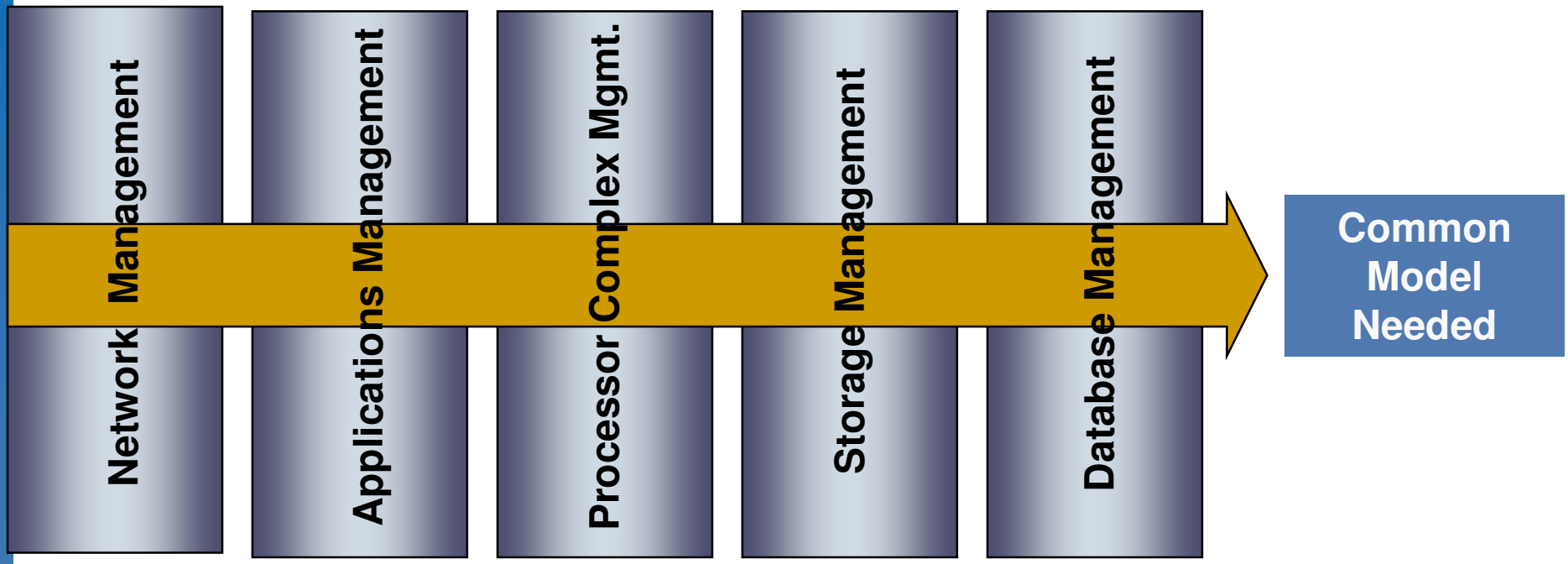


Device Vendor Accelerator

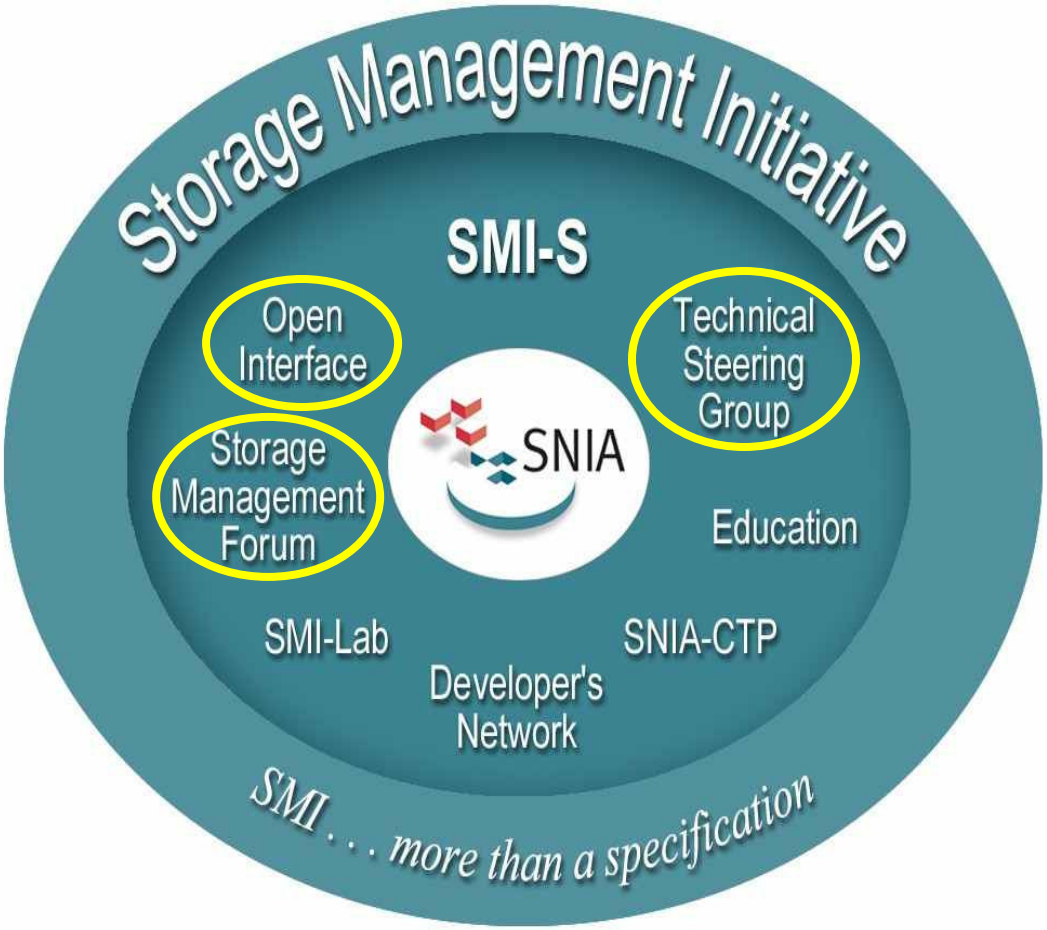


The Larger Problem

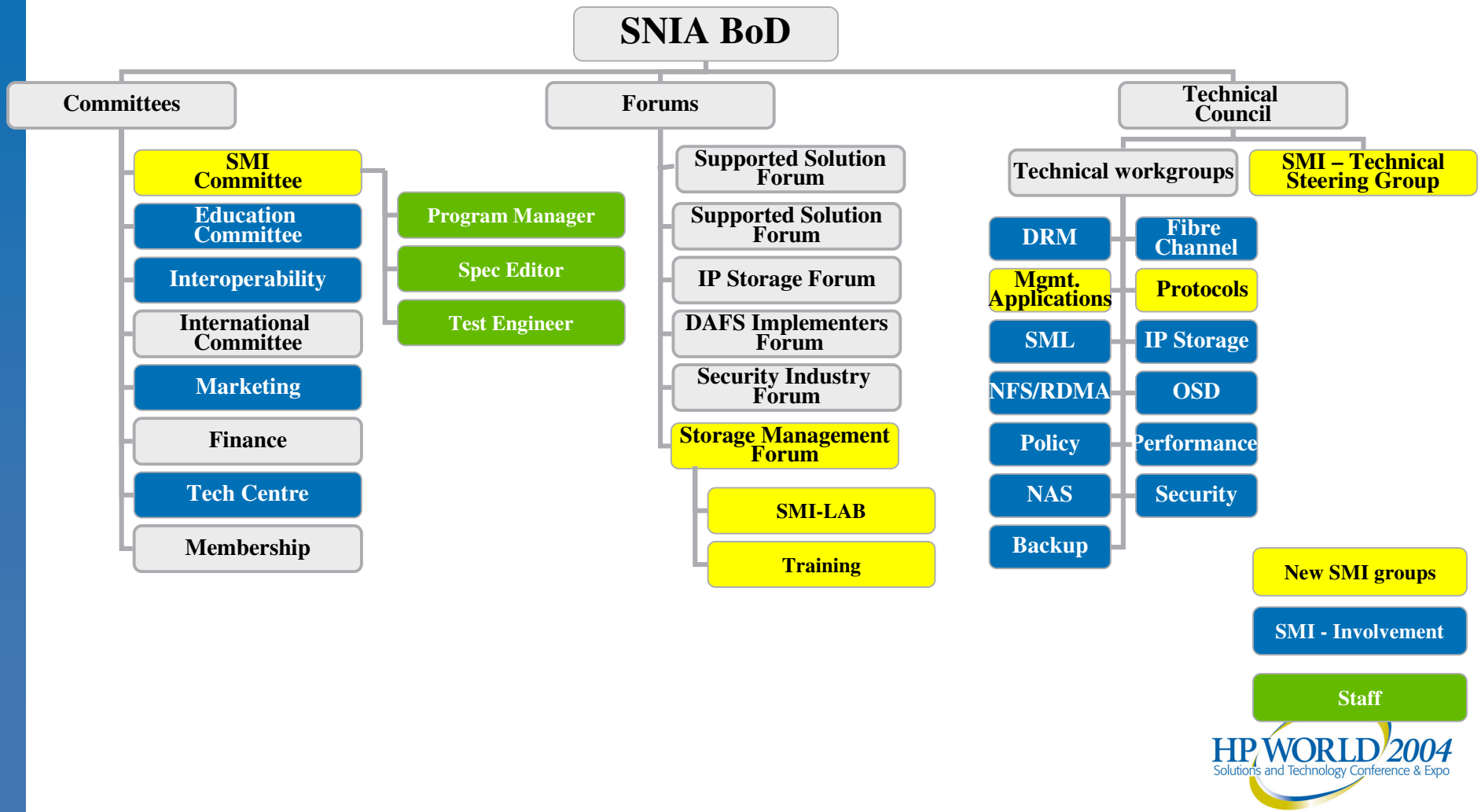
Systems Management “Stovepipes”



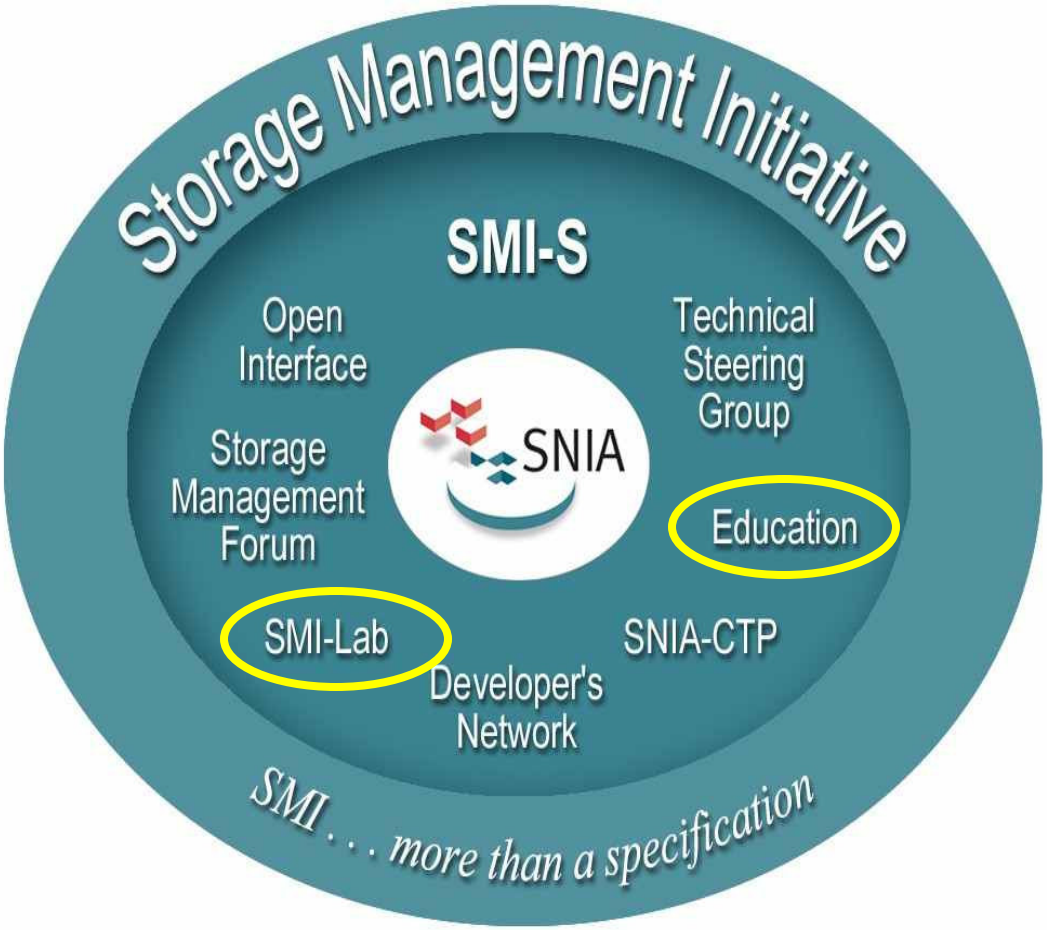
Storage Management Initiative



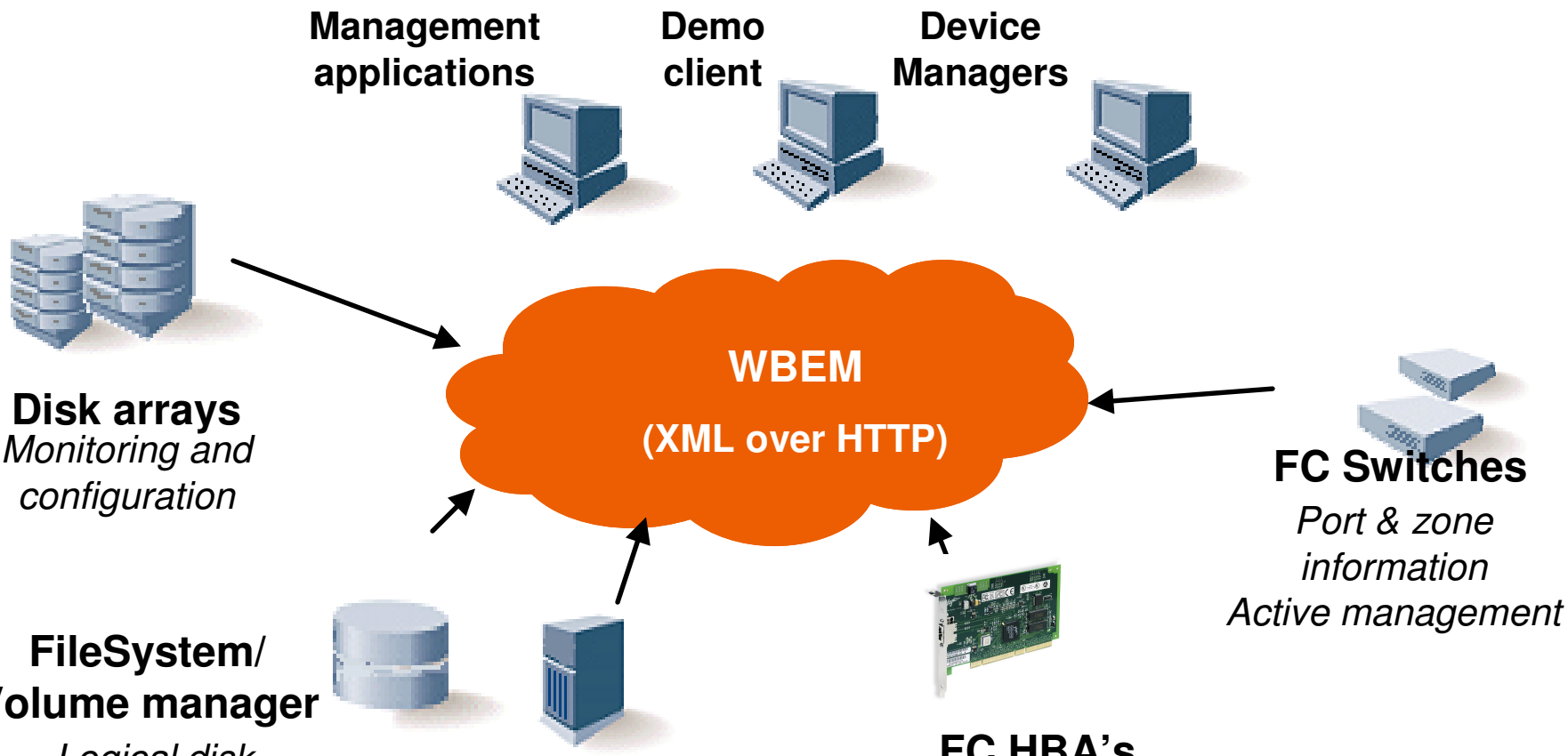
SNIA Organization



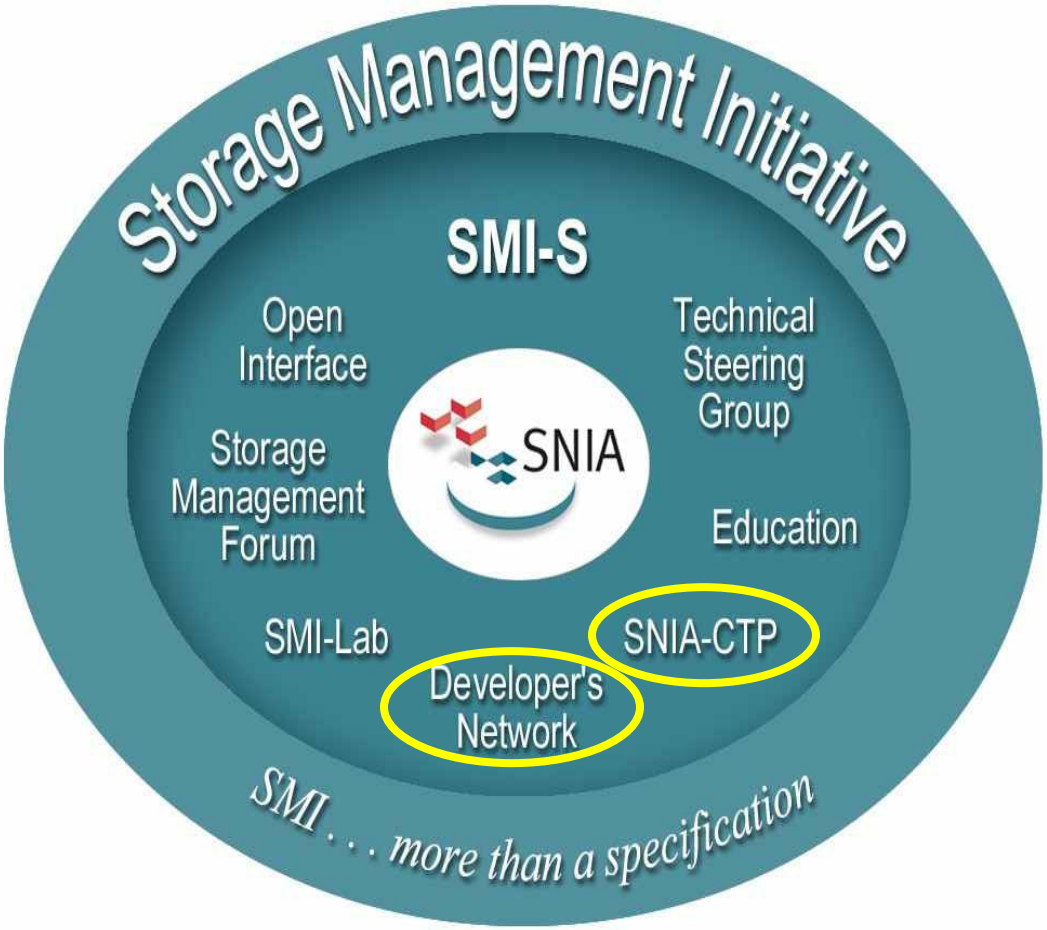
Storage Management Initiative



SMI-lab Topology

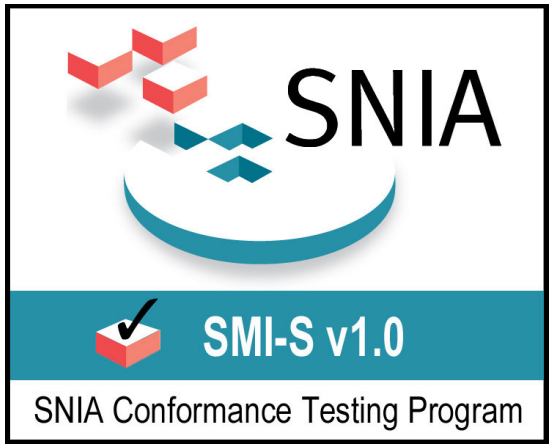


Storage Management Initiative



SMI Conformance Test Process

- SNIA-CTP bulletproofs SMI-S
- SNIA-CTP certification Instills trust
- Vendors passing receive SNIA “Mark”
- Privacy/confidentiality for vendors
- Source code made available to vendors



SMI-S v1.0 Functionality

Array Volume Creation

Create logical volumes in an array and make them available to a host

Array Snapshot & Mirror Control

Create, split, and synchronize snapshots and mirrors

Indications

Provide device awareness and operations monitoring

Fabric Topology & Zoning Discovery

Discover the path between hosts, switches and arrays; configure and report on zones

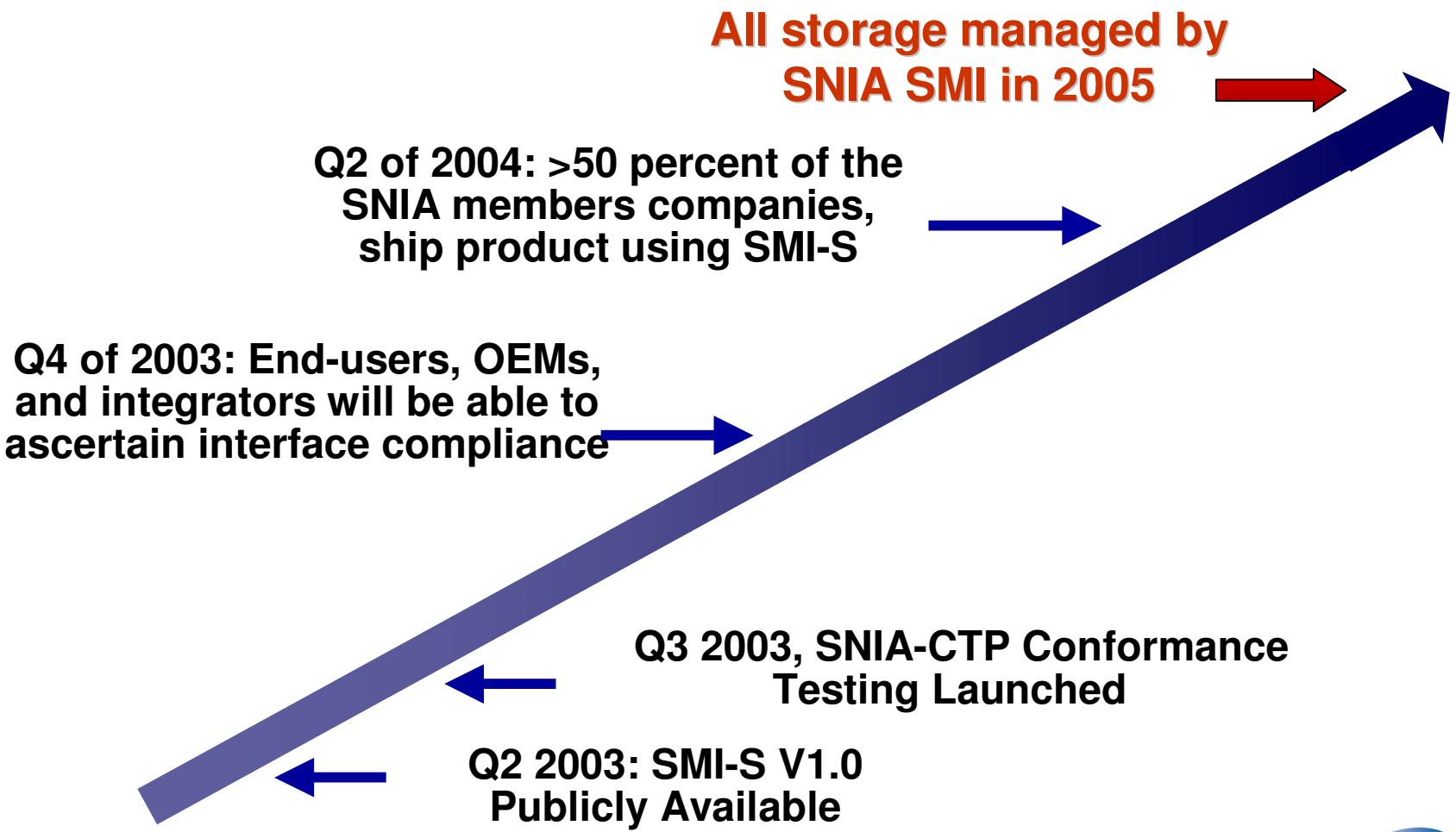
Array LUN Masking

Control the visibility of logical volumes to hosts (a form of security)

Tape Library Management

Track library health, capacity and resources, plus LAN-based media movement

SMI-S Strategic Vision

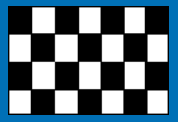


Overview of SMI-S at HP

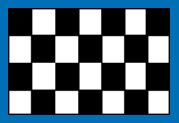
SNIA Conformance Test Program (CTP)

- Provides “validation” of storage vendors implementation

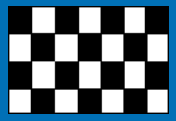
Current HP CTP Status



EVA Provider
- Passed SNIA CTP certification on March ‘04
- Announced at SNW in April ’04

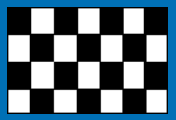


B-Series Switch Provider
- Passed SNIA CTP certification on March ‘04
- Announced at SNW in April ’04



XP Provider
- Passed SNIA CTP certification on March ‘04
- Announced at SNW in April ’04

EMA Provider
- Plans to CTP certify in Summer ’04



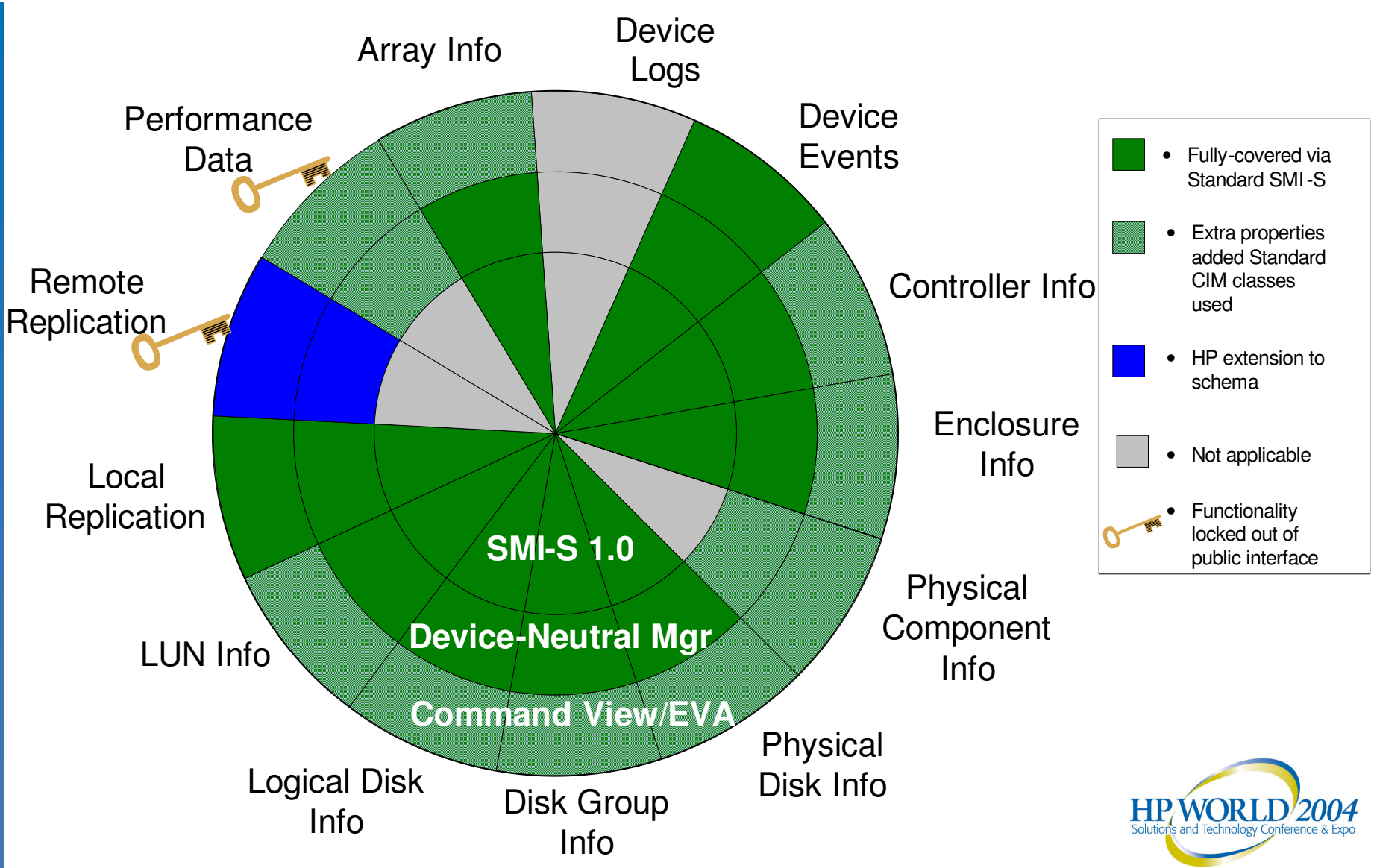
MSA Provider
- Passed SNIA CTP certification on April ‘04
- Announced at SNW in April ‘04

VA Provider
- Plans to CTP certify in Summer ’04

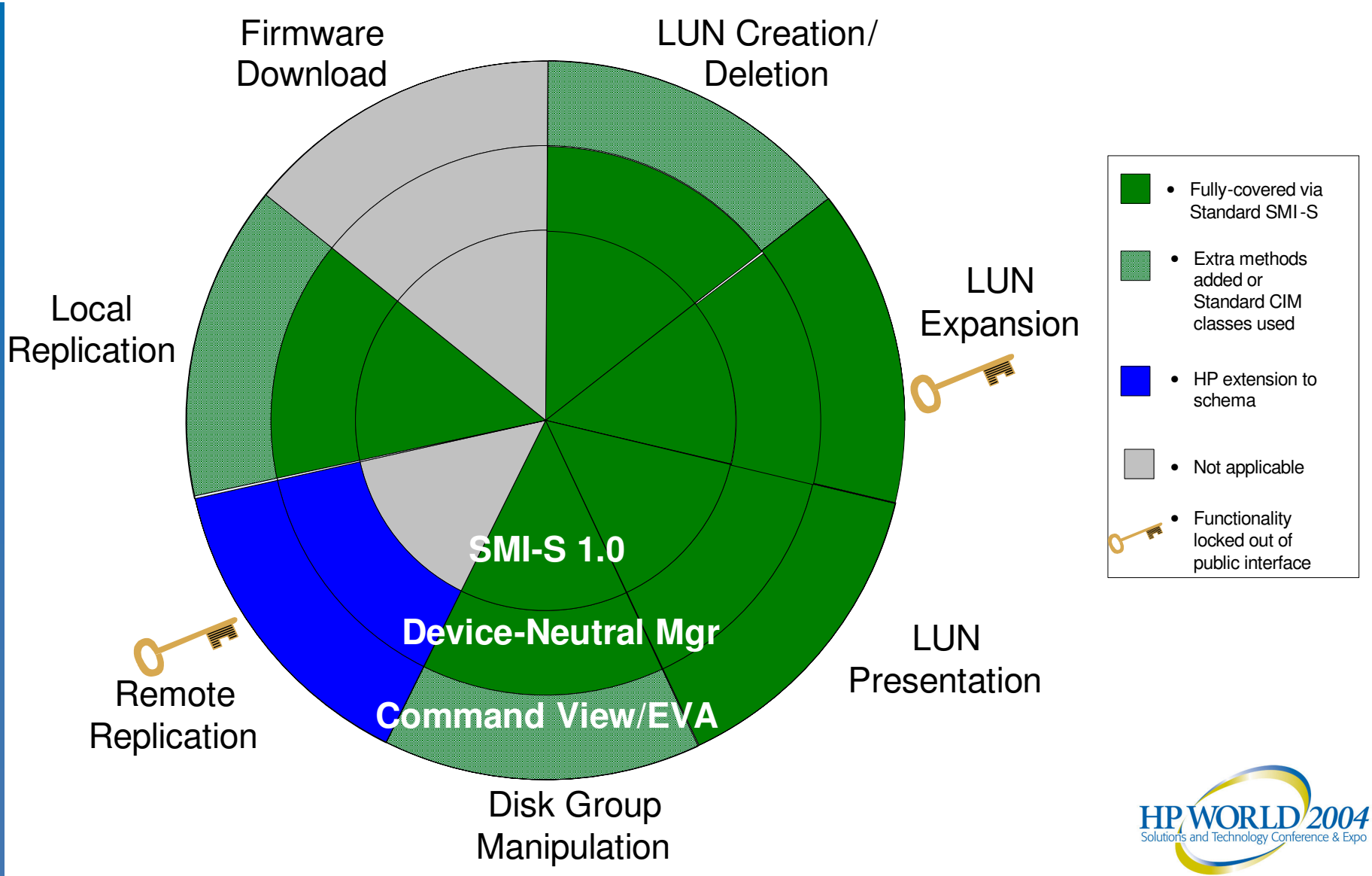
HP Storage Software Developers Program

- Program to facilitate third party management application support of HP storage products.
- Initially aimed at independent software/hardware vendors (ISV/IHV) who want to manage HP arrays (other storage products TBD)
- Available through HP's Developer & Solution Partner Program (DSPP)
- Provides development, support, and marketing services
- Based on SNIA's Storage Management Interface Specification

SMI-S for EVA - Instrumentation

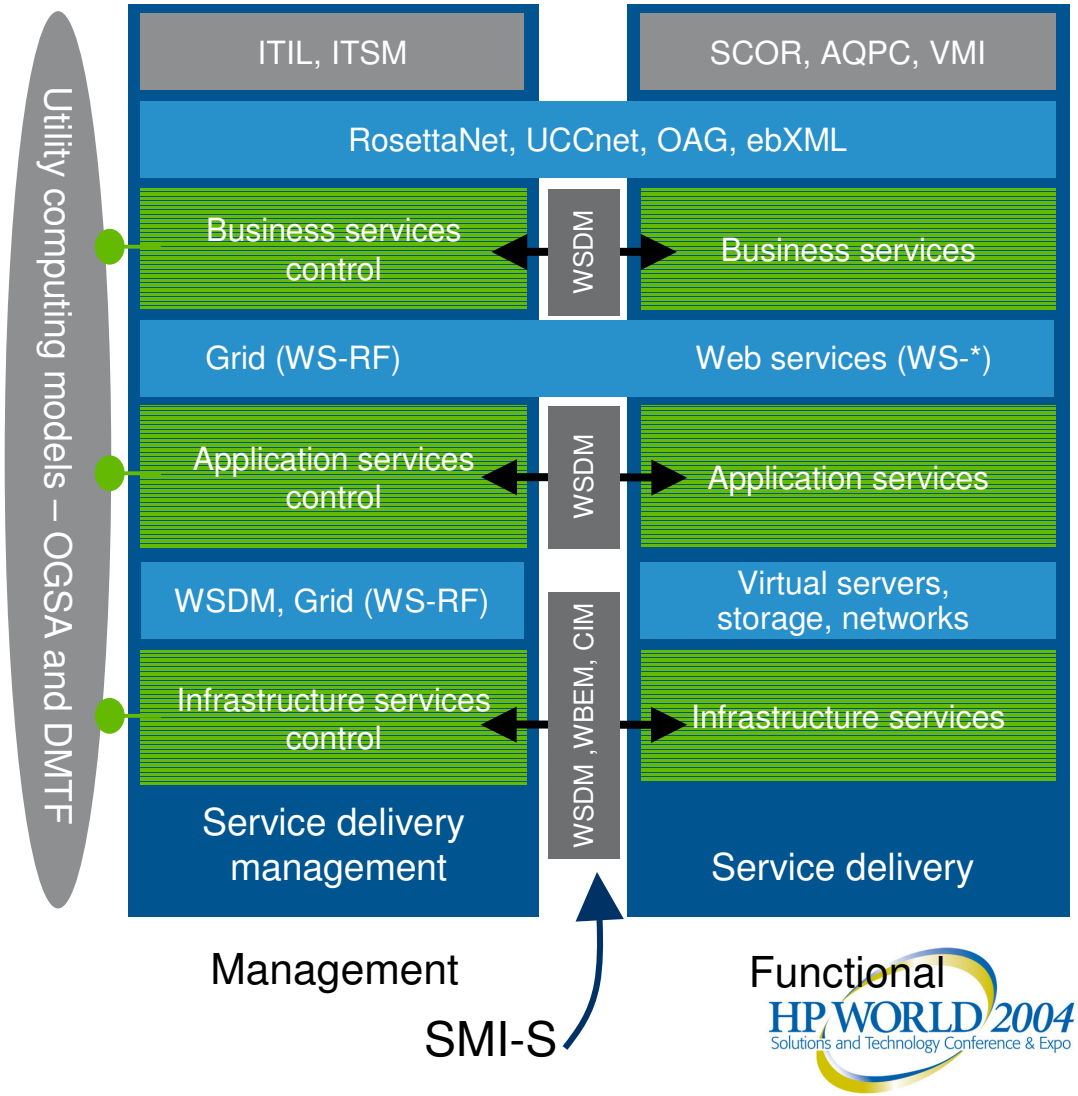


SMI-S for EVA - Control



SMI-S in the context of Adaptive Enterprise

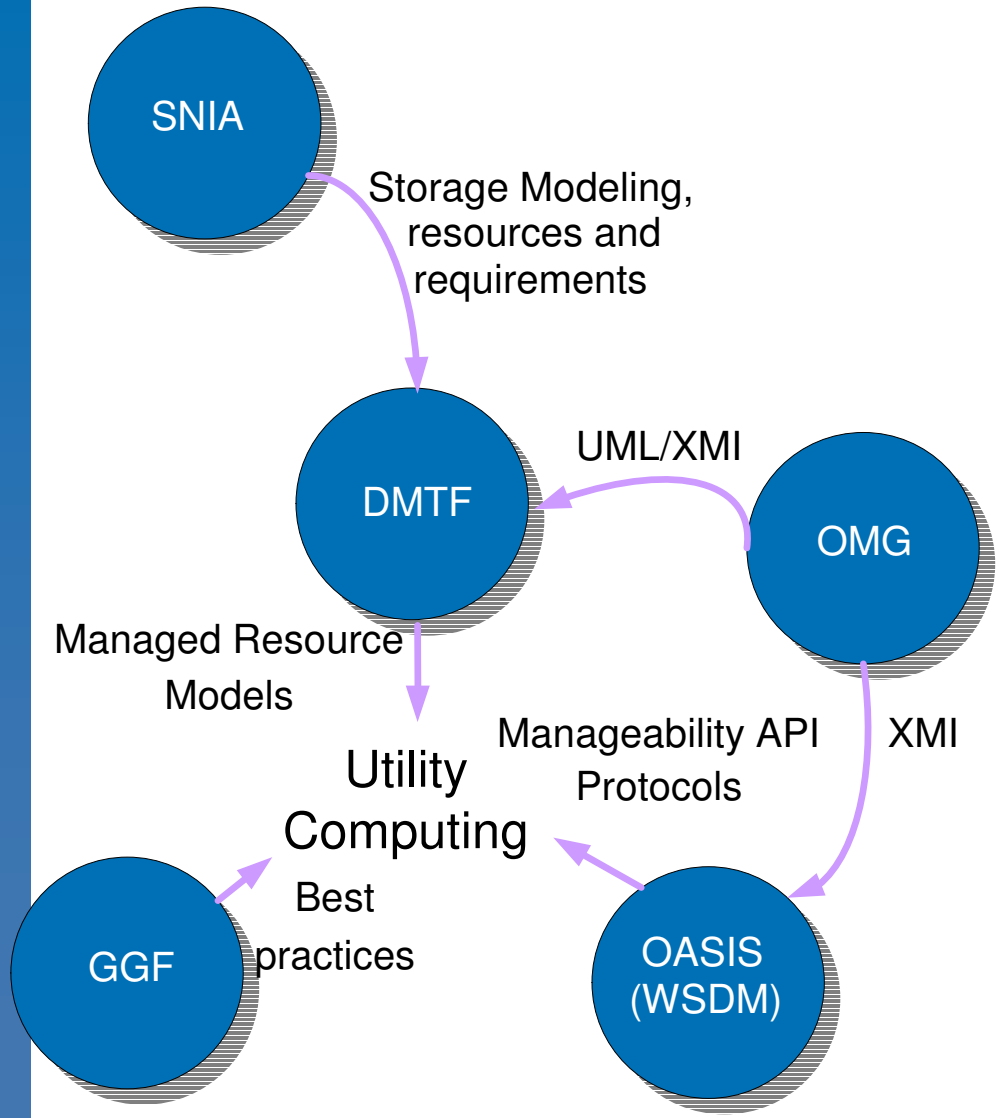
SMI-S provides the manageability interface for the storage infrastructure.



CIM, WBEM and WSDM

- CIM is a meta-model specification and a series of schema for managing IT resources.
  - Implementation independent.
- WBEM is a pre WSDL, pre SOAP Web API for the Common Information Model (CIM)
  - Adopted for storage, system, and preOS manageability.
- WSDM is a WSDL based API for manageability initially for service and business levels.
  - HP contributed WSMF as a part of the standard.
  - The scope of WSDM is much broader than WBEM.
  - One of the models of managed objects that will be usable with WSDM is CIM.

Standards for the Adaptive Enterprise



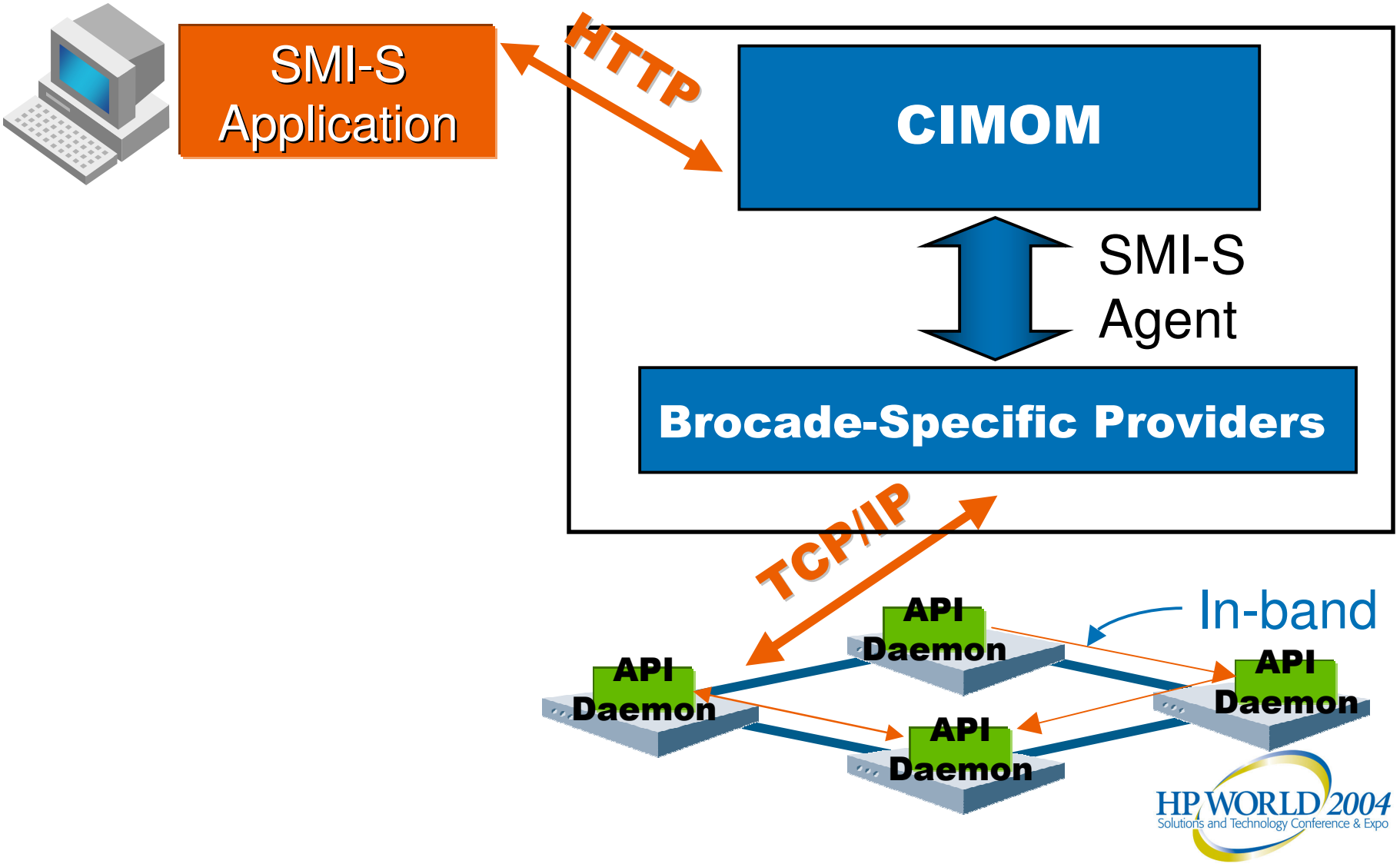
- DMTF:
  - CIM - Common Information Model
  - WBEM – protocol/API
- OMG:
  - UML - Unified Modeling Language.
  - XMI - XML Metamodel interchange.
- OASIS:
  - XML interchange standards
  - WSDM - Web based Manageability API (includes HP proposed WSMF)
- Global Grid Forum:
  - Group developing grid computing solutions and best practices.

Overview of SMI-S at Brocade

SMI-S: What's the Brocade Offering?

- AN SMI-S Agent
  - Consists of a CIM Object Manager (CIMOM) and custom Brocade Providers
  - Runs on a host (Solaris, Windows and Linux)
  - Implements complete SMI-S 1.02 standard plus some Brocade-specific extensions
  - Has passed all certification tests for the complete Brocade product line

API and SMI Architectures Compared



Embedded to Enteprise

SAN Director 2/128 & 2/128 PP

Core Switch 2/64 & 2/64 PP

SAN Switch 2/32 & 2/32 PP

SAN Switch 2/16N PP

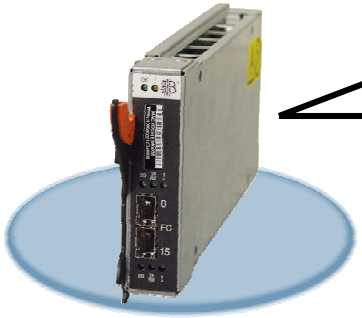
SAN Switch 2/16N

SilkWorm Multiprotocol Fabric Router

SAN Switch 2/8V & 2/8V PP

MSA SAN Switch 2/8

Brocade SAN Switch Module



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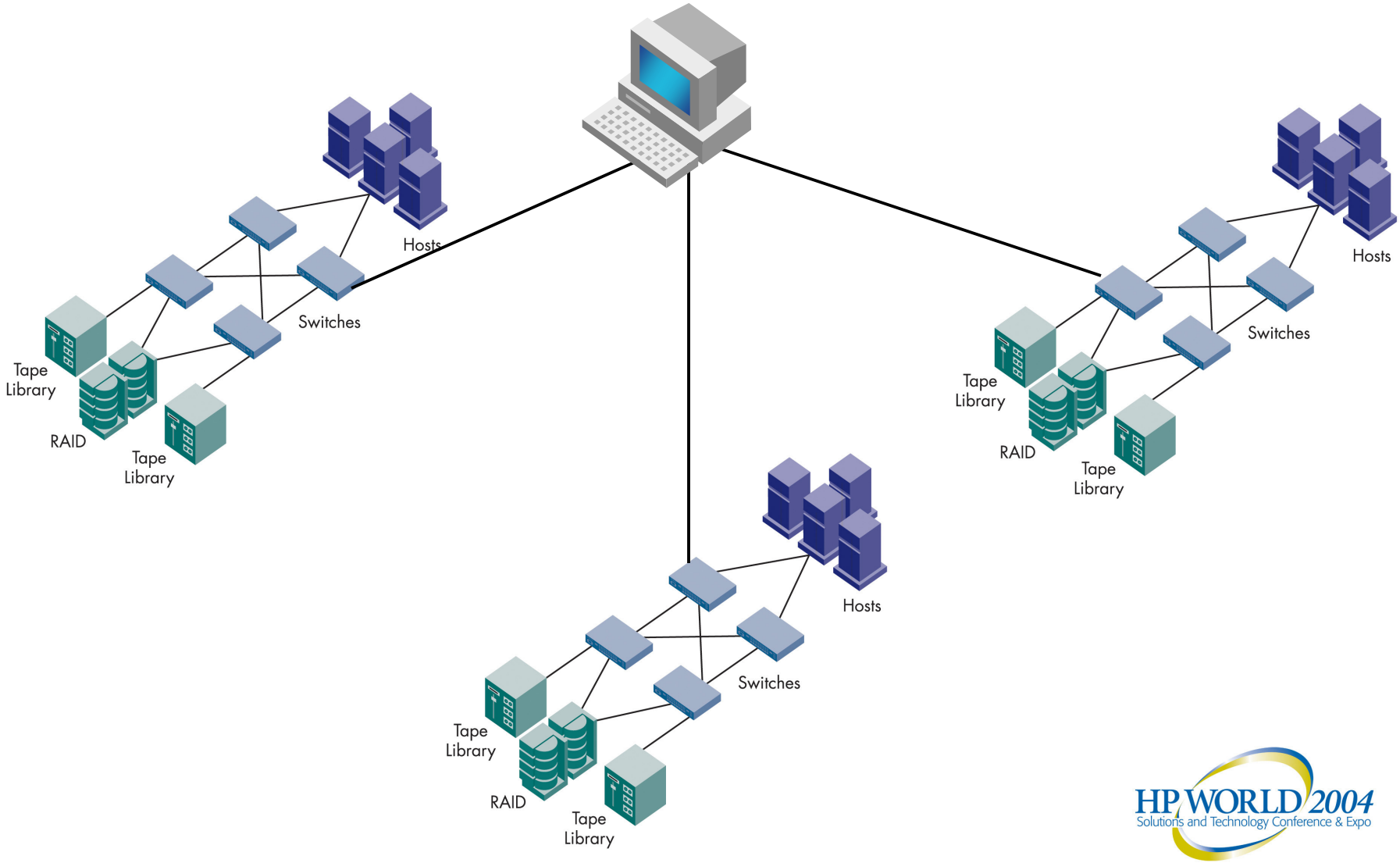
One Agent, Multiple Fabrics



HP B-Series SMI Support

- The HP B-Series offering provides the following capabilities:
- SMI-S compliant CIM agent with support for the following profiles/sub-profiles:
  - Server
  - Fabric
    - Zoning control
    - Enhanced zoning and zoning control
    - FDMI
  - Switch
    - Blades

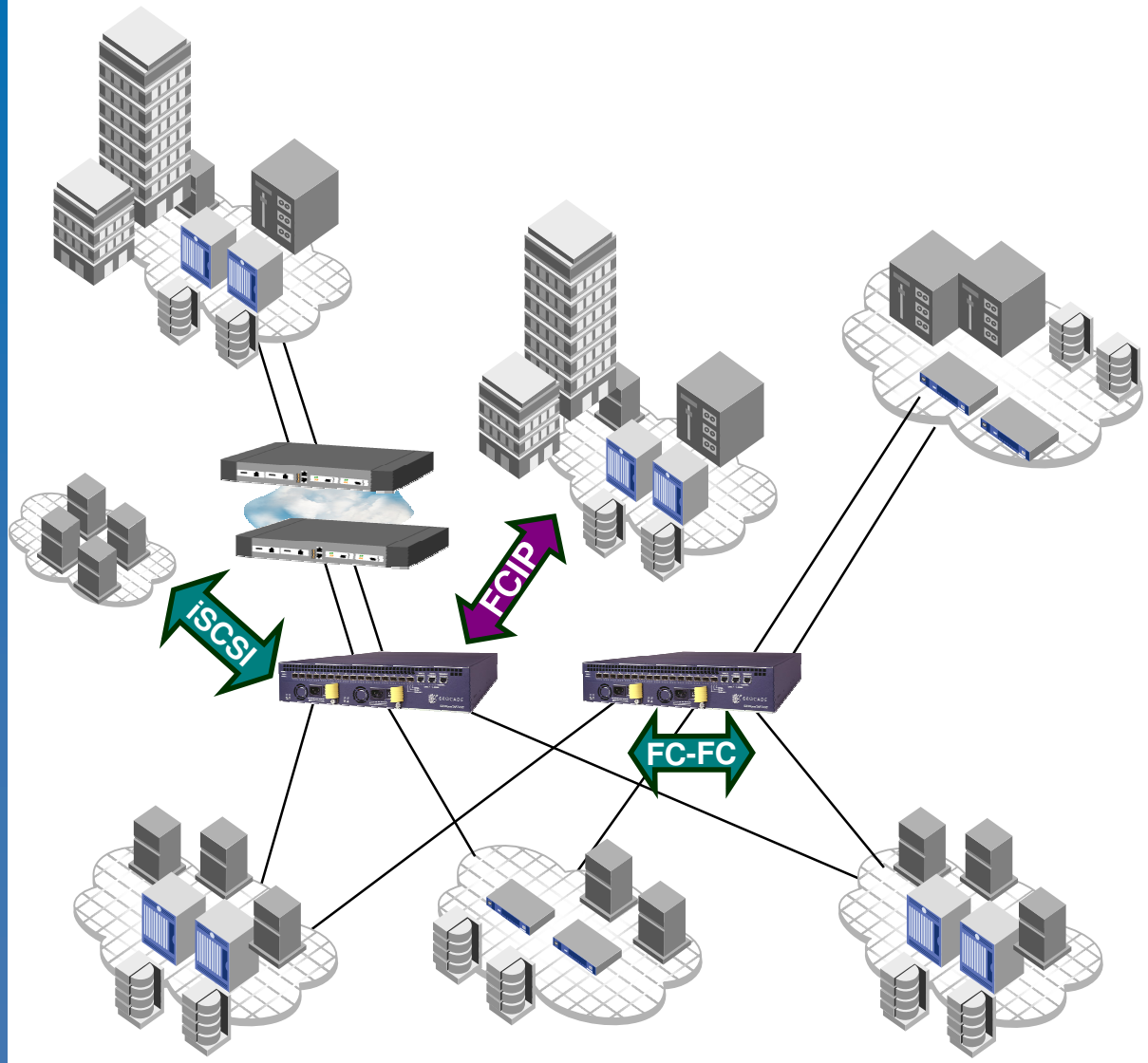
HP B-Series SMI Support (cont.)

- Support for physical objects such as chassis, blades, fans, power supplies, temperature sensors, and transceivers
- Support for connection/account management
- Support for port performance/error statistics
- Support for HBA/device information via FDMI
- Support for configuration download to switches
- Support for Service Location Protocol (SLP) to discover SMI-S profile support for
- CIM agent management

HP B-Series SMI Support (cont.)

- Event support, including lifecycle indications for fabrics, SANs, nodes, and switches
- Support for many fabric-based alert indicators
- Basic support for non-Brocade switches (switches, ports, topology information)
- Support for HTTP, RMI, and HTTPS protocols
- Support for security authorization using native operating system access control mechanisms
- Support for provider logging of exceptions, operations, performance metrics for diagnostic purposes
- Support for secure SAN fabrics
- Support for CIM queries (using WQL)

Increasing Connectivity and Intelligence



Fabric Applications

Within Fabric or Inter-Fabric
Volume mgmt, Virtualization
Replication, Migration

Multiprotocol Routing

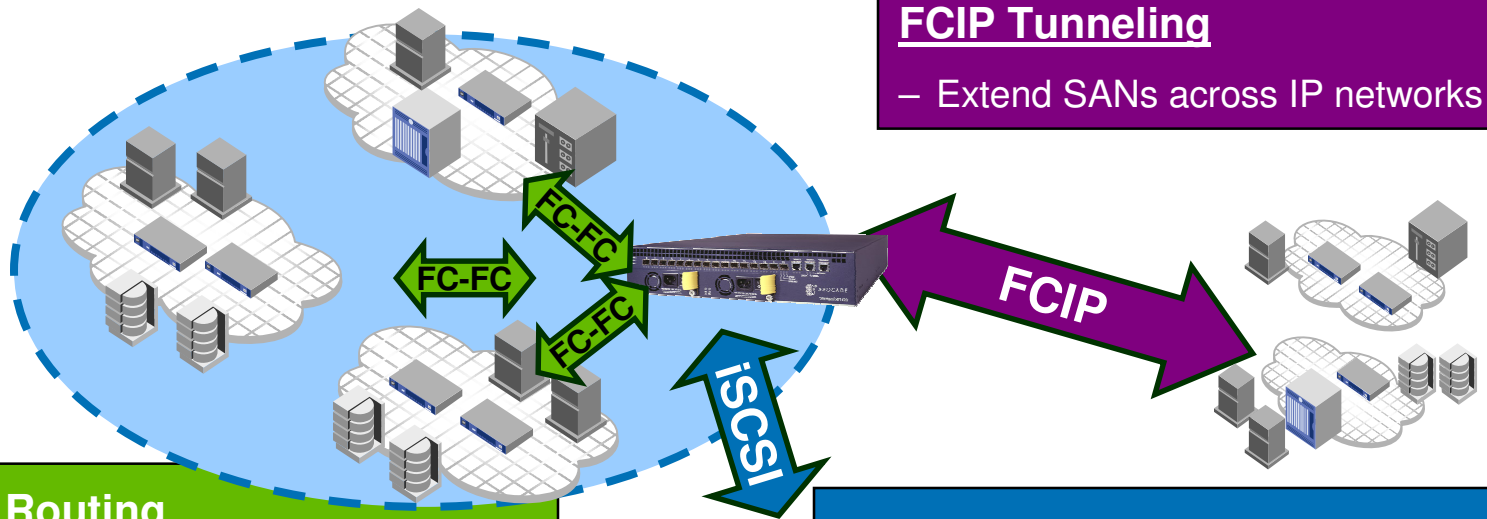
Fabric Interoperability
Transport Flexibility

SAN Connectivity

Layer 2

The future … Still One Agent, Multiple Fabrics, Multiple Protocols

- Connecting all of your resources
  - Multiprotocol solution: Fibre Channel, iSCSI and FCIP
  - Sharing resources across geographies, departments and functional areas
- Simplifying connectivity and scalability… while maintaining separately managed environments



FCIP Tunneling

- Extend SANs across IP networks

FC-to-FC Routing

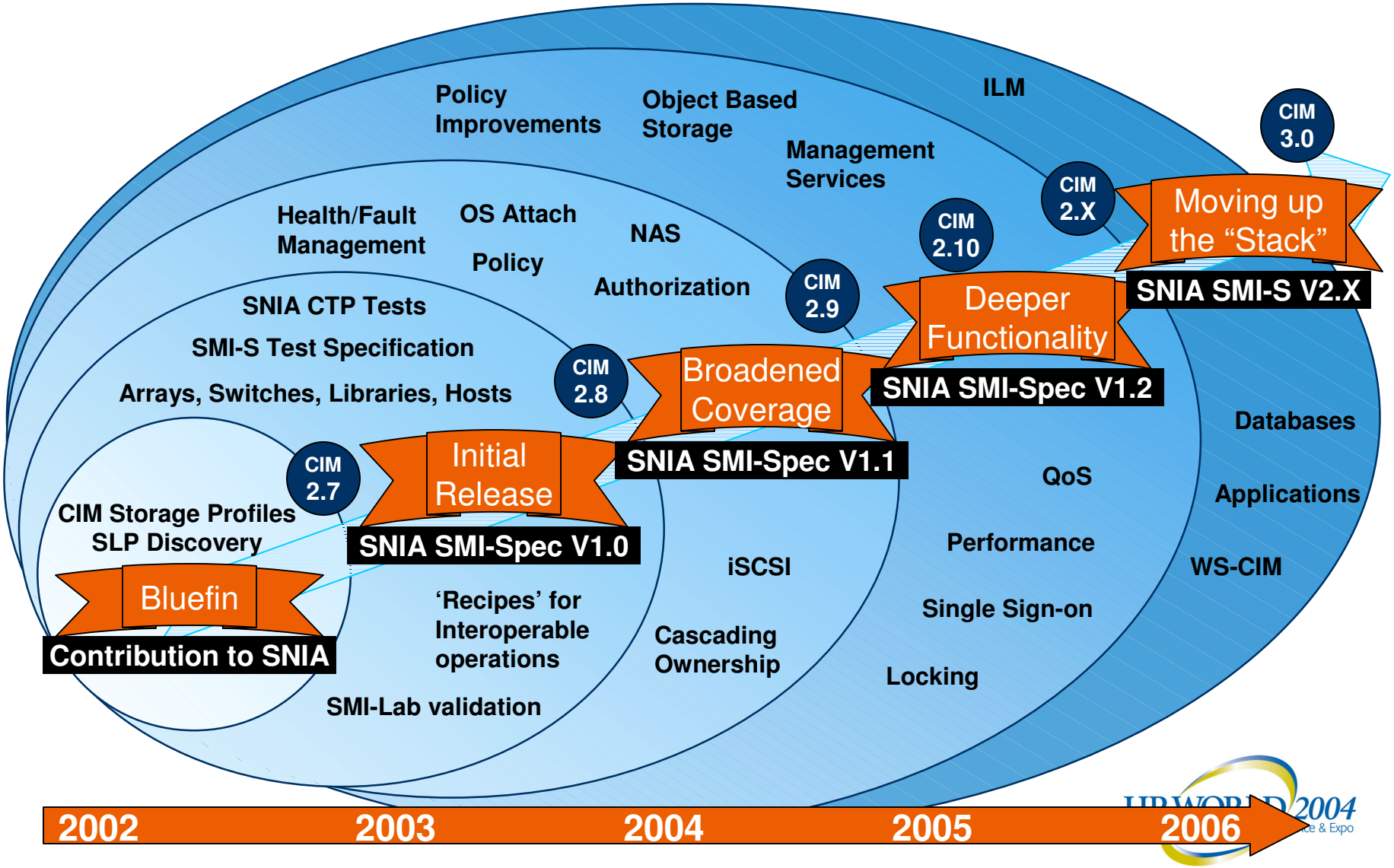
- Logically connect SAN islands and share resources across multiple fabrics
- Maintain administration and fault isolation of ***separately managed fabrics***

iSCSI-to-FC Gateway

- Protocol conversion from iSCSI to FC
- Connect lower-cost Ethernet-connected servers to SANs

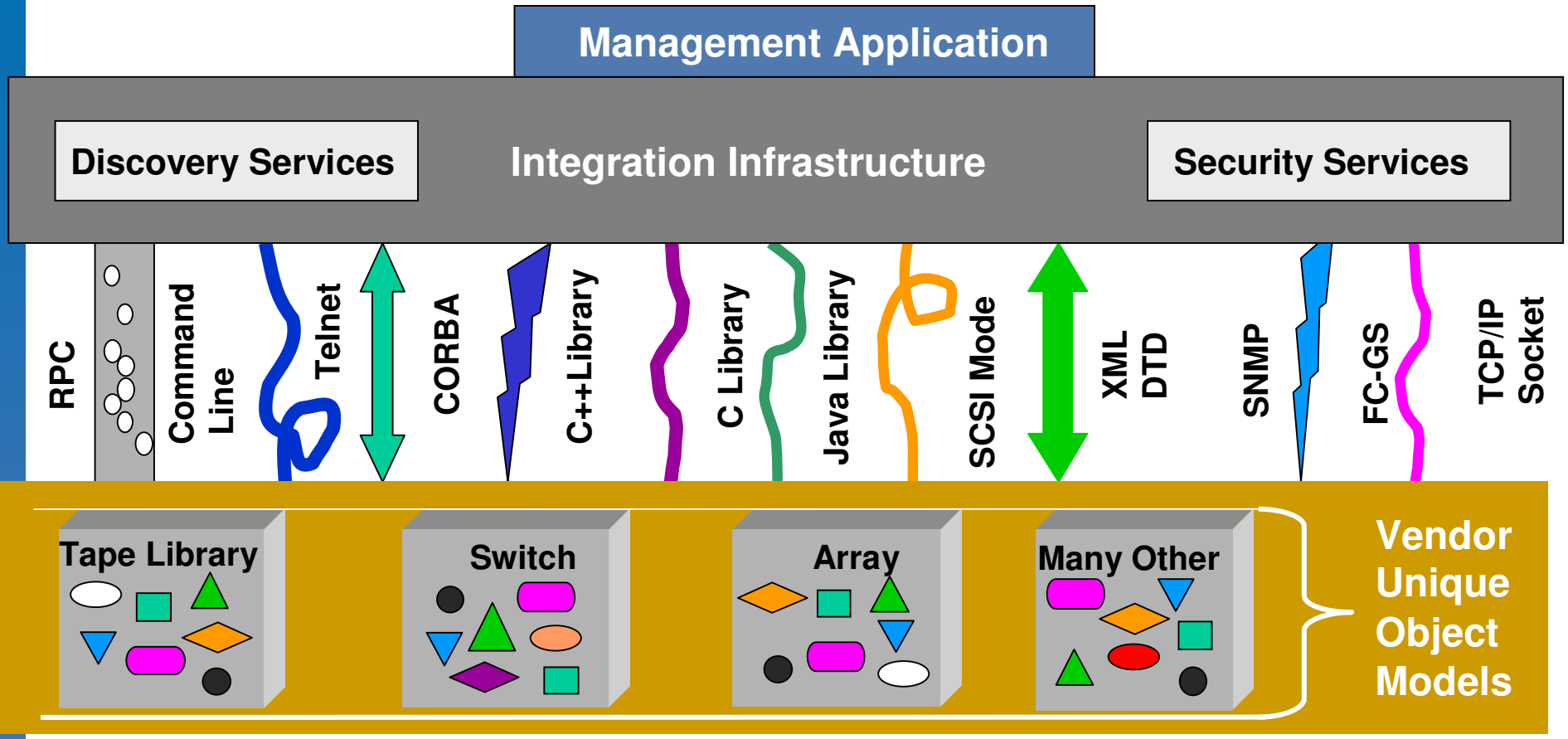
Future roadmap for SMI-S

SMI: Functionality Onion

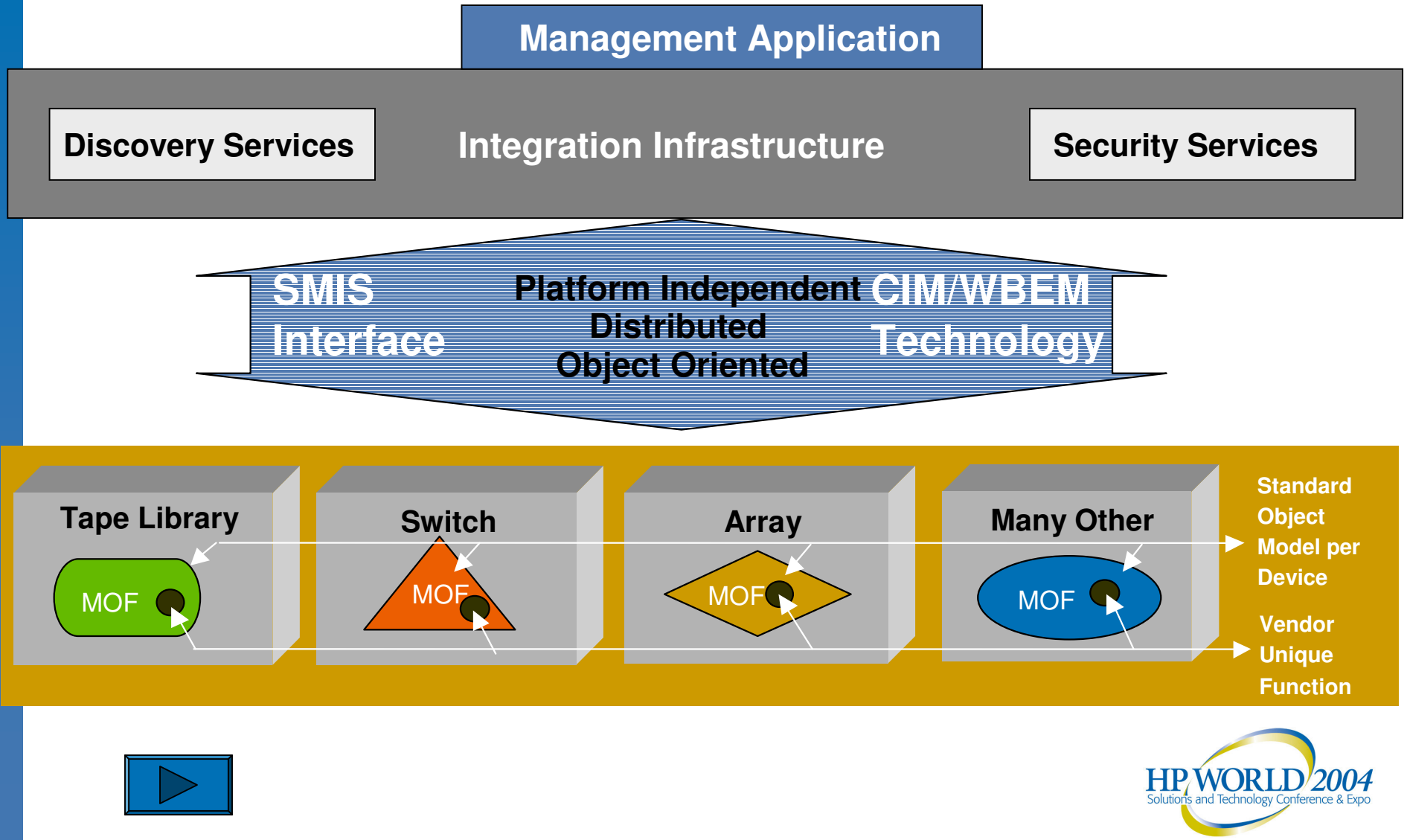


Technical Overview of SMI-S

Proprietary APIs

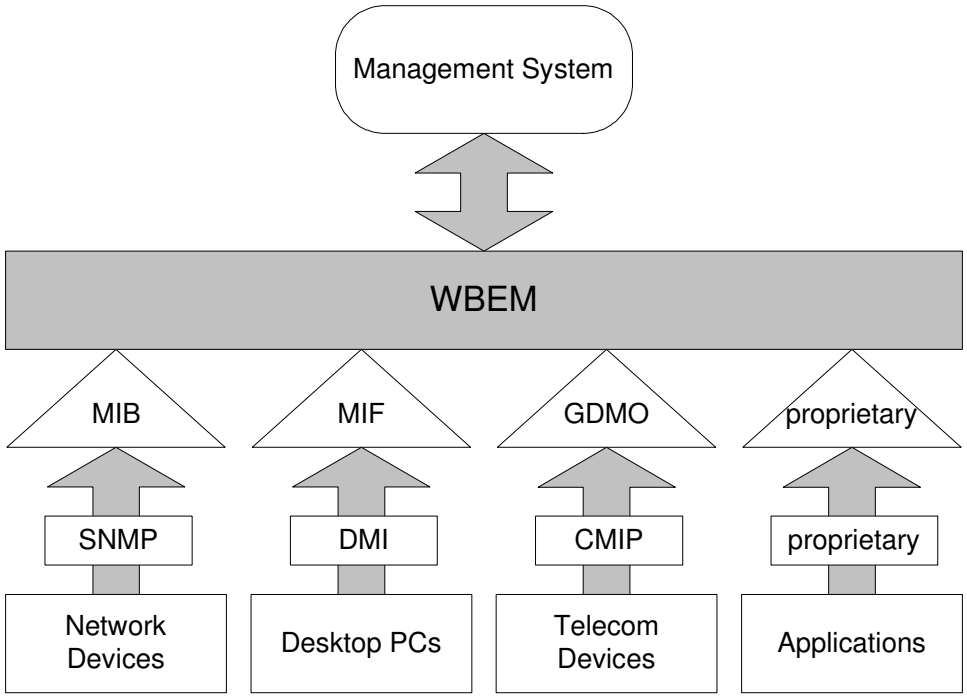


SMI-S – a standard API



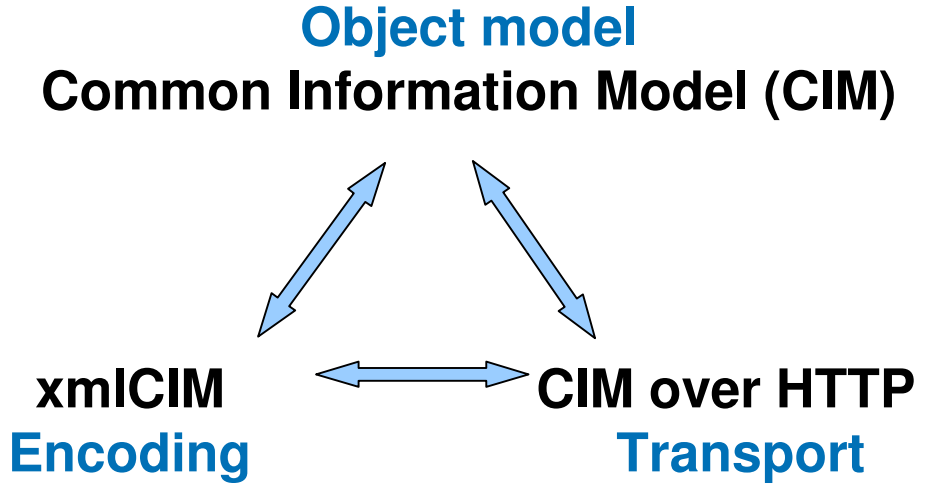
Web Based Enterprise Management

- WBEM
  - Initiative of the Distributed Management Task Force (DMTF)
  - Goal: faciliate the management of complex IT infrastructures
  - uses web techniques like XML and HTTP for access to and presentation of management information
  - Defines interfaces for integration of conventional management mechanisms like SNMP, DMI, CMIP



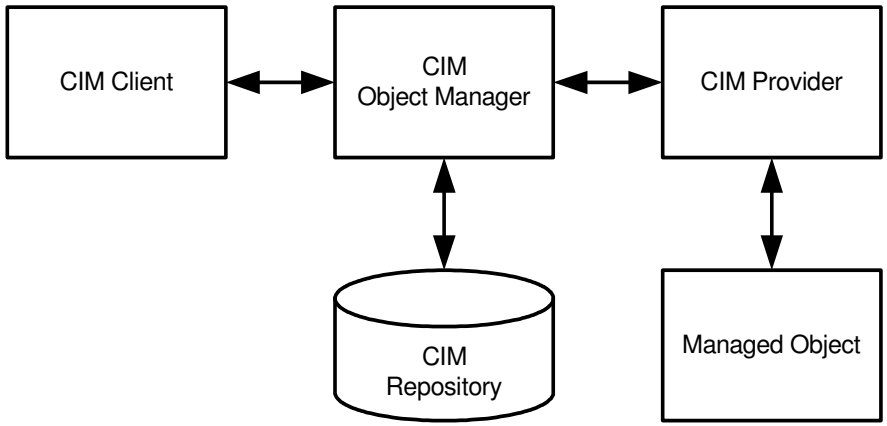
The 3 basic components of WBEM

- Common Information Model (CIM)
  - formal object oriented modelling language
  - Designed for description of all system management aspects
- xmlCIM Encoding Specification
  - Transfer syntax in a WBEM environment
  - Encoding of method calls and responses in XML
- CIM Operations over HTTP
  - Transport mechanism for exchanging xmlCIM encoded messages in a WBEM environment



WBEM Architecture

- CIM Managed Object
  - denotes the object to be managed
- CIM Provider
  - provides management information for a managed object
- CIMOM - CIM Object Manager
  - implements the CIM Repository
  - provides interfaces for CIM Providers and CIM Clients
- CIM Repository
  - contains templates for CIM Schemas and object instances
- CIM Client
  - e.g. a management application
  - contacts the CIMOM, to detect and retrieve management information of managed objects

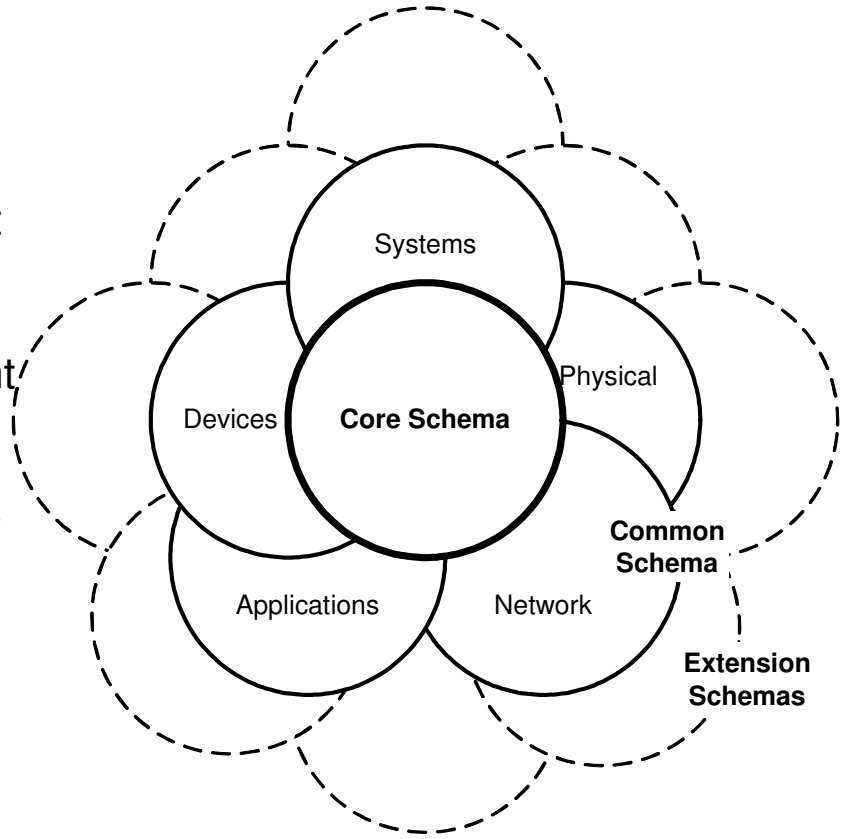


Object-Oriented Modelling

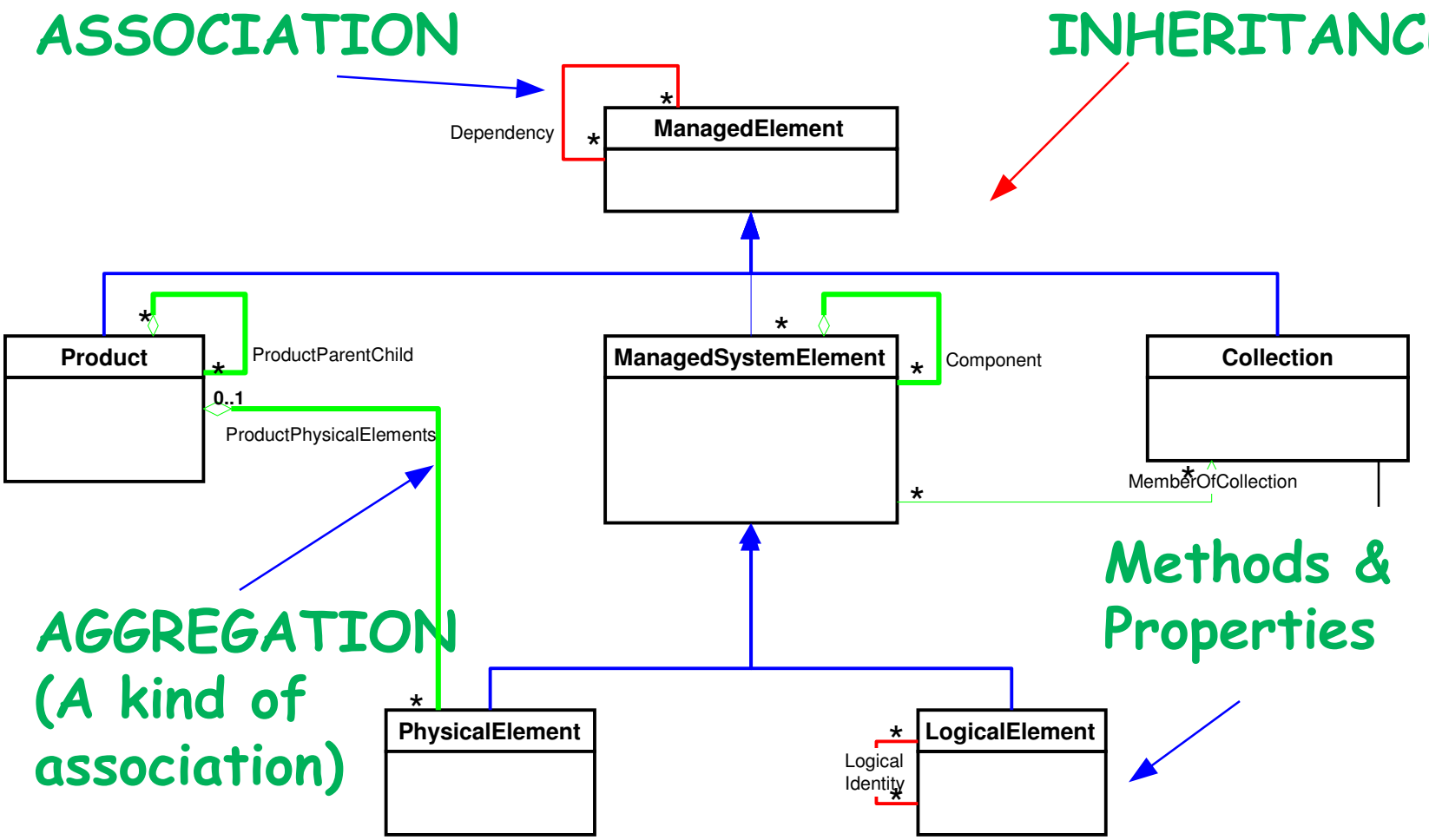
- Class
  - Defintion of a type of managed object.
- Properties and Methods
  - Properties of a class
  - Methods exposed by that class
- Association
  - Relationship between two classes
  - Can have properties and methods
- Sub- or Child-Class
  - A class that extends the functionality of a parent class (adds extra properties and methods).
- Instance
  - The ‘real obect‘.

CIM Schemas

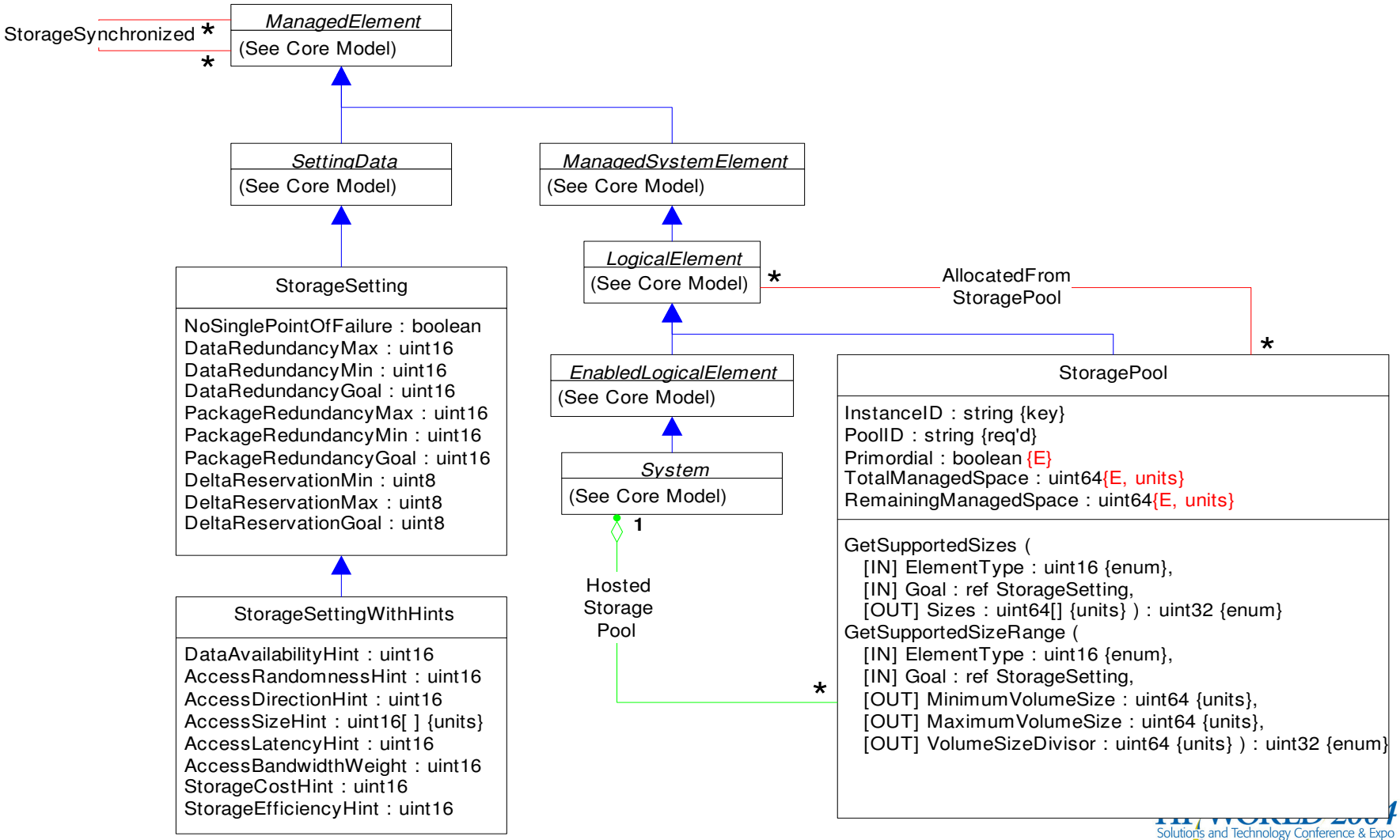
- Schema
  - Description of a complex management environment in CIM language
- 3 Types
  - Core Schema
    - contains basic definitions of abstract classes and relations for a management environment
    - 'there exist manageable elements, that possess logical and physical components'
    - systems, applications and networks represent such manageable elements and can be realised as extensions of the Core Schema
    - conceptual template for all further extensions
  - Common Schema
    - based on the Core Schema
    - defines common components for systems, applications, devices, networks and physical properties
  - Extension Schemas
    - further concretion of the object model based on the Core and Common Schemas using inheritance
    - entry point for vendors to implement their own schema



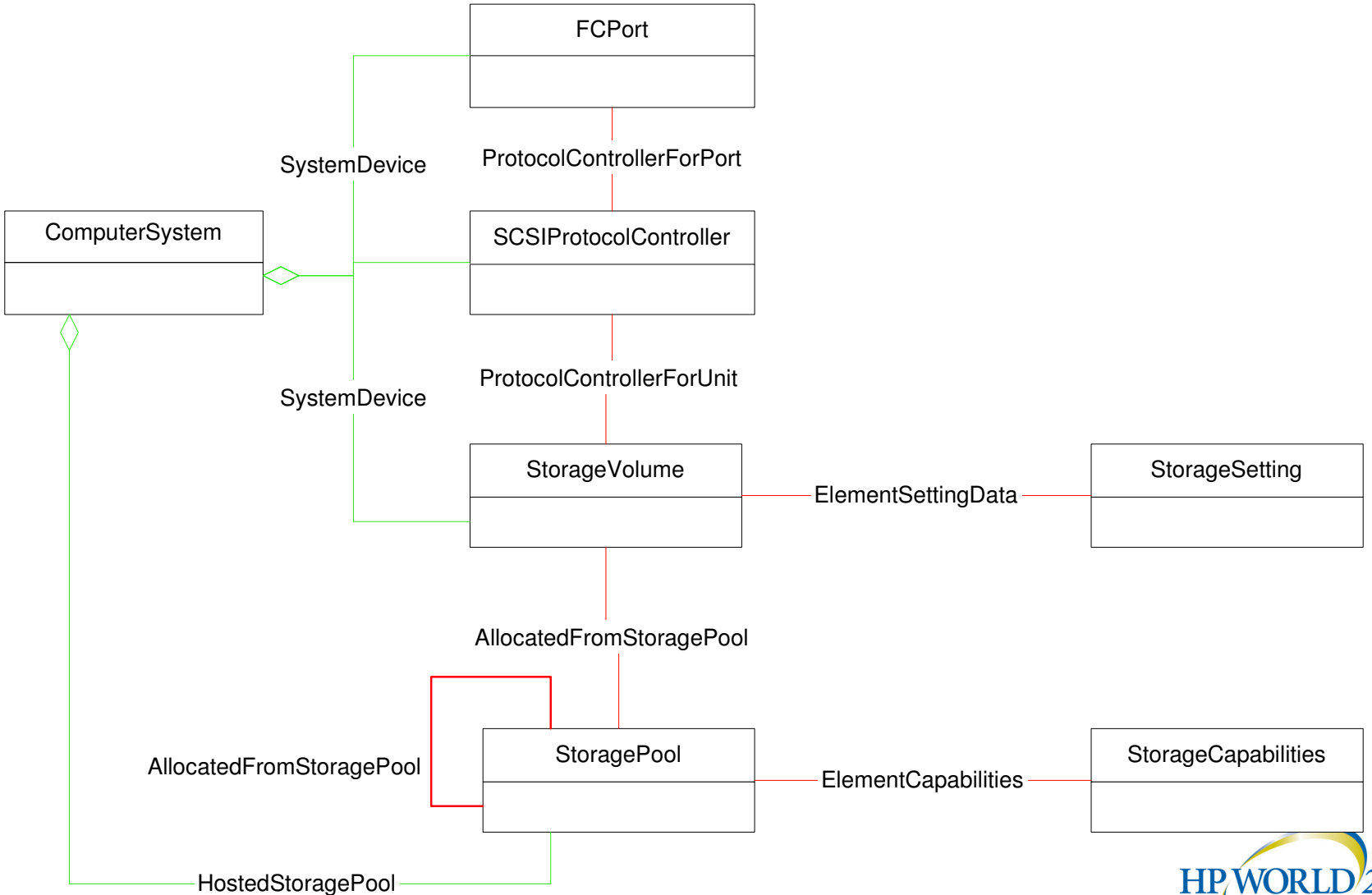
UML/Visio Example



UML/Schema Example

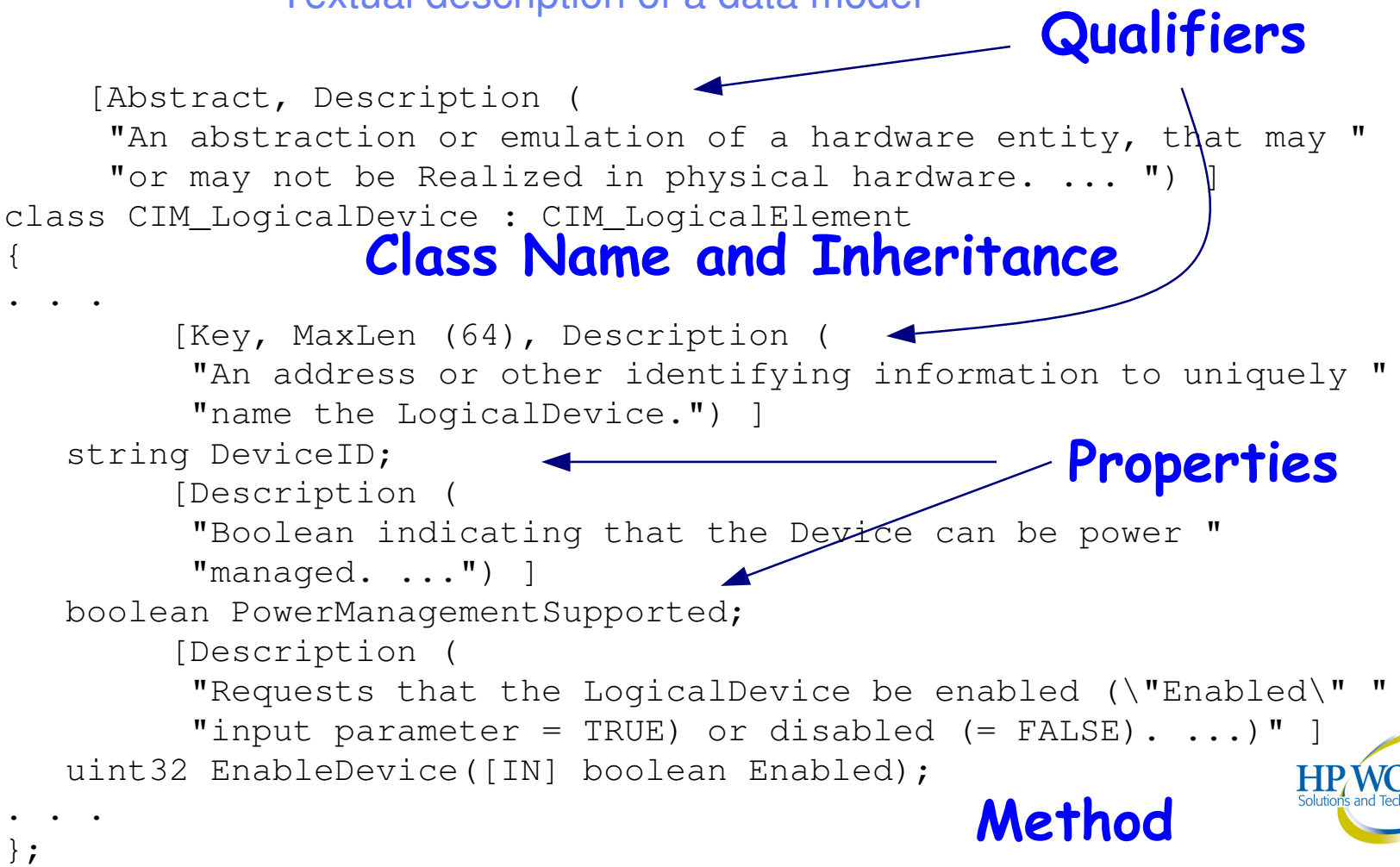


UML/Instance Example



MOF

- Managed Object Format
  - Textual description of a data model



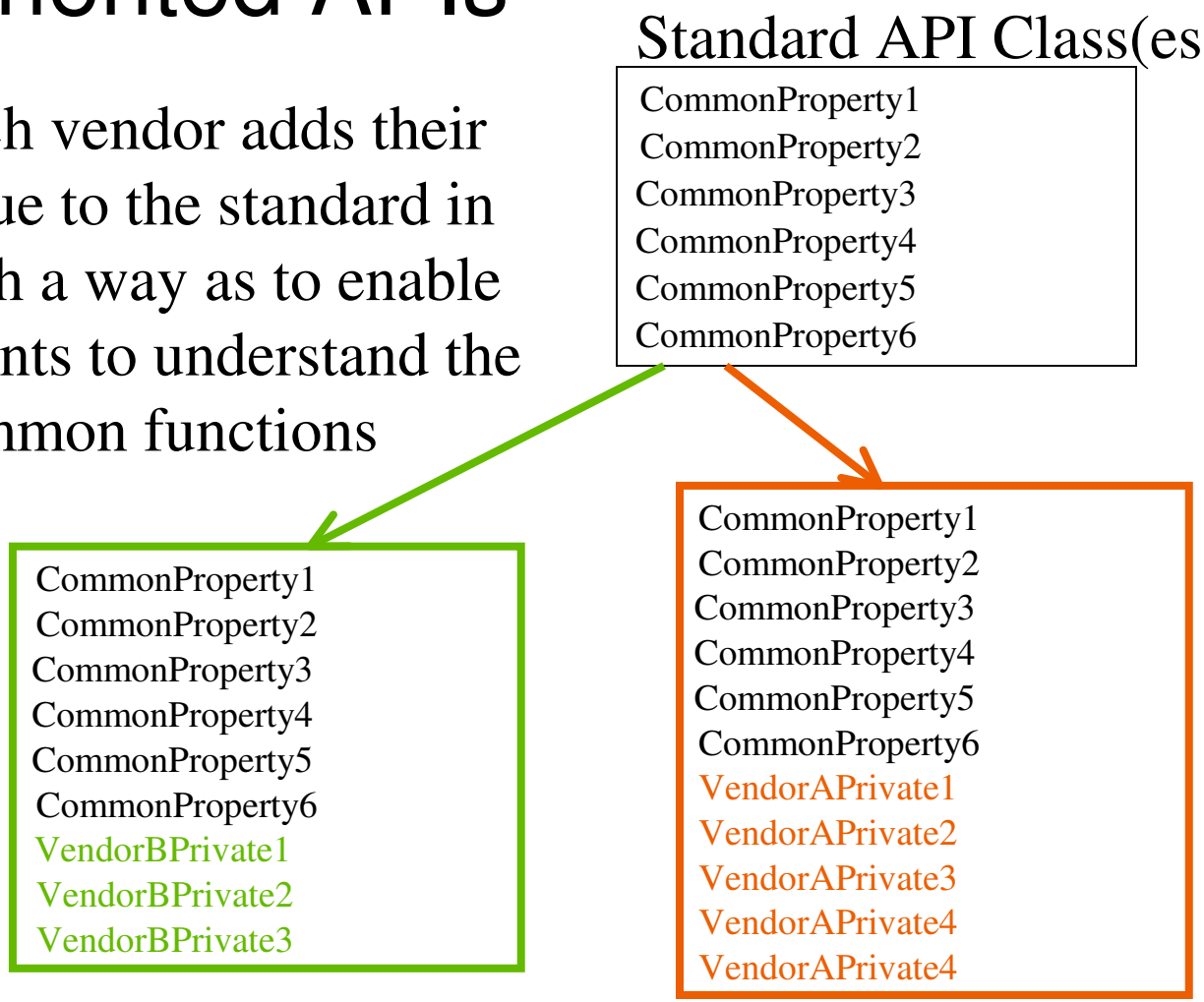

```
    [Abstract, Description (
     "An abstraction or emulation of a hardware entity, that may "
     "or may not be Realized in physical hardware. ... ") ]
class CIM_LogicalDevice : CIM_LogicalElement
{
. . .
        [Key, MaxLen (64), Description (
         "An address or other identifying information to uniquely "
         "name the LogicalDevice.") ]
   string DeviceID;
        [Description (
         "Boolean indicating that the Device can be power "
         "managed. ...") ]
   boolean PowerManagementSupported;
        [Description (
         "Requests that the LogicalDevice be enabled (\"Enabled\" "
         "input parameter = TRUE) or disabled (= FALSE). ...)" ]
   uint32 EnableDevice([IN] boolean Enabled);
. . .
};
```

Object Oriented APIs

- Part of API is in common with other vendors
  - Base class(es) have common properties
- Rest of API is an extension of the Base Classes
  - Proprietary properties extend the common ones
- No need to swap APIs
- One transport (protocol) for all functions
  - Public and Private

Object Oriented APIs

Each vendor adds their value to the standard in such a way as to enable clients to understand the common functions

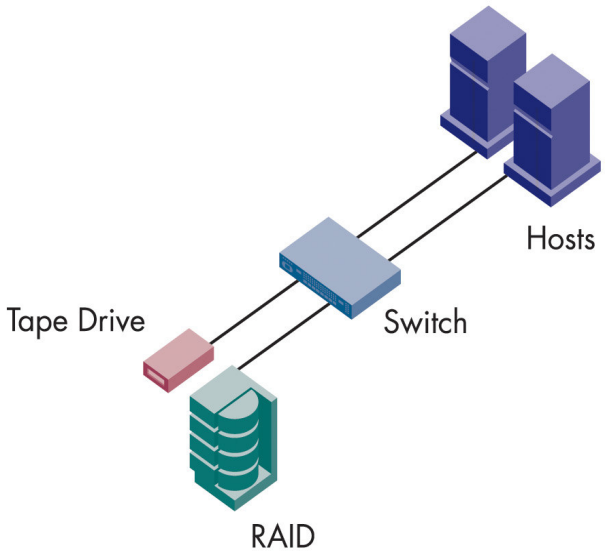


Other Key Benefits

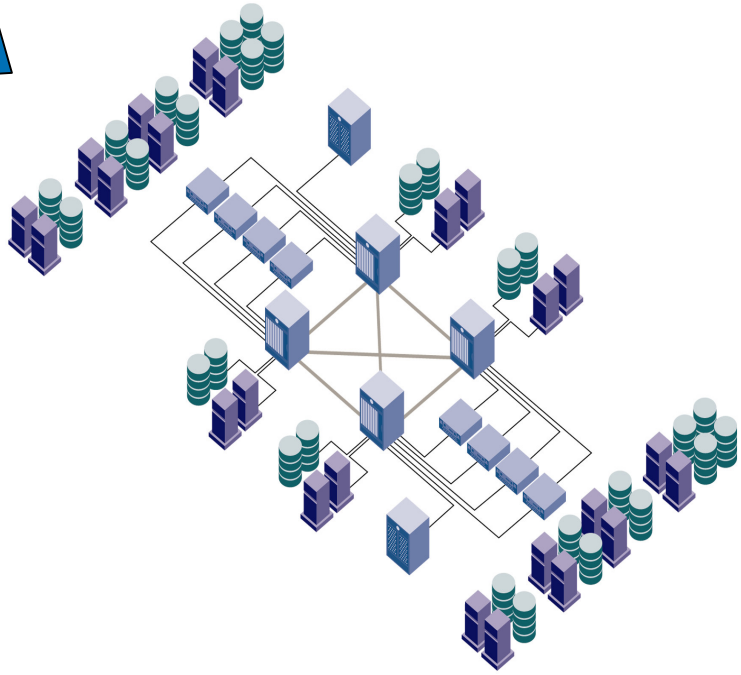
- Automated Discovery
  - Allows new devices to be configured, monitored and deployed automatically
  - Discovery of what the device is capable of and the interface for managing that capability
- Indications
  - Events are signaled asynchronously and delivered to any application that needs to know

Sample Use Cases

Managing Growth



As the storage network grows, each new device is discovered and managed



Indications allow clients to manage more devices by not polling each one

Monitoring

- SMI-S Provides basic status for each device
- Changes in status can be sent as indications
- SAN Managers can discover and show a topology of the SAN and the status of each device
- The topology can be used as a launch point for device and vendor specific user interfaces
- Indications can also be fed into event managers and correlated
- More comprehensive Health and Fault Management capabilities (common error, etc) targeted for 1.1

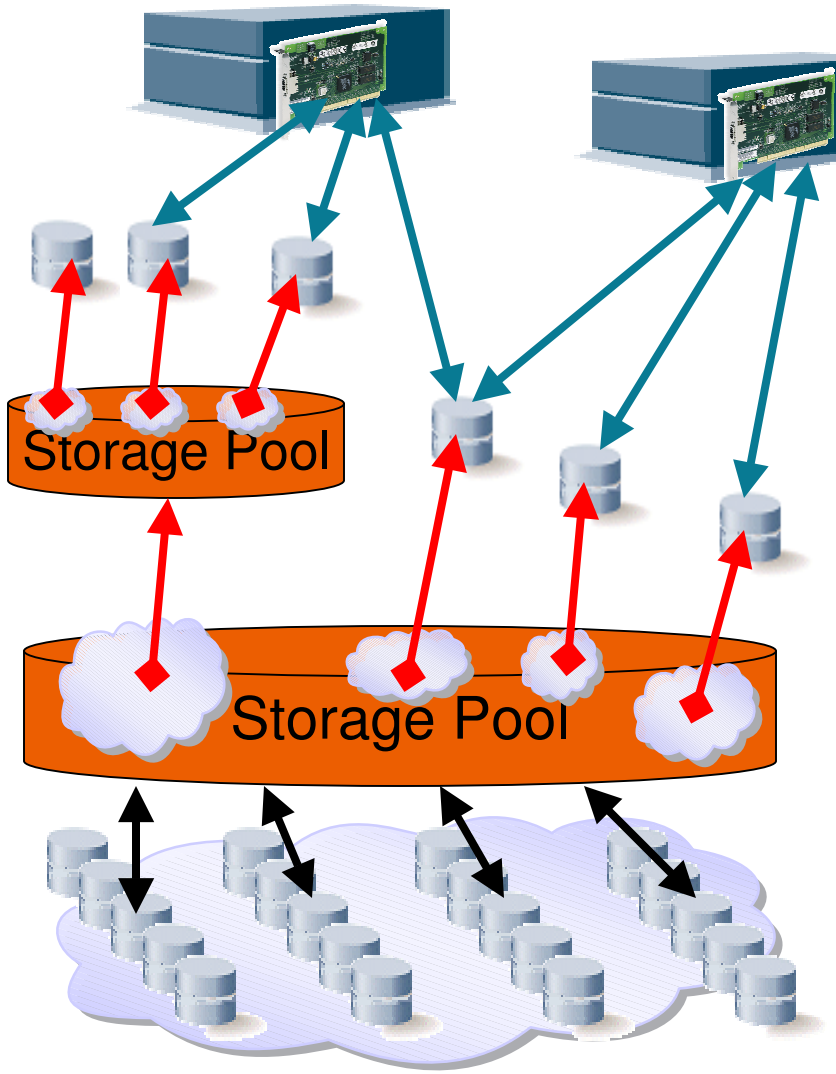
Automated Configuration

- SMI-S based instrumentation forms the basis for more automated configuration capability
- Examples:
  - All new arrays are to be configured for RAID5
    - Discovery triggers the invocation of LUN creation profile
  - Newly discovered fabric devices are put into a “Quarantined Zone”
    - Discovery triggers the invocation of the Zone modification in the fabric profile to add the new device to the specific zone
  - All newly discovered devices get Indication Subscriptions

Active Management

- SMI-S enables control over storage devices in the SAN in addition to monitoring and configuration
- LUN Masking and Mapping
  - Ability to manipulate the access control to array volumes (LUNs) from host FC ports
- LUN Creation and Pool Management
  - Carve volumes from undifferentiated storage specifying Quality of Service - like parameters
- Active Zone Management
  - Create and manage fabric zones

Storage Pools



LUN Masking and Mapping is done to one or more host HBA fibre channel ports

A Setting is provided for the volume during creation which specifies performance and availability (QoS)

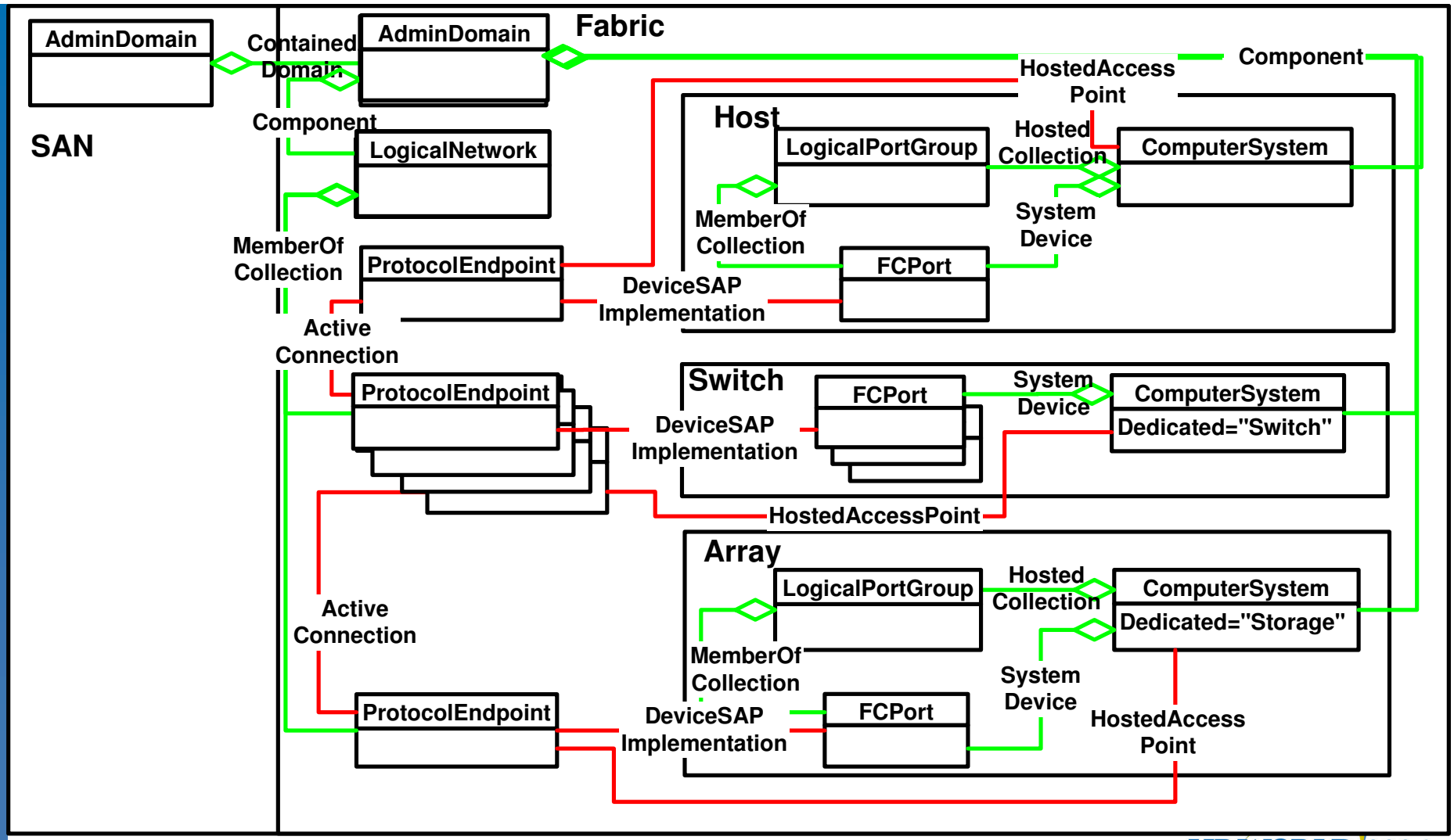
Virtualization of storage at the pool level allows either refined storage (pools) or virtual volumes to be created

Raw disks are aggregated into an undifferentiated pool of storage from which LUNs can be allocated

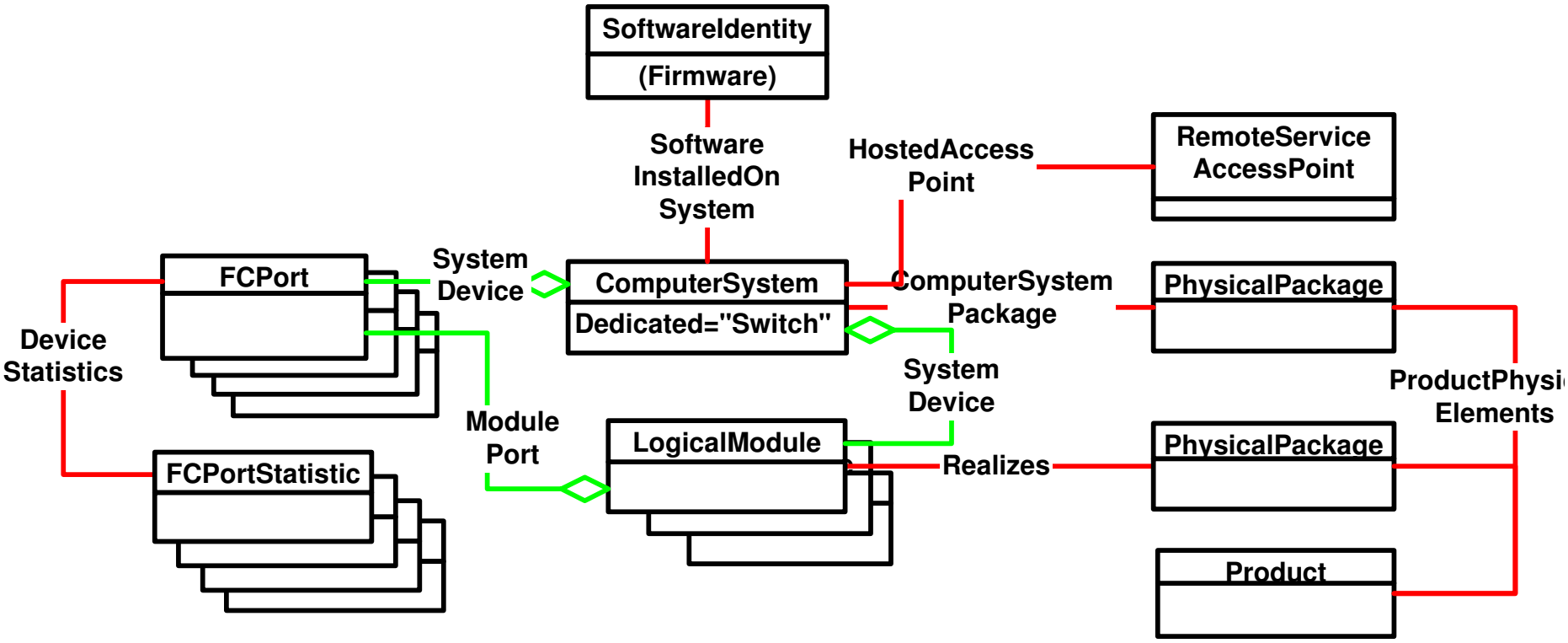
Storage Settings

Example Property	Meaning
NoSinglePointOfFailure	**Indicates the desired value for No Single Point of Failure. Possible values are false = single point of failure, and true = no single point of failure.**
DataRedundancy (Min and Max specified)	**DataRedundancy describes the number of complete copies of data to be maintained. Examples would be RAID 5 where 1 copy is maintained and RAID 1 where 2 or more copies are maintained. Possible values are 1 to n.**
PackageRedundancy (Min and Max specified)	**PackageRedundancy describes the number of spindles to be used. Package redundancy describes how many disk spindles can fail without data loss including, at most, one spare.**

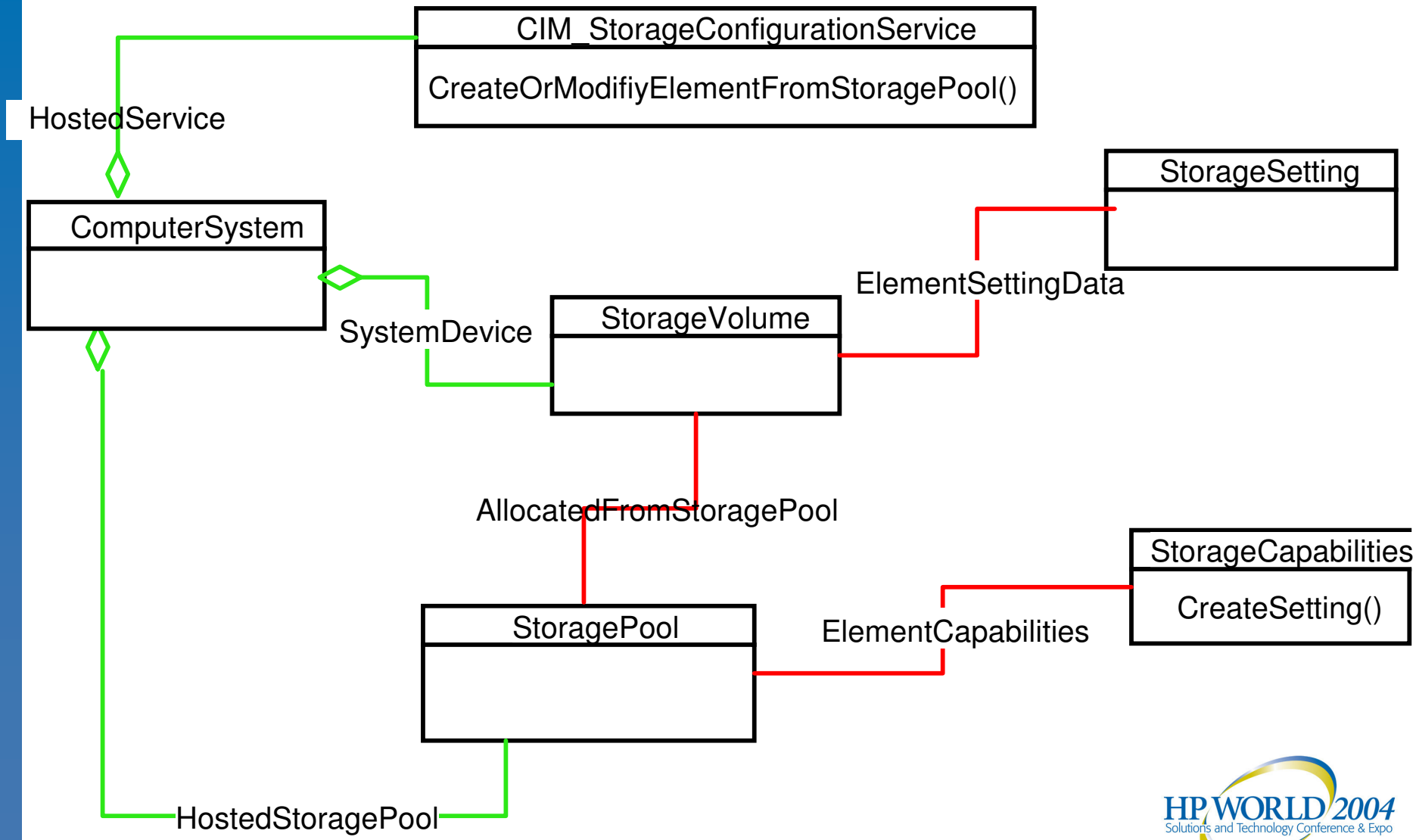
Network Instance Diagram



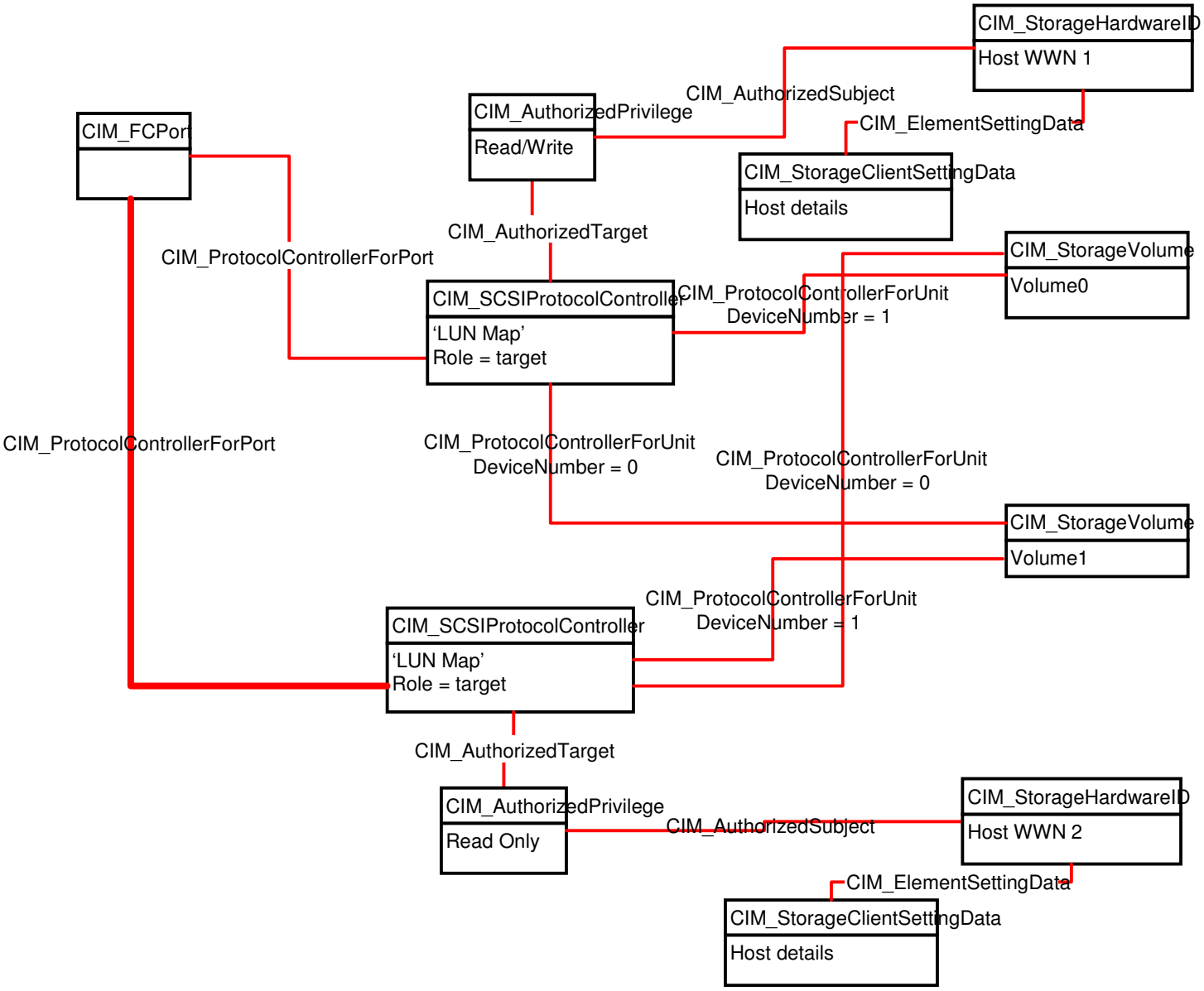
Switch Instance Diagram



Create a Volume



Fibre Channel / LUN Masking



Questions?

Thank You!

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