

CIM 101

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Agenda

- Information Modeling
- Management Environment
- DMTF Terminology
- CIM Advantages
- DMTF Models and Process



An abstraction and representation of the entities in a managed environment, their properties, attributes and operations, and the way that they relate to each other. It is independent of any specific repository, software usage, protocol, or platform.



Excerpt from IETF RFC 3198



A mapping of the contents of an information model into a form that is specific to a particular type of data store or repository; the rendering of an information model according to a specific set of mechanisms for representing, organizing, storing and handling data.



Excerpt from IETF RFC 3198



Elements of an Information Model

- Key Concepts
 - Abstraction
 - Modularity
 - Encapsulation
 - Hierarchy
- Key Elements
 - Classes
 - Objects
 - Relationships



Denotes the essential characteristics of an object that distinguish it from all other kinds of objects and thus provide crisply defined conceptual boundaries.



Excerpt from Object-Oriented Analysis and Design – Grady Booch

Cheeseburger



Good to eat!



Fun to cook!





Decomposition of abstractions into
discrete units.



Excerpt from Object-Oriented Analysis
and Design – Grady Booch

Example - Modularity





Process of compartmentalizing the elements of an abstraction that constitute its structure and behavior; encapsulation serves to separate the interface of an abstraction and its implementation.



Excerpt from *Object-Oriented Analysis and Design* – Grady Booch

Encapsulation - Example

To cook the cheeseburger:

- Is the stove available?
- Are the burners working?
- Are the ingredients available?



To eat the cheeseburger:

- Is it made correctly?
- Is my plate clean or disgusting?

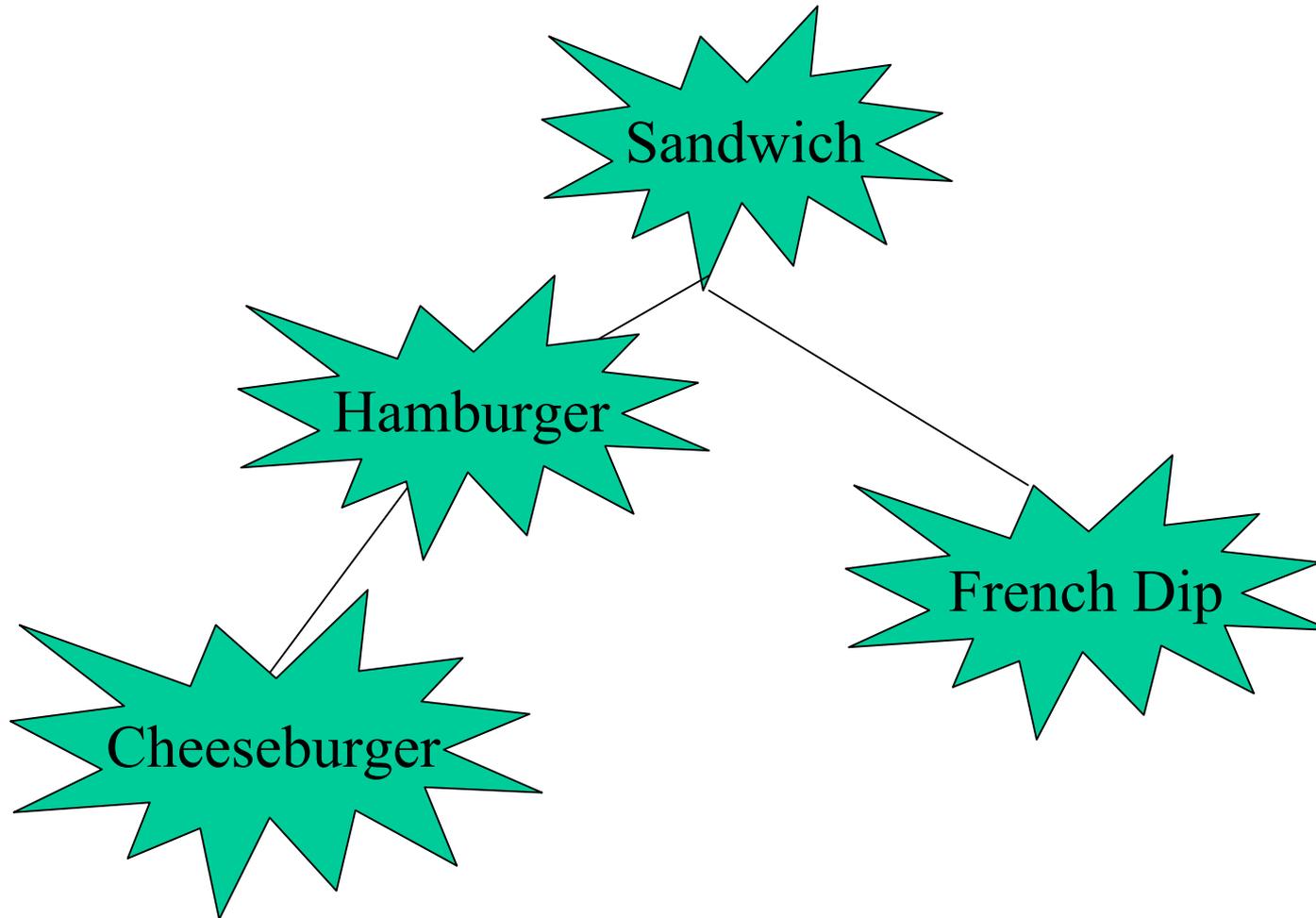


A ranking or ordering of abstractions.



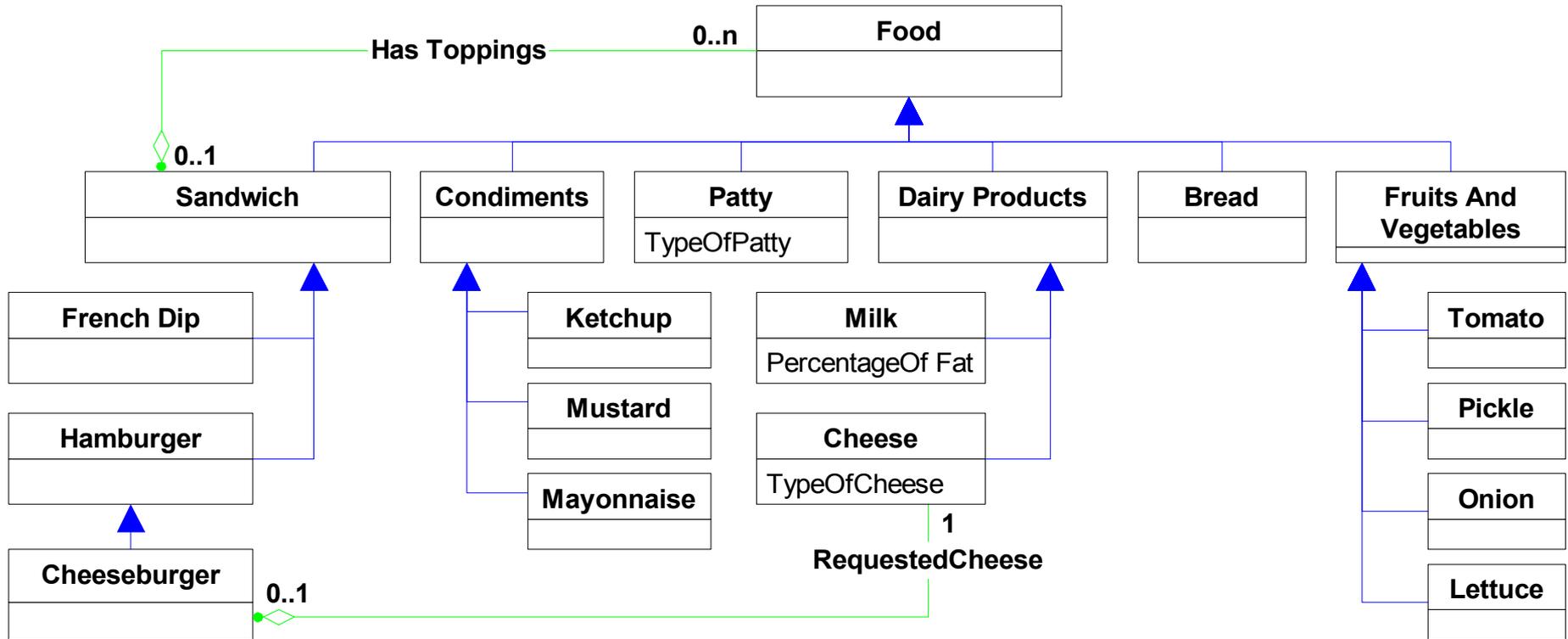
Excerpt from Object-Oriented Analysis and Design – Grady Booch

Hierarchy - Example



- Classes – A collection of definitions of state, behavior, and/or identity
 - Properties
 - Methods
- Objects – Instances of a class
- Associations - Relationships
 - Dependency
 - Identity
 - Aggregation
 - Composition
 - And others

Information Model - Example



- Information Modeling
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- CIM Advantages
- DMTF Models and Process

Address Operations and Management

General Disciplines / FCAPS

Event, Change/Configuration, Asset/
Accounting, Performance, Security,
Policy and Automated Operation

Day-to-Day Tasks

Service Tasks
Administrative Tasks
Operational Tasks

Areas of Expertise

Networks, Users,
Storage, Systems,
Software, Databases,
etc.

Scope

Local, Rollup and Aggregation
(For example, Clusters) and Enterprise



Management Environment

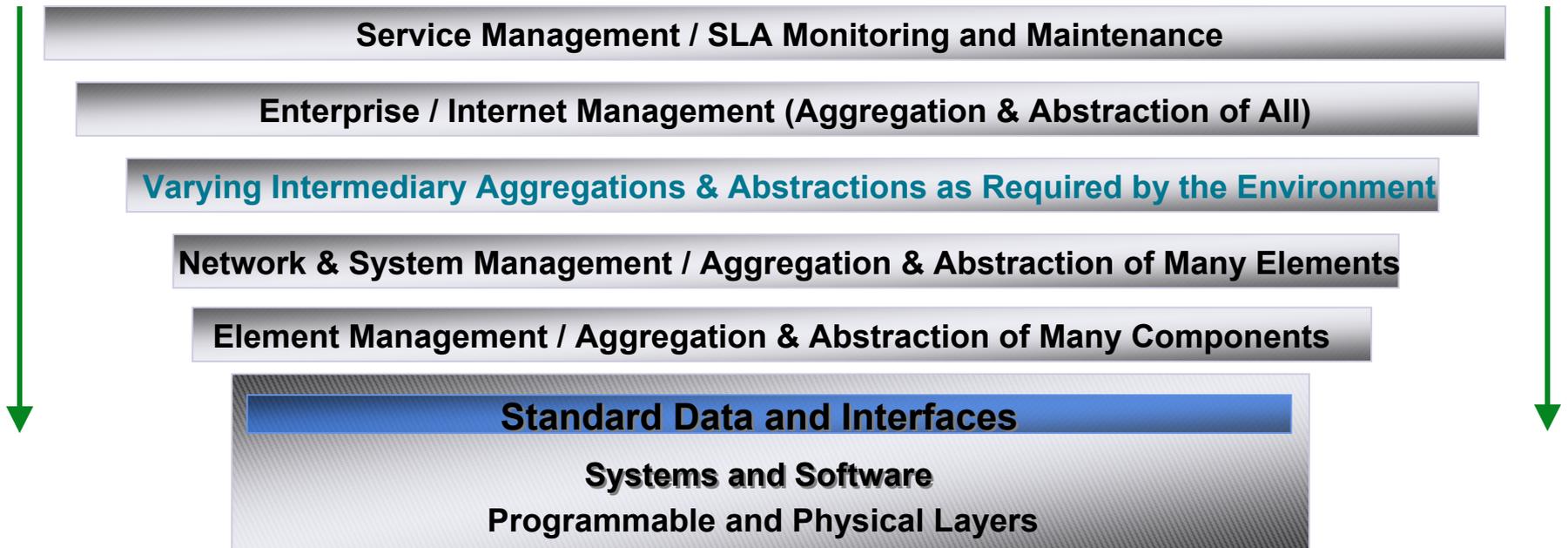
- Customer problems, product base and requirements are hugely variable
- Need coordination of standards and collaboration of vendors
- Win by having **manageability**/managed products that operate & interoperate in a customer's environment
- Focus on standards and open-source as basis for infrastructure and common abstractions
 - Broad model abstractions -> Coverage of multiple problem and technology domains
 - Abstractions and reusable infrastructure enable new devices to be managed more rapidly, and existing app's to manage them with minimal change



Customer Versus Product Views

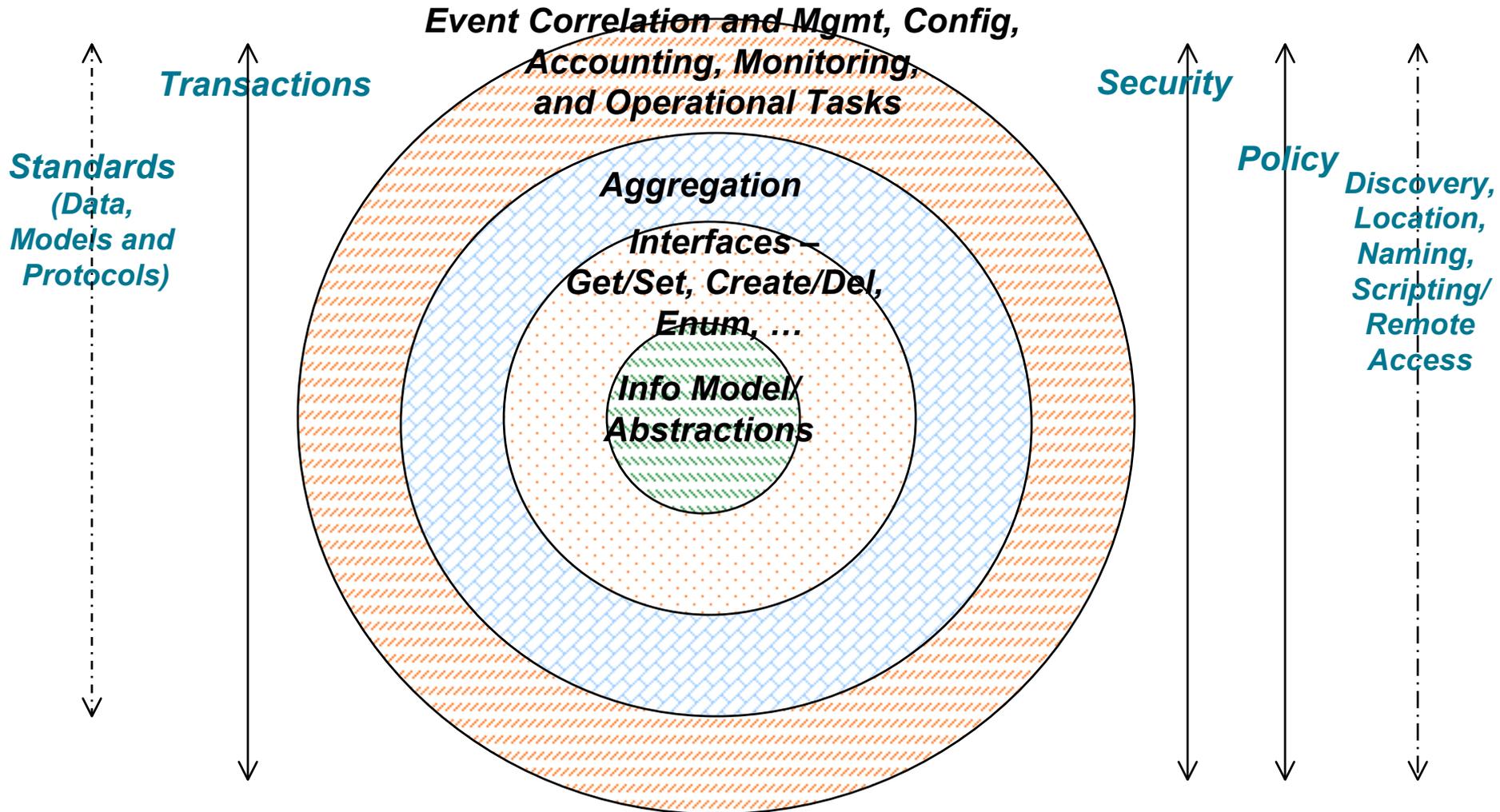


Vendor and Customer Information Model (Common Basis in Standards)



Management view based on aggregating and abstracting data (higher "levels" dependent on the data from underlying ones).

A Management Architecture



- Utilize standard data and interfaces, instrumented in products
 - SMBIOS (BIOS interface on Intel-based architectures), DMI (desktop interface), ASF (pre-OS alerting), WBEM/CIM, SNMP, ...
- Enabled by a single information model (CIM)
 - Defines basic constructs (user, group, system, interface, service/functionality, ...)
 - Is extensible within problem domains and for specific vendor functionality
 - Provides mechanisms to deduce semantics - For example, “know” (via inheritance) about a new FooDevice when it is defined as a subclass of LogicalDevice -> CoolingDevice

“Inner Circles”

- Interfaces defined generically such that they work at all levels
 - Manipulating data via get/set, create/delete, etc.
- Objects/instances change (or are manipulated, added onto, etc.) at the different levels
- Interfaces and model abstractions/ aggregations provide consistent semantics, as well as consistent programmatic interfaces
- Address ALL management views, tasks and levels



Mgmt Architecture from Another Angle

**Integrated
Mgmt
Services**

System/Service Data
Aggregated in CIM
Repositories

Business-wide,
Directory-based Info
and Policy via DEN

**Mgmt
and Client
Software**

DMI

CIM + CIM Ops +
Encoding/Transport

**Managed
Elements**

Desktop Mgmt
Interf + Master.MIF

WBEM + CIM

SNMP + MIBs

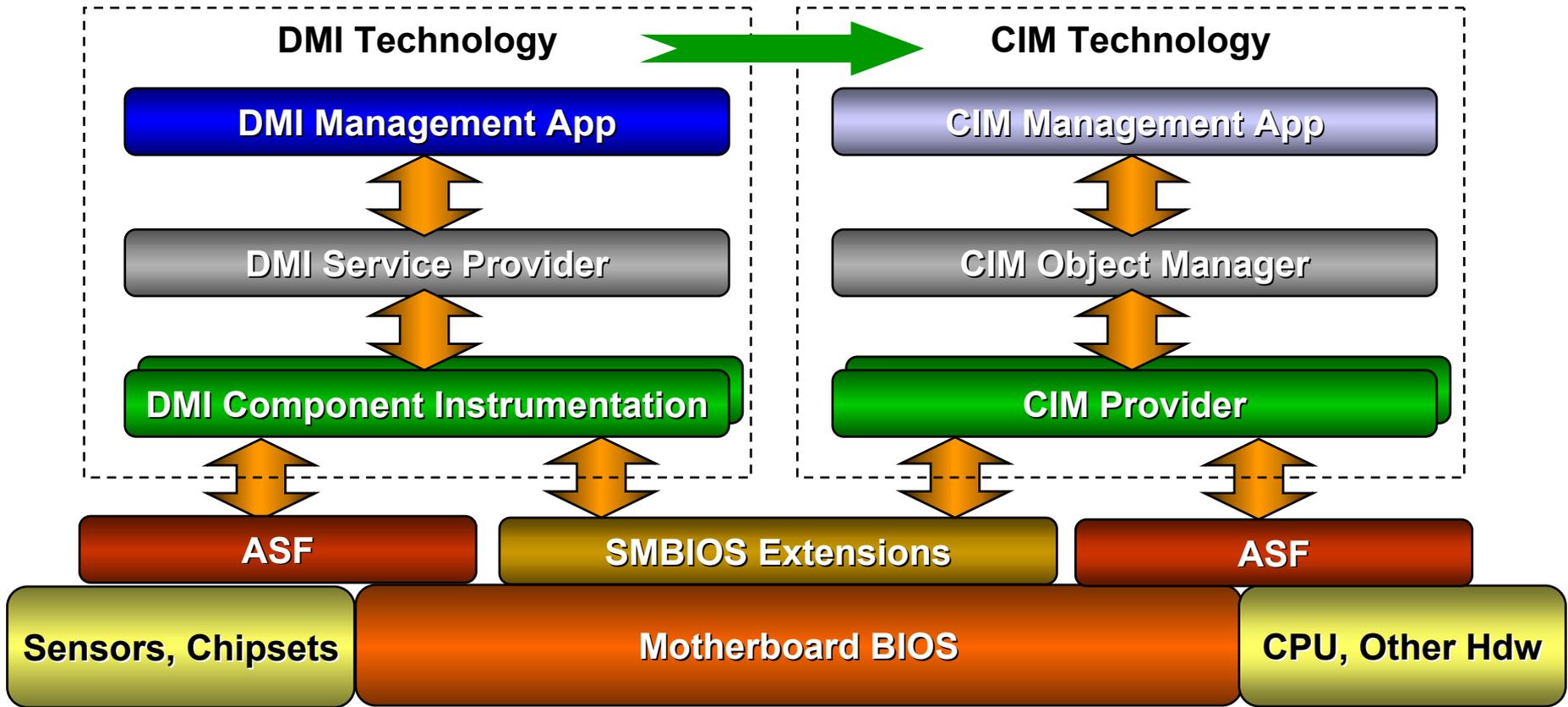
And More

Sys Mgmt BIOS

Alert Std Format -
OS-Absent Envs

Where Do the Pieces Fit?

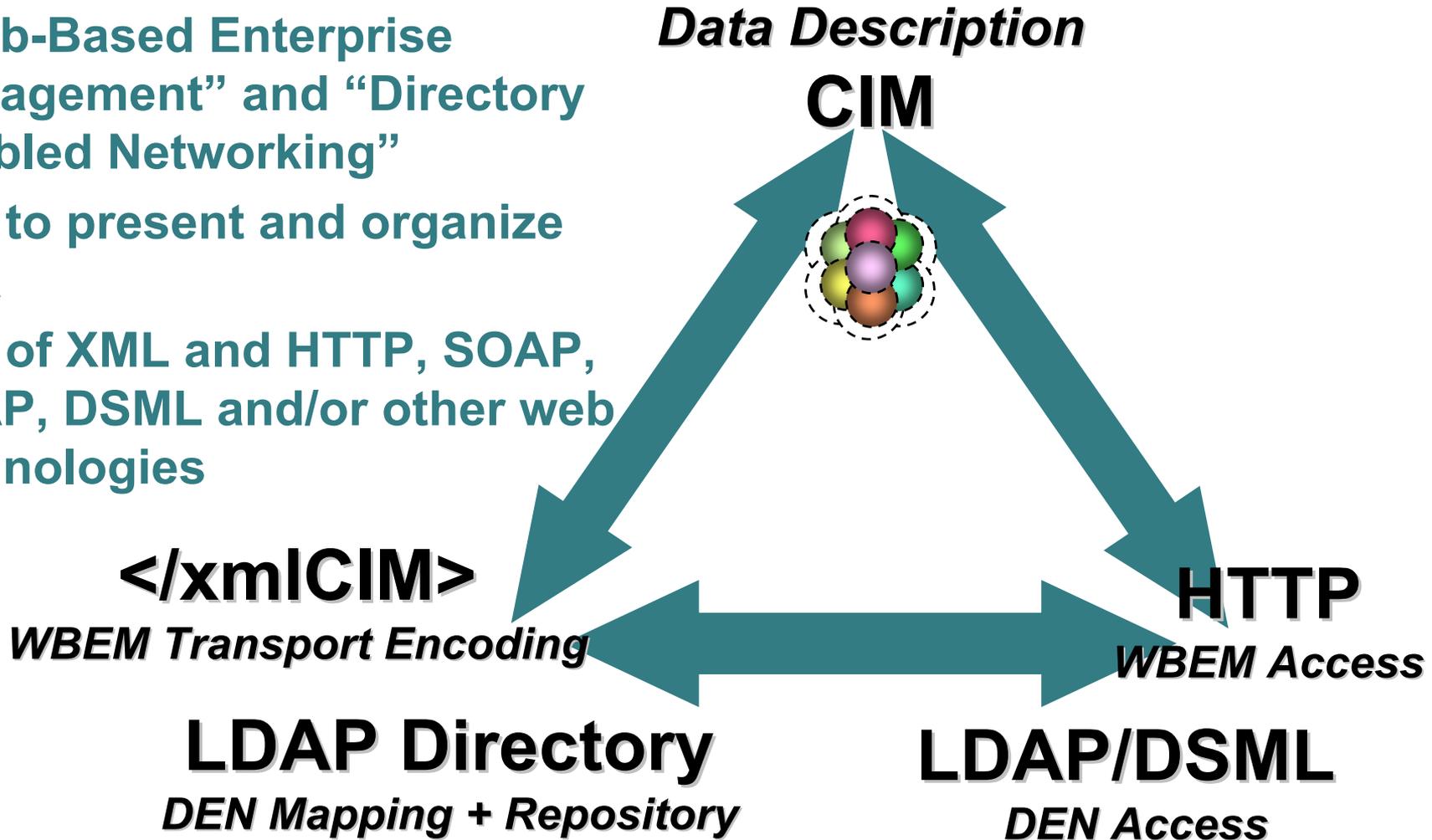
**Management Client and Applications –
WBEM, CIM and DEN Based**



- Information Modeling
- Management Environment
- **DMTF Terminology**
- CIM Advantages
- DMTF Models and Process

- WBEM – Web Based Enterprise Management
- CIM – Common Information Model
- Meta Schema
- MOF - Managed Object Format (ASCII or Unicode)
- VISIO for UML (Unified Modeling Language)
- XML - eXtensible Markup Language
- DTD – Document Type Definition
- DEN – Directory Enabled Networking

- “Web-Based Enterprise Management” and “Directory Enabled Networking”
- CIM to present and organize data
- Use of XML and HTTP, SOAP, LDAP, DSML and/or other web technologies

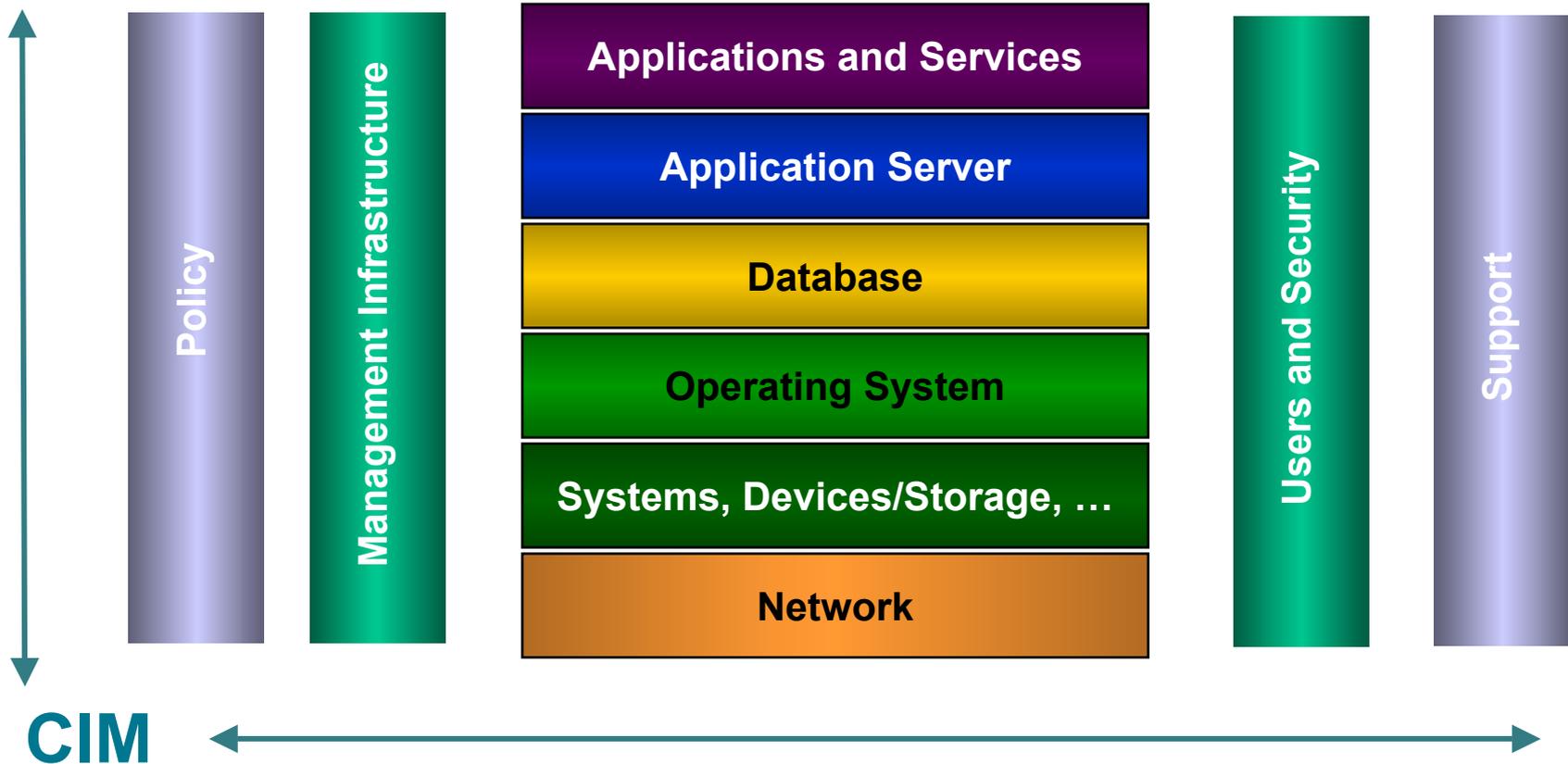


- Web-Based Enterprise Management
 - http://www.dmtf.org/standards/standard_wbem.php
- A set of technologies
 - CIM Schema
 - XML DTD to encode the Schema
 - CIM Operations over HTTP
 - Synchronous and asynchronous message request and response; Simple and multiple methods supported
 - Publish/subscribe mechanism for Indications (event notifications)
 - Extrinsic (methods on a class) and intrinsic (model operations) methods are defined – Get, Create, Delete, Modify, Enumerate, ...

- Common Information Model
 - http://www.dmtf.org/standards/standard_cim.php
- Core Specification
 - “Meta”-model, high level concepts and language definitions
- “Core” and “Common” Models
 - Object oriented design
 - Core Model contains info applicable to all management domains
 - Common Models address specific domains - Systems, Devices, Applications, Networks, Users, ...
 - Subclass from the Core Model
 - Models overlap and cross-reference
 - Vendor extensions encouraged



Customer's Mgmt Information Stack



- Meta Schema concepts
 - Class
 - Property
 - Method
 - Trigger
 - Indication
 - Association
 - References
 - Qualifiers

MOF Example

```

[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);
  . . .
};

```

Qualifiers

Class Name and Inheritance

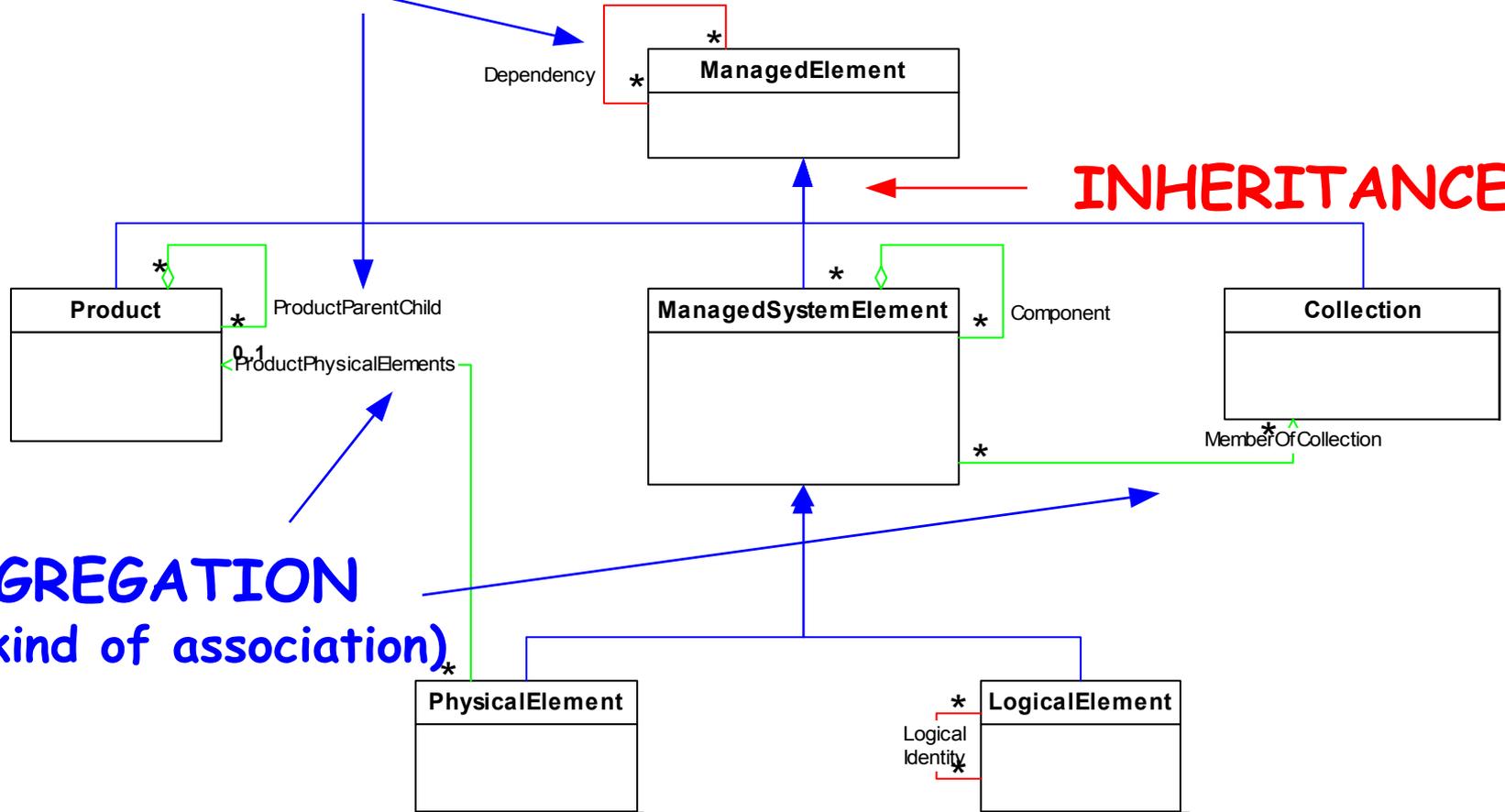
Properties

Methods

ASSOCIATIONS

INHERITANCE

AGGREGATION (A kind of association)



```
<CLASS NAME="CIM_LogicalPort" SUPERCLASS="CIM_LogicalDevice">
  <QUALIFIER TRANSLATABLE="true" NAME="Description" TYPE="string">
    <VALUE>The abstraction of a port or connection point of a Device. This object
      should be instantiated when the Port has independent management
      characteristics from the Device that includes it. Examples are a Fibre Channel
      Port and a USB Port. This class would not be instantiated for an Ethernet Port
      which is not managed independently of the EthernetAdapter.</VALUE>
  </QUALIFIER>
  <PROPERTY NAME="Speed" TYPE="uint64">
    <QUALIFIER TRANSLATABLE="true" NAME="Description" TYPE="string">
      <VALUE>The speed of the Port in Bits per Second.</VALUE>
    </QUALIFIER>
    <QUALIFIER TRANSLATABLE="true" NAME="Units" TYPE="string">
      <VALUE>Bits per Second</VALUE>
    </QUALIFIER>
  </PROPERTY>
  <PROPERTY NAME="MaxSpeed" TYPE="uint64">
    <QUALIFIER TRANSLATABLE="true" NAME="Description" TYPE="string">
      <VALUE>The max speed of the Port in Bits per Second.</VALUE>
    </QUALIFIER>
    <QUALIFIER TRANSLATABLE="true" NAME="Units" TYPE="string">
      <VALUE>Bits per Second</VALUE>
    </QUALIFIER>
  </PROPERTY>
</CLASS>
```

- Directory Enabled Networks
 - http://www.dmtf.org/standards/standard_den.php
- Map concepts from CIM (such as systems, services and policies) to a directory, and integrate this info to provide complete management architecture
- Use a directory FIRST to “direct” (register and discover) and to hold the “right” subset of management data
 - “Right” subset based on user scenarios and profiles

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- **CIM Advantages**
- DMTF Models and Process

- Internet- and enterprise-wide management
 - Wide breadth of objects + repository independent
 - Unifies and extends existing standards (MIBs, X.500, M.3100, ...)
- OO design
 - Abstraction, inheritance, ability to “classify”, extensibility via subclassing
 - Well-defined “locations” and usage semantics for classes and associations
- Associations depict relationships
 - Dependencies, topologies, aggregations, scoping, ...
- “Standard”, inheritable methods



Industry Adoption and Alliances

- WBEMSource (open source) initiative
 - TOG's Pegasus and SNIA CIM Object Manager
 - Sun's WBEM Services
 - Caldera's OpenWBEM
 - Major vendors contributing to Pegasus
- SNIA (Storage Networking Industry Association)
 - BlueFin and the Storage Management Initiative
 - "Develop, standardize, and drive the adoption of an open storage management interface"
- CompTIA
 - Diagnostics and trouble ticketing



Industry Adoption and Alliances

- Consortium for Service Innovation
 - Service incidents and trouble ticketing
- The Open Group
 - Unix and application modeling, QoS and Mobile Management
 - Directory initiatives and Challenge
- InTAP (Interoperability Technology Association for Information Processing)
 - In Japanese market, management interoperability between vendors
- Network Applications Consortium (NAC)
 - Requirements and design feedback on identity and service management, security and DEN



Industry Adoption and Alliances

- TM Forum
 - UML and modeling convergence
- FAST (Federation Against Software Theft)
 - Software identity and license management
- NW Energy Alliance
 - Power management
- In progress - GGF (Global Grid Forum)
 - CIM to manage the grid
- For more details
 - See the Alliance Work Registers
(<http://www.dmtf.org/about/register.php>)

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- Core – High-level abstractions (Logical and Physical Elements, Collections, ...)
- Physical – Things that you see and touch (for ex, (PhysicalPackage, Rack and Location)
- System – Computer systems, operating systems, file systems, processes, jobs, diagnostic services, ...
- Device – Logical function of hardware (for ex, Battery, Printer, Fan, NetworkPort and StorageExtent)
- Network – Services, endpoints/interfaces, topology, ...
- Policy – If/then rules and their groupings/applicability
- User and Security – Identity mgmt, white/yellow page data, RBAC, ...

- Applications and Metrics – Deployment and runtime management of software and software services
- Database – Properties and services performed by a database (both inventory and behavioral)
- Event – Notifications and subscriptions
- Interoperability – Management of the WBEM infrastructure
- Support – Help desk knowledge exchange and incident handling



DMTF Working Groups

<http://www.dmtf.org/about/committees.php>

CIM TC (Technical Committee)

**Interoperability/
Events**
Chair: WBEM Solns

Chair: Andrea Westerinen, Cisco
Board Members:
Intel, Microsoft, Cisco, Sun,
Tivoli/IBM, Dell, HP,
3Com, BMC, NEC, Oracle,
Novell, Symantec, Veritas
Contributing Members,
Alliance Partners, WG Chairs

System/Devices
Chair: Cisco

Applications/Metrics
Chair: TOG

Database
Chair: Oracle

Networks
Chair: Cisco

**DEN/
LDAP Mapping**
Chair: Cisco

Policy/SLA
Chair: IBM

User/Security
Chair: IBM

Under Discussion:
Security WG
Behavior/State WG

DMI
Chair: Smart Tech

PreOS
Chair: Intel

Support
Chair: CSI



DMTF Development Process

- Five phases in the release of DMTF Specifications and Schema:
 - Development by Working Groups
 - Member Comment
 - Company Review
 - Preliminary Standard
 - Final Standard
- All additions and updates to CIM submitted as Change Requests to the appropriate WG and then forwarded to the Technical Committee