Management of Dynamic Networks and Services
Correlation-Based Solutions

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Introduction:
Some Thoughts About Dynamics and Intelligence
(hopefully relevant to network and services management)

- The Dynamic, Dynamic, Dynamic World
- How Much Intelligence We Need?

What Makes Systems Dynamic?

Dynamic System:

- Changes its Entity (parameters, configuration, states, etc.)
- Consumes (and Redistributes) Resources
- Interacts with the World

Living (Biological) System:
- Has a Lifecycle (Note: Lifespan for Events!)
- And Reproduction Capability (Note: Reproduction of Abstract Automata,…and Machine Learning!)

What Makes Things Intelligent?

Intelligent System:

- Reflects (Interprets, Models) the World
- Organizes its Behavior (For survival and Achieving Goals)
- Learns (Discovers, Improves Skills)
- Communicates (with others; forms collectives, federations, cooperations under different organizational paradigms)
- Explains its Behavior (Results)

Synergy Between System Dynamics and Intelligence

- Dynamics is Pre-Requisite for Intelligence
- Intelligence Gives Dynamics Purposeful Behavior

Dynamics   Intelligence

Event Model ⟷ Correlation Model
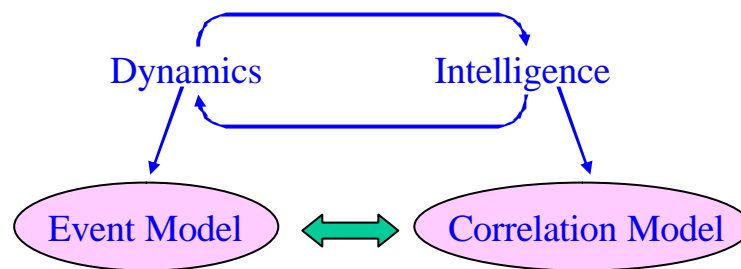
From Static Convenience To Dynamic Reality

• Many aspects of dynamic systems are often perceived as static

• "Living" in the real dynamic world, the systems are subjects for
  many internal dynamic transformations, such as:
  - changing the system internal states
  - dynamic system re-configuration
  - changes in the functionality of the nodes
  - transformations of link semantics
  - dynamic adjustment of behavioral goals and agreements
  - on-fly selection of system optimization criteria
  - dynamic re-specification of system interfaces

• Observation of these system aspects as dynamic entities, could
  lead to more adequate modeling of reality with significant rewards

Dynamic Systems: Basic Notions

- State - a set of system parameter values

- Dynamic System - a system, which changes its states over time

- Fault - a state with pre-defined abnormal parameter values

- Event – an act of transition of a system from state to state

- Informational Event - manifestation of an event via time-stamped piece of information

- Alarm – an informational event; external manifestation of a fault

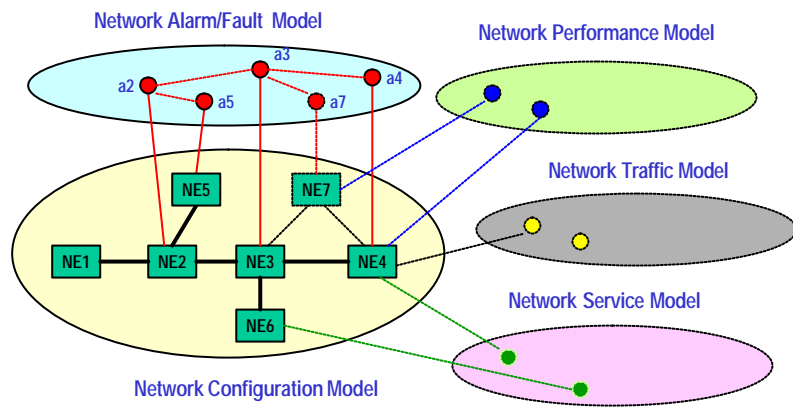# System Internal Events and Observable External (Informational) Events
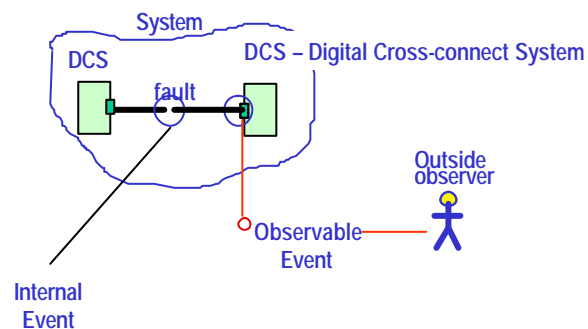
Event Types

- Event types by their source of origin
  - Base events - external events originated outside the correlation process
  - Derived events - events generated by the correlation process
- Event types by their function
  - Fault alarms
  - Clear messages
  - Status messages
  - Clock events
- Event types by their method of origination
  - Natural events, i. e. equipment faults
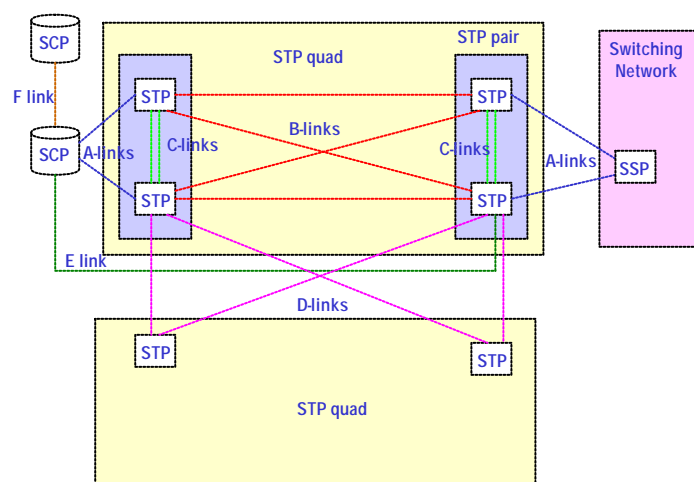 - Artificial events, i.e performance events

Dynamic Networks

- Traditionally network topology is considered as a static component in network management tasks
- Models of dynamic networks
  - Dynamically re-configurable networks
  - Active (programmable) networks
  - Dynamic VPN
  - Network updates during the management process
  - Mobile and survivable defense networks
  - Reconfigurable cellular networks (e.g. dynamic channel allocation)
- Dynamic network topology models
  - Real-time construction of network topology models

Dynamic Network Modeling

Network Alarm/Fault Model

Network Performance Model

a3

a2 a5 a7 a4

NE5 NE7

Network Traffic Model

NE1 NE2 NE3 NE4

NE6

Network Service Model

Network Configuration Model

Network Topology: Signaling Network

SCP

STP pair

Switching Network

STP quad

F link

STP STP

A-links C-links B-links C-links A-links

SCP SSP

STP STP

E link

D-links

STP STP

STP quad

Network Topology: Domain Class Hierarchy

Single inheritance

Class

Class/Subclass Relations
(is-a relation)

Subclasses

Multiple inheritance

Abstract Classes –
classes describing
mathematical abstractions
of real domain entities

Instances – objects
describing real physical
entities of the network
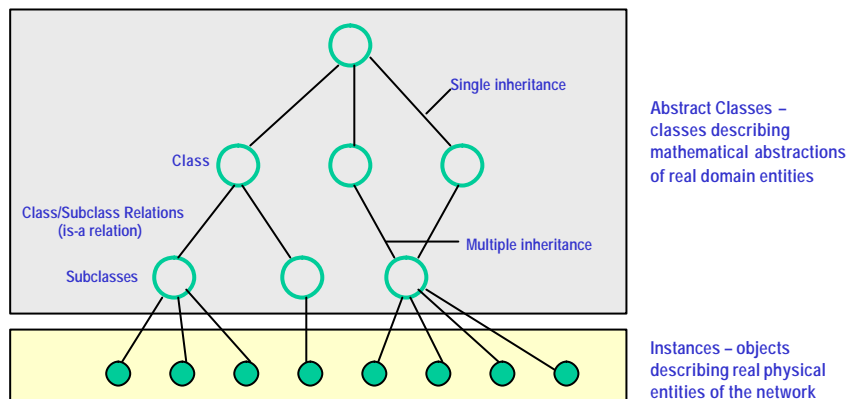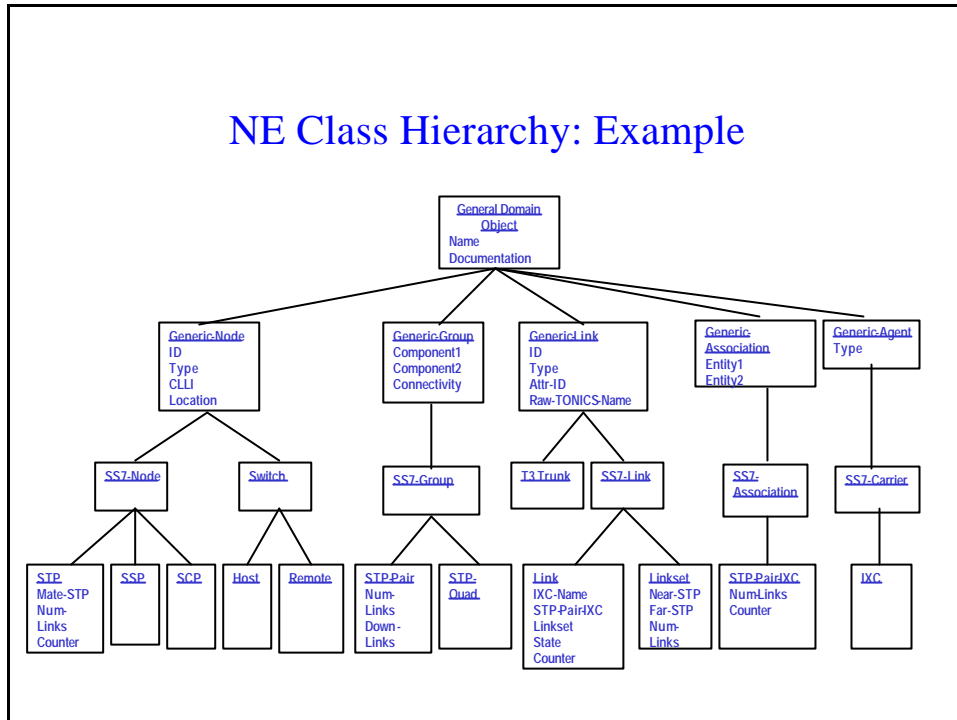
Network Topology Elements

- Network Element (NE) class specifications
  - Name
  - Type
  - Parents, children
  - CLLI code
  - Etc.
- NE instances descriptions
- Inter-NE relations
  - Class relations (is-a relations)
  - Connectivity relations
  - Containment relations
  - Part-of relations
  - Other domain-specific relations

NE Class Hierarchy: Example

General Domain Object
Name
Documentation

Generic-Node
ID
Type
CLLI
Location

Generic-Group
Component1
Component2
Connectivity

Generic Link
ID
Type
Attr-ID
Raw-TONICS-Name

Generic Association
Entity1
Entity2

Generic-Agent
Type

SS7-Node

Switch

SS7-Group

T3 Trunk

SS7-Link

SS7 Association

SS7-Carrier

STP
Mate-STP
Num-Links
Counter

SSP

SCP

Host

Remote

STP-Pair
Num-Links
Down-Links

STP-Quad

Link
IXC-Name
STP-Pair-IXC
Linkset
State
Counter

Linkset
Near-STP
Far-STP
Num-Links

STP-Pair-IXC
NumLinks
Counter

IXC

Domain Classes:Examples

Generic-Domain-Object
  Parent
    Basic-NE
  Children
    Generic-Node
    Generic-Group
    Generic-Link
    Generic-Association
    Generic-Agent
  Attributes
    Name
    Documentation
  Methods

Generic-Node
  Parent
    Generic-Domain-Object
  Children
    SS7-Node
    Switch
  Attributes
    ID
    Type
    CLLI
    Location

SS7-Node
  Parent
    Generic-Node
  Children
    STP
    SSP
    SCP
  Attributes

STP-Node
  Parent
    SS7-Node
  Attributes
    Mate-STP-CLLI
    Num-Links
  Methods
    GetNumLinks
    SetNumLinks

STP Class Specification in XML: Example

```
<DomainClass Name="STP-Node" Documentation="A class describing all STPs">
    <DomainClassParents>
        <DomainClassLink Name="Generic-Node"/>
    </DomainClassParents>
    <DomainClassSlots>
        <DCStringSlot Name="Mate-STP-CLLI"/>
        <DCIntegerSlot Name="Num-Links"/>
    </DomainClassSlots>
</DomainClass>
```
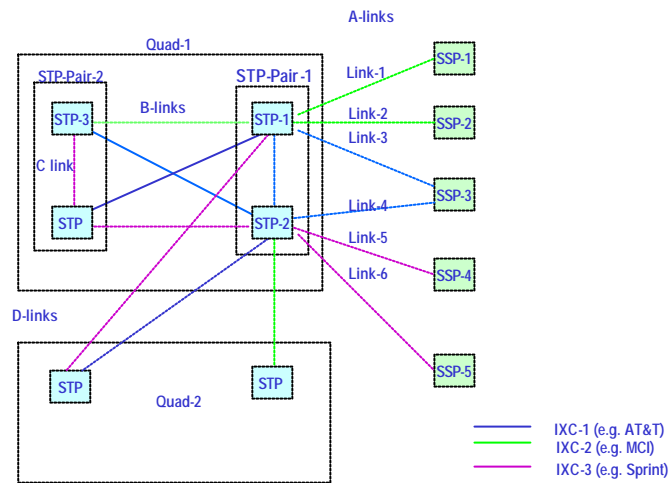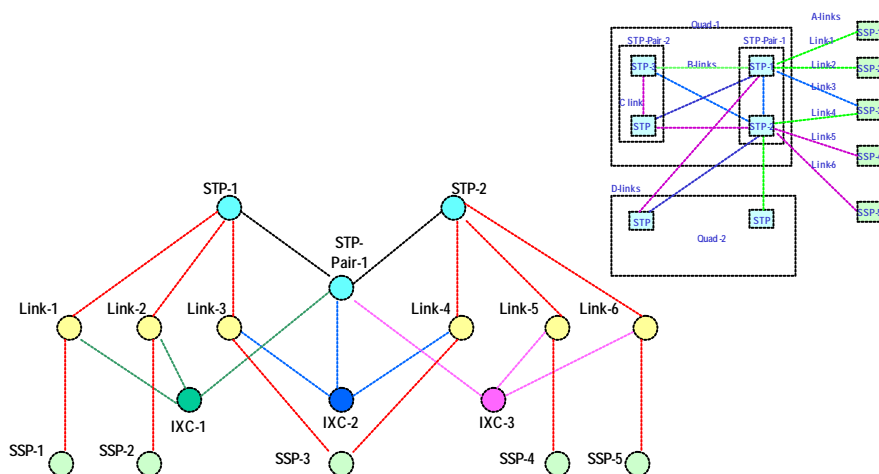
STP Object Specification in XML: Example

```
<DomainObject
    Name="dovrpaxd01w"
    Documentation="Description of the STP in Dover PA"
>
<Class>
    <DomainClassLink Name="STP-Node"/>
</Class>
<DomainObjectSlots>
    <DOSlot Name="ID" Value="1845888455"/>
    <DOSlot Name="NE-CLLI" Value="dovrpaxd01w"/>
    <DOSlot Name="NE-Name" Value="DOVER STP"/>
    <DOSlot Name="NE-Type" Value="dscstp"/>
    <DOSlot Name="Location" Value="Dover, PA"/>
    <DOSlot Name="Mate-STP" Value="yorkpaxm02w"/>
    <DOSlot Name="Num-Links" Value="9"/>
</DomainObjectSlots>
</DomainObject>
```
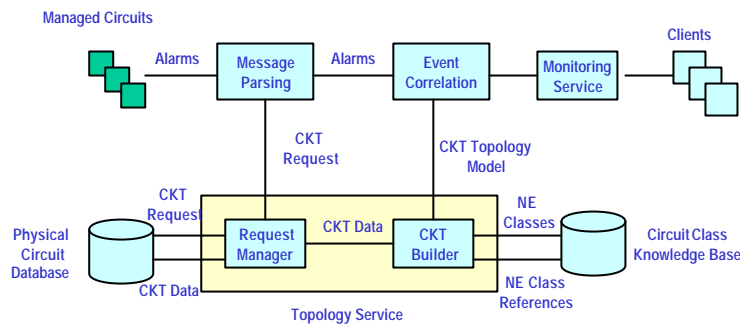
SS7 Network: A Fragment

Example: Fragment of a SS7 Network Topology Model

Dynamic Circuit Topology Building

Managed Circuits

Alarms → **Message Parsing** → Alarms → **Event Correlation** → **Monitoring Service** → **Clients**

CKT Request

CKT Topology Model

Physical Circuit Database

CKT Request

CKT Data

Request Manager — CKT Data — **CKT Builder**

NE Classes

Circuit Class Knowledge Base

NE Class References

Topology Service

Management of Dynamic IP Services

- Monitoring (in real-time) of services, SLAs, resources, and QoS is becoming a critical aspect of successful service provisioning
- Any fault or degradation of the network may result in violation of the SLAs or even halt the requested service
- Dynamic aspects of service management may include:
- - On-the-fly changes in service definitions
- - Dynamic re-specification of SLAs
- - Changes in resources
- - Requests for rapid near real-time deployment of new
-    services

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What is Event Correlation?

- Event Correlation is a real-time event analysis procedure, which, by using event pattern matching rules, assigns a new meaning to the events

- It is a critical process enabling the real-time fault diagnosis of complex networks and services

- It is Artificial Intelligence and Expert Systems technology based software, which is part of general Network/Service Management OSS

The Dual Role Of Event Correlation

- The traditional role of event correlation is to answer to the question: What did go wrong with the network?

- The new emerging role of event correlation is to answer to the question: How do understand the network situation?
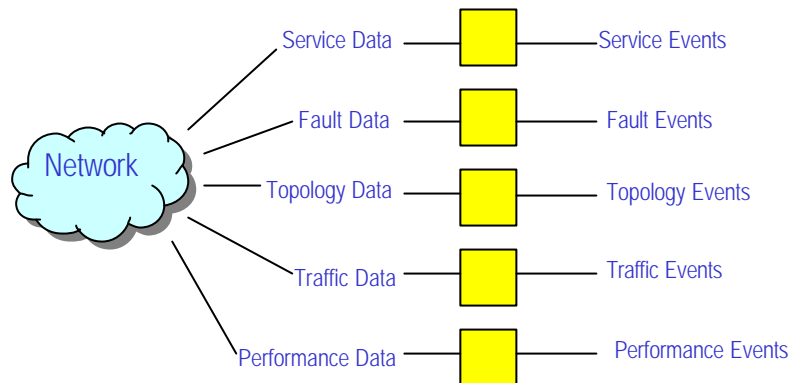
The Role of Time in Event Correlation

- Models of time
  - Interval
  - Point time
  - Event duration and lifespan
- Temporal aspects of event correlation
  - Temporal constrains
  - Temporal reasoning
- (Hard) real time processing
  - Synchronous and asynchronous events
  - Performance
- Natural delays, event masking, event racing, non-deterministic system behavior

Examples of Time –Dependent Correlation Functions

- Monitoring of Event Lifespan
  - For garbage collection purpose
  - For taking account of domain-specific event duration, e.g. "generator

    provides power for 2 hours (until fuel lasts)"
- Managing Correlation Time Window
  - E.g. "correlate 3 alarms during 5 seconds"
- Scheduling Time Dependent Actions

- Managing Time Relations Between Events

Event Sources

Network

Service Data	—	Service Events
Fault Data	—	Fault Events
Topology Data	—	Topology Events
Traffic Data	—	Traffic Events
Performance Data	—	Performance Events

Generalized Event Correlation Model

- Generalized (Abstract) Event Model

    $e = < dS, t>, e \in E; t \in T, T = \{0, 1, 2, 3, ...\}$

  e - event, E - set of all events, dS - system state change, T - time
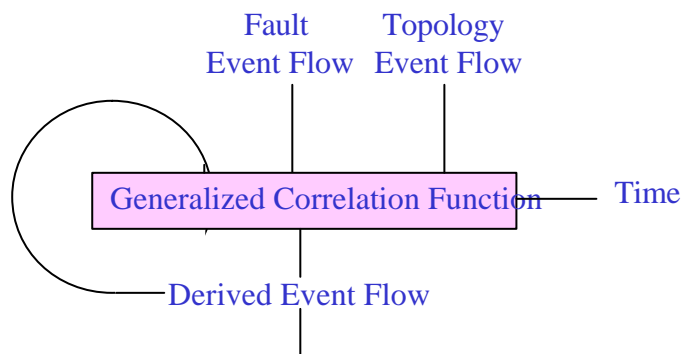
- Generalized (Abstract) Event Correlation Model

    $S = (E, CF), \quad CF: E^* \times T \longrightarrow E$

  CF – correlation function, E^* - set of all subsets of E

Generalized Event Correlation Model (cont.)

- Generalized event is mathematical abstraction of specific event types, such as
  - Topology events
  - Performance events
  - Service events
  - Traffic events
  - Fault events

Generalized Correlation Model (Cont.)

Pro-Active Network Fault Management

- Fault Propagation Model - Classical Model

  FM $= \mathbf{F_1}$ (Root Cause)

- Primary Symptoms Model

  FM $= \mathbf{F_2}$ (Primary Symptoms)

- Performance Model

  FM $= \mathbf{F_3}$ (Performance Trends)

Approaches to Event Correlation

- Rule-based reasoning
- Case-based reasoning
- Binary coding
- Other methods
  - model-based reasoning
  - finite state machines
  - neural nets
  - database methods
  - hardcoded programs

Codebook Approach
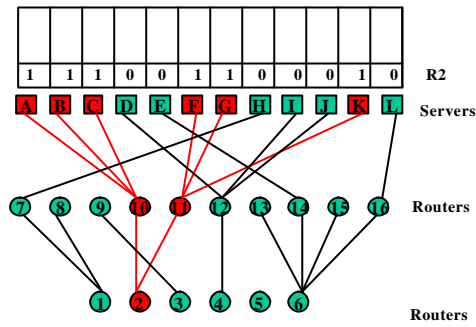
1. Incoming events are coded as binary 0/1 vectors.
2. Each problem is presented by a unique binary code – signature composed from network element alarms and logical conditions
3. Correlation process - finding closest match between the incoming vector and a signature
(uses Hamming distance calculation)

**The Codebook method has been used in the InCharge product by SMARTS**

Rete Algorithm

Very fast pattern matching algorithm
Rete algorithm takes advantage of two empirical observations:

Temporal Redundancy: The firing of a rule usually changes only a few facts, and only a few rules are affected by each of those changes.
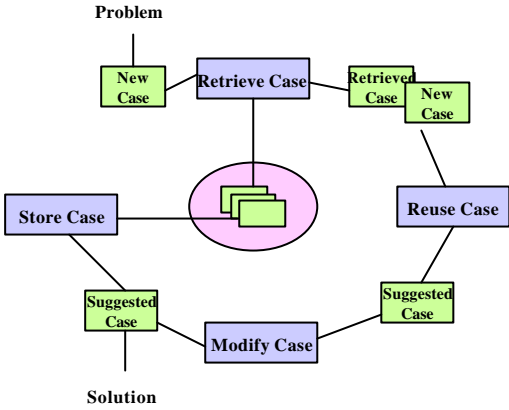
Structural Similarity: The same pattern often appears in the left-hand side of more than one rule.
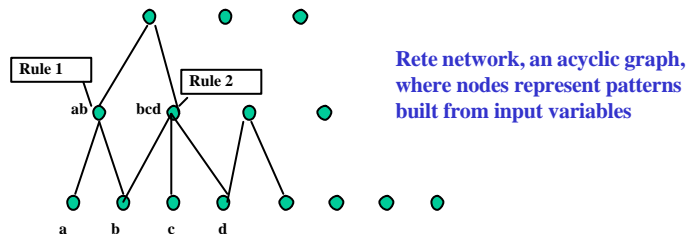
Rete network, an acyclic graph, where nodes represent patterns built from input variables

Charles Forgy, "Rete: A Fast Algorithm for the Many Pattern/Many Object Pattern Match Problem", Artificial Intelligence,19, pp 17-37, 1982.

Case-Based Approach

Problem

New Case — **Retrieve Case** — **Retrieved Case** — **New Case**

Store Case

Reuse Case

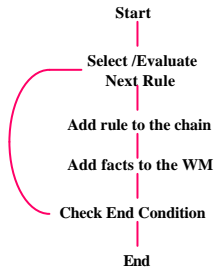**Suggested Case**

Suggested Case
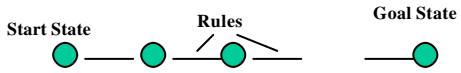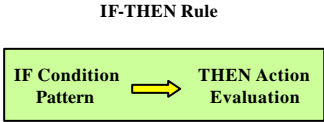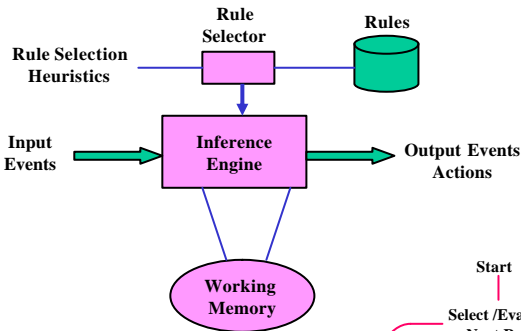
Modify Case

Solution

- Uses previous precedents (cases)
- Heuristics and indices to store and retrieve cases
- Modifies retrieved case to match new problems
- Contains some elements of learning

Rule-Based Approach

Planning RB Systems
 - opportunistic planning
 - agenda-based

Non-Planning RB
 - Rete network

Rule Selector

Rules

Rule Selection Heuristics

Input Events → **Inference Engine** → **Output Events Actions**

Working Memory

IF-THEN Rule

IF Condition Pattern ⟹ **THEN Action Evaluation**

Start State   **Rules**   **Goal State**

Start

Select /Evaluate Next Rule

Add rule to the chain

Add facts to the WM

Check End Condition
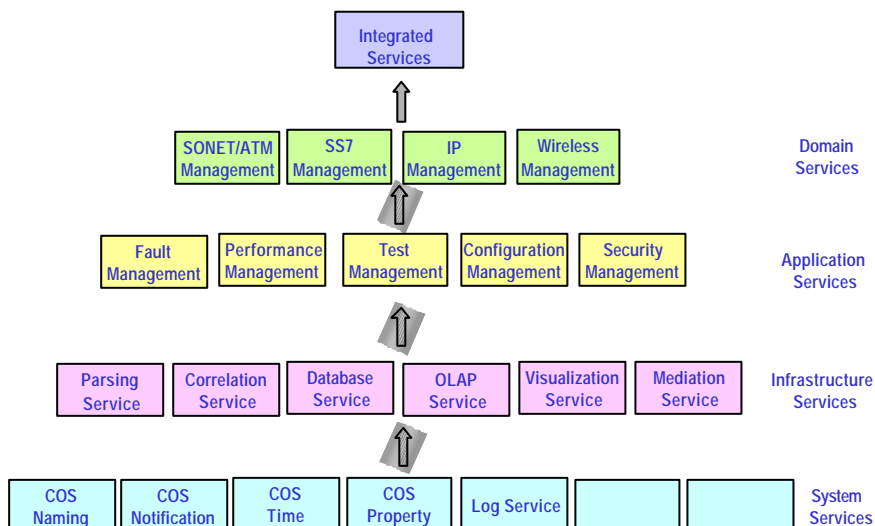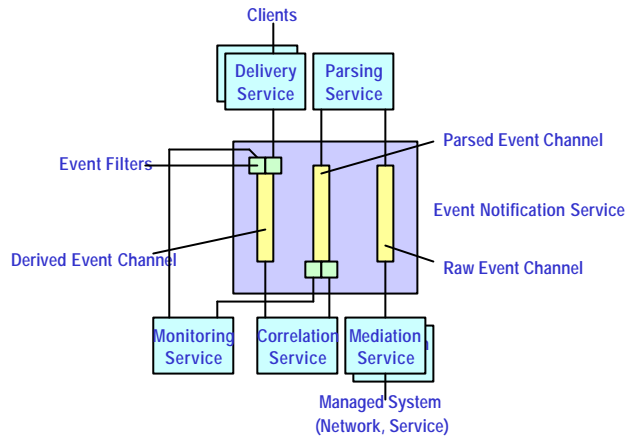
End

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Distributed Service-Based Architecture

- A major paradigm shift in building network management systems in general, and event correlation systems in particular.

- The use of standard services and communication protocols allows the building of open, scalable, and customizable systems.

- Encapsulation of idiosyncrasies of components and easy addition, replication, and replacement of components allows effective construction of multi-paradigm, fault-tolerant, and high performance systems

- Various technologies are used for building the infrastructure of distributed network management systems, including CORBA, DCOM, and RMI

Component-Based Service Framework

```
                    Integrated
                    Services

SONET/ATM    SS7          IP         Wireless              Domain
Management   Management   Management Management            Services

Fault        Performance  Test       Configuration Security Application
Management   Management   Management Management     Management Services

Parsing   Correlation Database OLAP      Visualization Mediation  Infrastructure
Service   Service     Service  Service   Service       Service     Services

COS      COS          COS   COS       Log Service                  System
Naming   Notification Time  Property                               Services
```
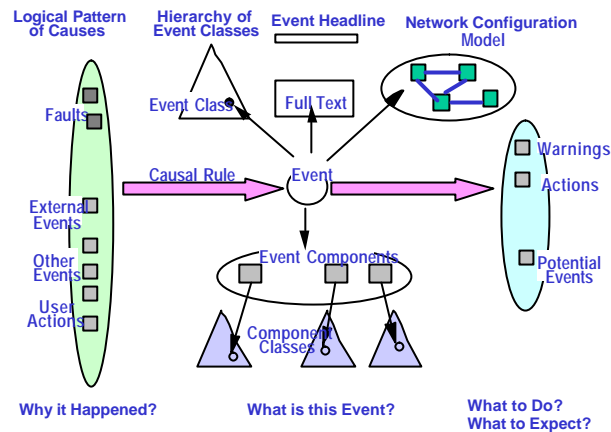
Event Notification Service


Distributed Event Management Architecture
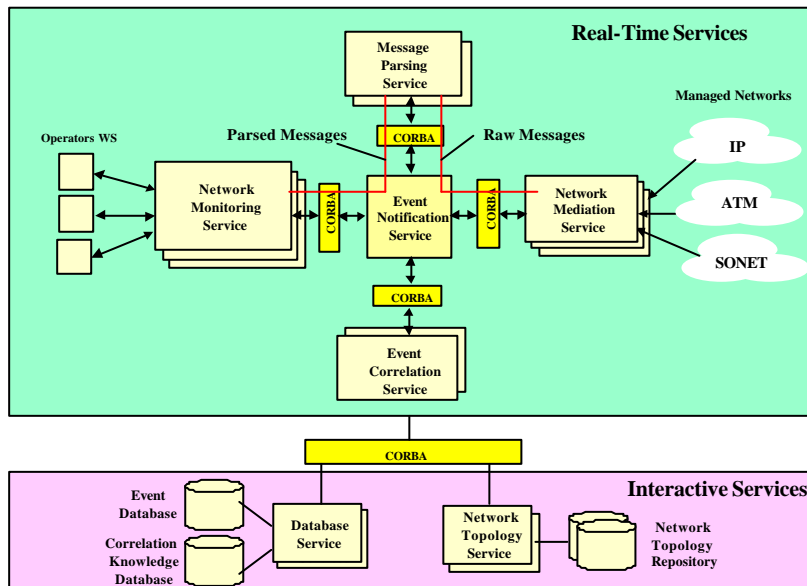
Event Explanation Process

Internet-Based Management

• The Internet is becoming a universal information
 transportation and service media.

• It will connect any business, home, device, transportation vehicle,
 process, living body or any other object - human or machine.

• Event correlation holds great potential for increasing the
 utility of information passed through the Internet.

• Provided as an Internet-based service to perform a variety
 of functions, e.g. stock market information correlation

• New opportunities will be open for customer-oriented event
 correlation, e.g. in the area of Customer Network management

Correlation DialTone:
Internet-Based Event Correlation Service
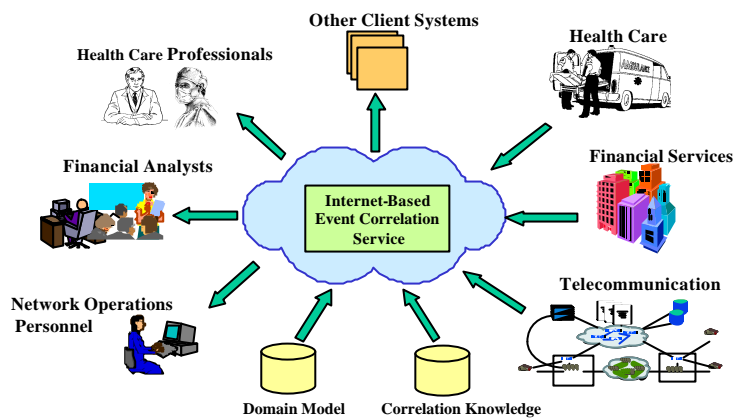

Advanced Correlation Features

- Explanation of the content of the derived solutions and   their logical reasons

- Discovery of correlation knowledge, e.g. learning correlation rules

- Extension of correlation paradigms with hypothetical reasoning

- Use of inexact (fuzzy) knowledge to estimate the possibility of derived solutions,

- Extensive use of the logic of time, space and action.

Multi-Paradigm Event Correlation

- Different solutions can be used to implement the same network management functionality, based on alternative reasoning paradigms.
- A paradigm will be selected based on the specificity of the tasks, the operational context, and the goals of the management process.
- While using multiple paradigms, the implementation, maintenance and support costs of parallel modules need to be evaluated

Event Correlation and Knowledge Discovery
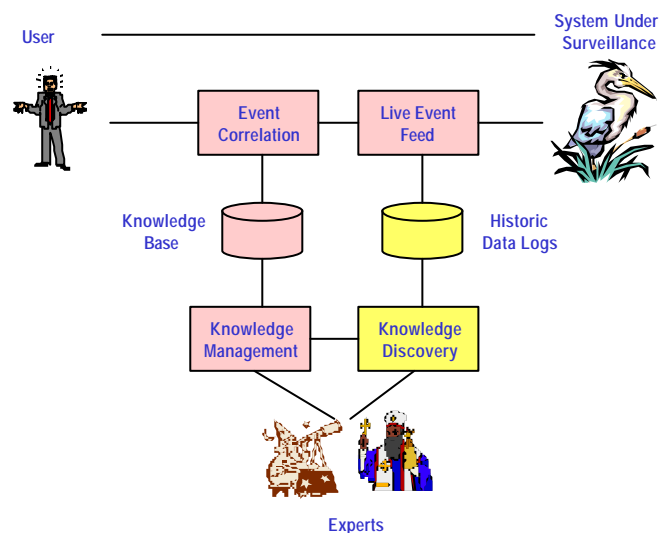
IETF NM activities Update

DSOM 2001, Oct 17th, 2001

Lucent Technologies
Bell Labs Innovations

IETF NM Activities

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Agenda

- IETF documents
  - ◆ RFC status
  - ◆ Internet Drafts
- SNMP Status
- IETF – Current NM (SNMP) Actvities
- Other NM Activities in IETF
- What do Operators Want/Need ?
- Service Management ?

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IETF – RFC status

■ Not All RFCs are Standards !!!!!!

◆ Standards Track
  ☞ Proposed Standard (PS)
  ☞ Draft Standard (DS)
  ☞ (full) Internet Standard (STD)
◆ Best Current Practice (BCP)
◆ Informational (some are FYI)
◆ Experimental
◆ Historic
◆ April 1st

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IETF - RFC Status (continued)

■ Standards Track Advancement (RFC2026)
  ◆ Proposed Standard (WG Consensus)
    ☞ 6 to 24 months
    ☞ Please implement and try; Recycle if problems
  ◆ Draft Standard
    ☞ Solid Specification; We believe it will not change
    ☞ Multiple Independent Interoperable Implementations
    ☞ Safe to implement and deploy in mission critical environment
  ◆ Internet Standard
    ☞ Wide deployment and useful in real world

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Internet Drafts

- Not all Internet Drafts are WG or IETF endorsed documents
- Most WG documents are named
  - Draft-ietf-<wg-name>-something-nn.txt
- Most non-WG documents are named
  - Draft-ietf-<author>-something-nn.txt
  - Draft-ietf-<author>-<wg-name>-something-nn.txt

- See http://www.ietf.org/html.charters/wg-dir.html
  - For all WG charters and WG documents

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SNMP Status - versions

- SNMP Message Wrappers:
  - SNMPv1
  - SNMPv2c
  - SNMPv3
- SNMP Protocol Operations (PDUs):
  - SNMPv1 Protocol Operations
  - SNMPv2 Protocol Operations
- Structure of Management Information (SMI):
  - SMIv1
  - SMIv2

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SNMP Status - version 1

- SNMPv1 message wrapper
  - no Security,
  - i.e. community string (plain text password)
- SNMPv1 Protocol Operations
  - GET, GETNEXT,
  - SET
  - GETRESPONSE,
  - TRAPv1
- SMIv1 data types
  - MIBs in SMIv1 format

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SNMP Status - version 1 (continued)

- SNMPv1 - (Full) Internet Standard
  - RFC1157 (STD 15)
    - ☞ Specifies Message Wrapper
    - ☞ Specifies Protocol Operations (PDUs)
- SMIv1 - (Full) Internet Standard
  - RFC1155 and RFC1212 (STD16)
  - RFC1215 (informational)
- MIB II(Full) Internet Standard
  - RFC 1213 (STD 17)
- Various Other MIBs (Proposed and Draft Stds)

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SNMP Status - version 2c

- SNMPv2c message wrapper
  - no Security (communityString (plain text pw))
- SNMPv2 Protocol Operations
  - Improved PDU error codes, exceptions
  - GET, GETNEXT, GETBULK
  - SET
  - GETRESPONSE
  - TRAPv2, INFORM
- SMIv2 data types
  - Textual Conventions
  - Conformance
  - MIBs in SMIv2 format

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SNMP Status - version 2c (continued)

- SNMPv2c - Mixed Standardization Levels
  - RFC1901 - experimental
    - ☞ Specifies Message Wrapper
  - RFC1905 (Draft Standard)
    - ☞ Specifies Protocol Operations (PDUs)
  - RFC1906 (Draft Standard)
    - ☞ Specifies Transport Mappings
- SMIv2 - (Full) Internet Standard (STD 58)
  - RFC2578 - SMIv2
  - RFC2579 - Textual Conventions for SMIv2
  - RFC2580 - Conformance Statements for SMIv2
- Various MIB s
  - RFC1907 (Draft Standard) and many others

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SNMP Status - Architecture

- SNMP Architecture
  - ◆ Modular Approach, Extensible
  - ◆ Multiple Security Protocols/Mechanisms
  - ◆ View Based Access Control Model
  - ◆ Coexistence of multiple SNMP versions
    - ☞ Specifically SNMPv1, SNMPv2c, SNMPv3
    - ☞ Also future versions (if any)
  - ◆ Remotely Configurable via SNMP
    - ☞ users and their security mechanisms/secrets
    - ☞ access to MIB objects
    - ☞ notification destinations and filtering
    - ☞ proxy configuration

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SNMP Status - version 3

- SNMPv3 message wrapper
  - ◆ Real Message Security
    - ☞ User Based Security Model
      - • Authentication (SHA -1 and MD5)
      - • Privacy (CBC-DES encryption)
    - ☞ Allows 3 security Levels
      - • not Authenticated, no Privacy (same as SNMPv1/v2c)
      - • authenticated but no Privacy
      - • authenticated with Privacy
    - ☞ Replay protection (limited)
  - ◆ Message level error reporting (Reports)
  - ◆ Scoped PDU allows for Multiple Contexts

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SNMP Status - version 3 (continued)

- SNMPv2 Protocol Operations
  - ◆ Improved error codes, exceptions
  - ◆ GET, GETNEXT, GETBULK
  - ◆ SET
  - ◆ GETRESPONSE
  - ◆ TRAPv2, INFORM
- SMIv2 data types
  - ◆ Textual Conventions
  - ◆ Conformance
  - ◆ MIBs in SMIv2 format

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SNMP Status - version 3 (continued)

- SNMPv3 - Draft Standard
  - ◆ RFC2070 - Introduction (Informational)
  - ◆ RFC2071 - Architecture
  - ◆ RFC2072 - Message Processing
  - ◆ RFC2073 - Applications
  - ◆ RFC2074 - User Based Security Model
  - ◆ RFC2075 - View-Based Access Control Model
  - ◆ RFC1905 - Protocol Operations
  - ◆ RFC1906 - Transport Mappings
- SMIv2 - (Full) Internet Standard (STD 58)
  - ◆ RFC2578 - SMIv2
  - ◆ RFC2579 - Textual Conventions for SMIv2
  - ◆ RFC2580 - Conformance Statements for SMIv2

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SNMP Status - version 3 (continued)

- Various MIBs (Draft Standard)
  - RFC1907 - SNMPv2 MIB
  - RFC2571 - SNMP-FRAMEWORK-MIB
  - RFC2572 - SNMP-MPD-MIB
  - RFC2573 - SNMP-TARGET-MIB
  -              SNMP-NOTIFICATION-MIB
  -              SNMP-PROXY-MIB
  - RFC2574 - SNMP-USER-BASED-SM-MIB
  - RFC2575 - SNMP-VIEW-BASED-ACM-MIB
  - and many others
- SNMP Co-existence - Proposed Standard
  - RFC2076 - SNMP-COMMUNITY-MIB

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SNMP Status – SNMPv3 Features

- Comes with Modular and Extensible Architecture
- Improved SNMPv2 Operations
  - GetBulk, Inform
  - Better error Codes and Exception Codes
- Security and Access Control to MIB objects
- Remote Configuration of SNMP Engine
- Coexistence with SNMPv1 and SNMPv2c
- Over 10 interoperable implementations
- Various vendors are shipping
- Deployment reports coming in
- See http://www.ibr.cs.tu-bs.de/projects/snmpv3/

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IETF – Current NM Activities 1/5

- Ongoing work SNMPv3 WG
  - ◆ advance SNMPv3 to Full Internet Standard
- SNMPCONF WG
  - ◆ Configuration Management with SNMP
  - ◆ Policy-Based Network-Wide Configuration Management
- SMIng WG - Next Generation of SMI
  - ◆ More Object Oriented
  - ◆ Merge SPPI and SMI
- EOS WG - Evolution Of SNMP
  - ◆ Performance Enhancements
  - ◆ Within SNMP Architecture (RFC2571)

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IETF – Current NM Activities 2/5

- DISMAN WG - Distributed Management
  - ◆ Advance various MIBs to Draft Standard
    - ☞ Remote Operations (Ping, Traceroute, dnslookup)
    - ☞ Script and Scheduling MIBs
    - ☞ Expression, Event and Notification Logging MIBs
  - ◆ New ALARM MIB
- RMONMIB WG - Remote Monitoring
  - ◆ Advance RMON1 and RMON2 MIBs to Full Standard
    - ☞ Including high capacity versions
  - ◆ APM MIB (Application Performance Monitoring)
  - ◆ DSMON MIB (Diffserv Monitoring)
  - ◆ etc

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IETF – Current NM Activities 3/5

- IPv6 MIB Design Team
  - ◆ INET-ADDRES-MIB
    - ☞ IPv4 and IPv6 Friendly
  - ◆ IANA-TADDRESS-MIB
    - ☞ IPv4 and IPv6 friendly, SNMP neutral
  - ◆ Various MIBs for IPv4 and IPv6
    - ☞ UDP-MIB, TCP-MIB
    - ☞ IPv6 related MIBs
- Various MIBs – O&M Area and most other Areas
- IRTF Services Management RG
- IRTF Network Management RG

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IETF – Current NM Activities 4/5

- AgentX WG - Extensible Agents
  - ◆ IETF Standards Track
    - ☞ AgentX is Proposed Standard, RFC 2741
    - ☞ AgentX MIB is Proposed Standard, RFC2742
  - ◆ IETF Experimental/Historic
    - ☞ SMUX (Historic) - RFC 1227
    - ☞ DPI (Experimental) - RFC 1592
  - ◆ Proprietary
    - ☞ SNMP Research Emanate
    - ☞ Others

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IETF – Current NM Activities 5/5

- IETF MIB Activities
  - In protocol or application WG
  - Some generic ones in O&M Area
- Other standard bodies MIB Activities
  - IEEE
  - ITU
  - Others
- In other Forums and Private MIB Activities
  - Enterprise MIBs
  - SAN,
  - etc

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Other NM Activities in IETF

- AAA WG
  - Authentication, Authorisation, Accounting
  - Focus on NAS, MobileIP, Roaming
  - Selected DIAMETER as base protocol
  - Working on specification for Proposed Standard

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Other NM Activities in IETF

- Policy Framework WG
  - Policy Core Information Model
    - Proposed Standard (RFC3060)
  - Policy Core Information Model Extensions
  - Policy Core LDAP Schema
  - Policy Framework (??)
  - Policy QoS Information Model
  - Policy Device Information Model
  - Policy Terminology (approved as RFC)
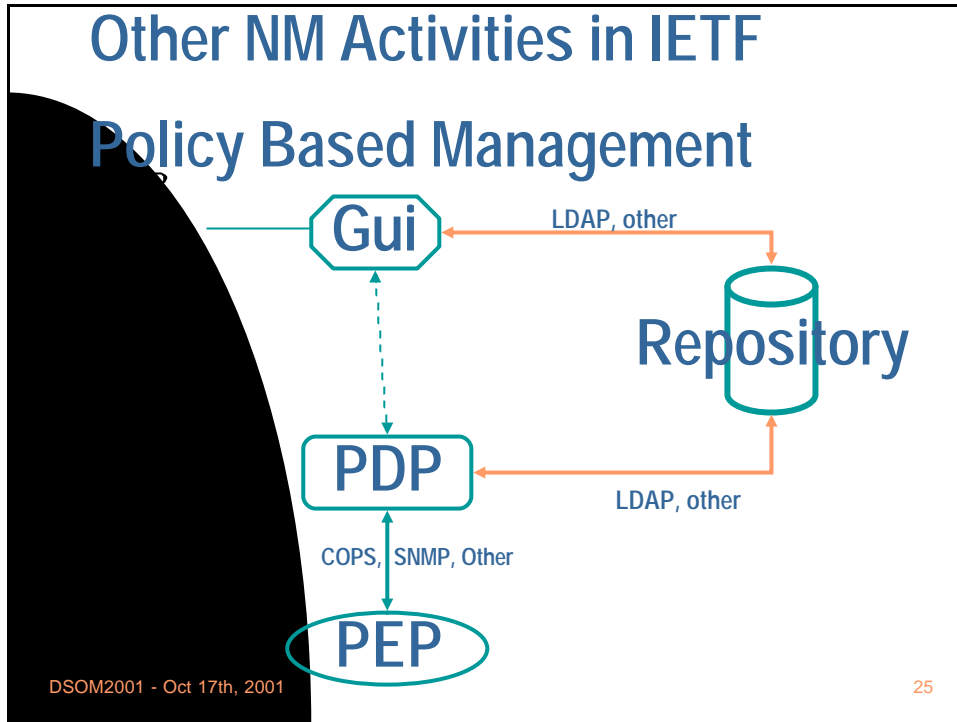
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Other NM Activities in IETF

- RAP WG - Resource Access Protocol
  - COPS
    - Common Open Policy Service Protocol
    - For Outsourcing Policy Decisions
    - Proposed Standard
  - COPS-PR
    - For Policy Provisioning
    - Proposed Standard
  - SPPI
    - Structure of Policy Provisioning Information
    - Proposed Standard
  - Base PIBs (Policy Information Base)

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Other NM Activities in IETF

Policy Based Management

Gui — LDAP, other → Repository

PDP ← LDAP, other

COPS, SNMP, Other

PEP

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Other NM Activities in IETF

- New sub-IP Temporary Area
  - ◆ WGs
    - ☞ CCAMP - Common Control & Measurement Planes
      - Does SNMP apply?
    - ☞ MPLS
      - Doing quite a few MIBs
    - ☞ IPO
    - ☞ IPORPR
    - ☞ TE-WG
      - Doing a MIB for Traffic Engineering
    - ☞ PPVPN
    - ☞ GSMP
      - Includes a MIB

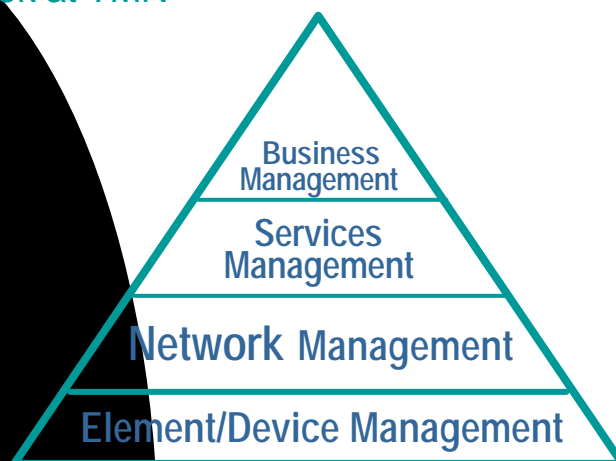DSOM2001 - Oct 17th, 2001

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What do Users/Operators Want?

- Plain CLI
- Text based interfaces aka SMTP
- See
  - ◆ Draft-ops-operator-req-mgmt-00.txt
- We had (will have) meetings with operators
  - ◆ At IETF 50 and 51
  - ◆ At NANOG (core IP network ISPs)
  - ◆ At RIPE (IP ISPs)
  - ◆ At LISA (in December 2001, Enterprise networks?)
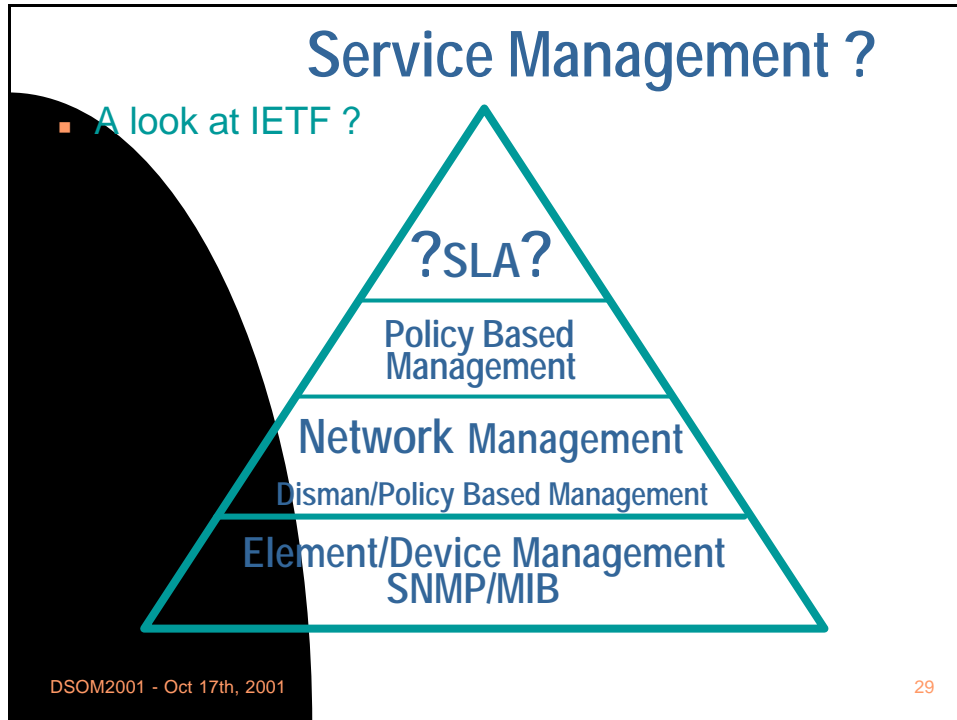- Not much talk about service management

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Service Management?

- A look at TMN

Business Management

Services Management

Network Management

Element/Device Management

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Service Management ?

- A look at IETF ?

?SLA?

Policy Based Management

Network Management

Disman/Policy Based Management

Element/Device Management
SNMP/MIB

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Service Management?

- Do Vendors want it Standardized?
  - ◆ In fact do they want NM Protocol standards?
  - ◆ Do they want standard MIBs
  - ◆ Is there an incentive? Only for Startups?
  - ◆ Operators want std protocol and MIBs
    - ☞ Allows them to mix and match
- Do operators want Standardized SM ?
  - ◆ I am not sure
  - ◆ It may take away their competetive advantage
  - ◆ If they do… they should step up to the task
- IRTF Services Management RG

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More Information

- http://www.ietf.org/html.charters/wg-dir.html
  - For all current IETF Working Groups
- http://www.ietf.org
  - Starting point for IETF information
- http://www.ops.org
  - Starting point for OPS Area specific web pages

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Q&A

- Any Questions ?

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JMX in
Java & Management
Environments
(DSOM 2001)

Christophe Ebro
JMX Foundation Spec Lead
Java Technology For Service Providers

JMX in Java & Management
Environments

? Status
? JMX and Java environments
? JMX and Management environments
? Evolution
? Q & A

? 60% market share for app server mgt
? 14 Major J2EE App Server vendors in JSR 77 expecting JMX to become a J2EE Standard Service
? Huge amount of JMX downloads
? JMX books:
  – One chapter in a Prentice Hall book (beg 2002)
  – One O'Reilly book (mid-2002)
? In major conferences (NOMS, IEEE, OMG)

- Status
- JMX and Java environments
- JMX and Management environments
- Evolution
- Q & A

- Standard optional package for generic management, widely adopted
- Possible following step could be to have JMX delivered along with the VM itself as standard way of doing management:
  - For user management
  - To monitor and manage the VM itself
- Your opinion?

The Management/Monitoring of the VM must be transparent: no need to have additional stuff for management, or to know anything about it
➢A possible solution could be the use of Dynamic MBeans representing the VM Java objects to be managed/monitored
➢Your ideas/feedback/requirements?

- ? Already used by all major app server vendors for app server management
- ? App server vendors involved in JSR77 have requested that JMX become a J2EE Standard Service
- ➢ Possible solution could be to include JMX API into J2EE 1.4 (with added security control)
- ➢ Your ideas/feedback/requirements?

Possible solutions to define a
Management Interface concept, similar to
the Remote one, but dedicated to
Management:
➢This interface would be referenced in
the Deployment Descriptor
➢It would automatically register itself
into the JMX MBean Server

---

Proposal: 3 types of EJBs:
? Pure Business EJBs
  – Created by a Business client via Home
 – Accessed by Business client using Remote
  – No management
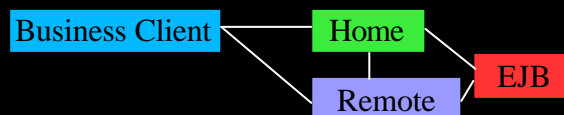
? Manageable Business EJBs
  – Created by a Business client via Home
  – Accessed by Business client using Remote
  – Manageable using operations described in their Management Interface (MBean), through the Container Management infrastructure (MBS)
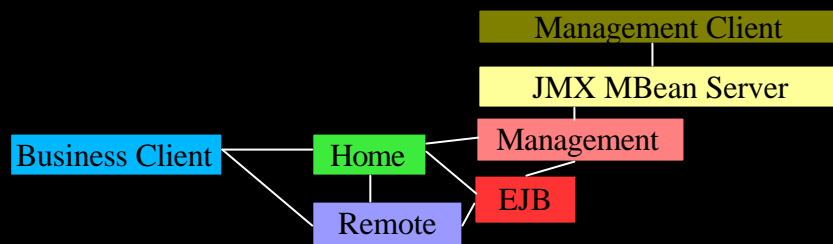
? Management EJBs (logs, monitors, etc.)
  – Created by a Management client via Home
  – Accessed by Management client using Remote
  – Manageable using operations described in their Management Interface (MBean), through the Container Management infrastructure (MBS)
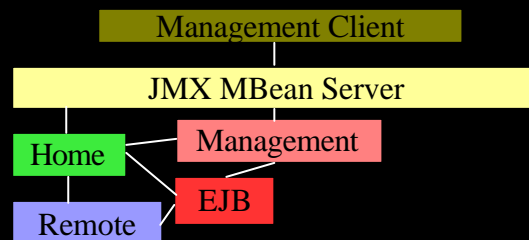
? Using JMX for J2EE Application Deployment?

? J2EE Connectors exposing the generic JMX Client API?
Allow J2EE developers to interface EISs in middle-tier apps by:
- Using a single interface
- Abstracting the underlying protocol

➢ Your ideas/feedback/requirements?

J2ME: opportunities

? Status
? JMX and Java environments
? JMX and Management environments
? Evolution
? Q & A

Consumer Devices	Enterprise desktops, servers, printers, LANs	Java Applications	Internet Infrastructure	Telecom Infrastructure
Existing No management RMON Proprietary	**Existing** SNMP Proprietary	**Existing** JMX	**Existing** SNMP	**Existing** TMN TL1 Proprietary
Emerging Java & Web -based	**Emerging** CIM/WBEM			**Emerging** J2EE-based

?

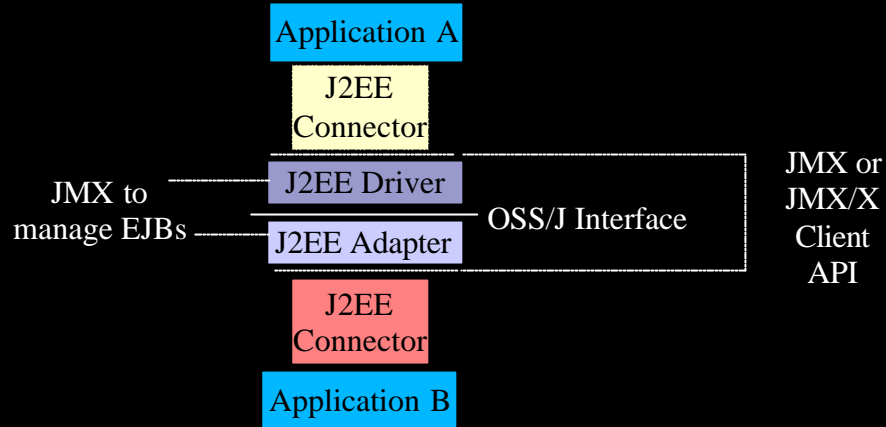?

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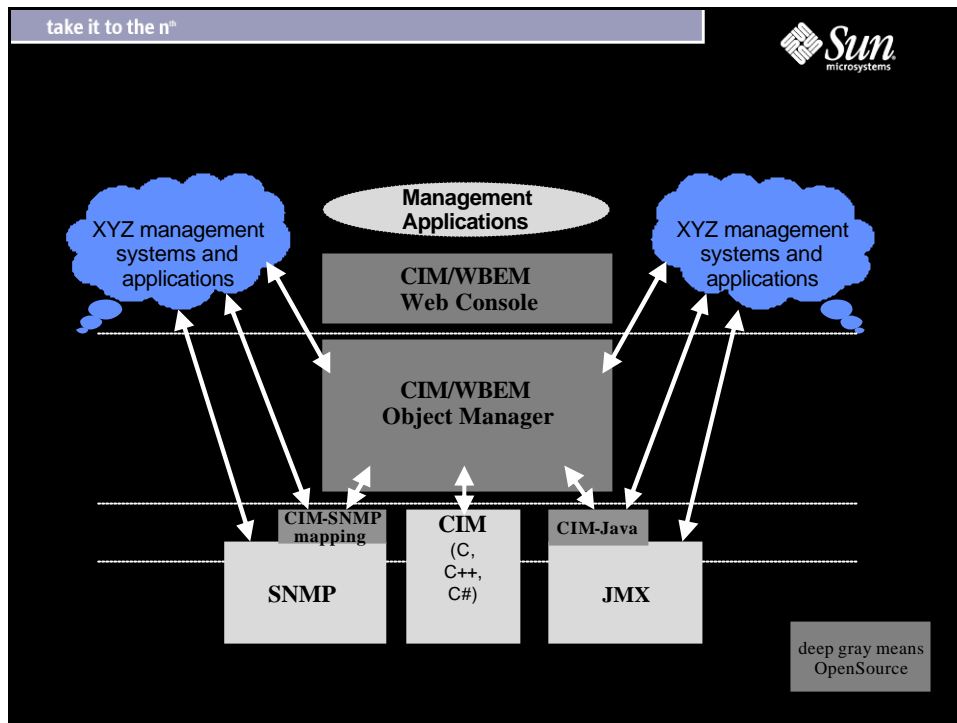
? JSR 146:
– CIM <-> JMX mapping
– JMX WBEM provider

?Possible to model using CIM and manage using any protocol

?Possible to manage existing JMX agents using CIM/WBEM by:
– Modeling in CIM extending CIM schemas
– Generating "mediation" Mbeans in agents

(JMX->CIM mapping not reusing CIM schemas!)

Application A

J2EE
Connector

JMX to
manage EJBs

J2EE Driver

J2EE Adapter

OSS/J Interface

JMX or
JMX/X
Client
API

J2EE
Connector

Application B

? Status
? JMX and Java environments
? JMX and Management environments
? Evolution
? Q & A

- Bug fixing (ModelMBean, etc.)
- Complete OpenMBean implementation
- Minor extensions (to be identified)

- JMX 1.0 has security problem in MBeanServerFactory class
- Static methods allow anyone to get a handle on MBean servers
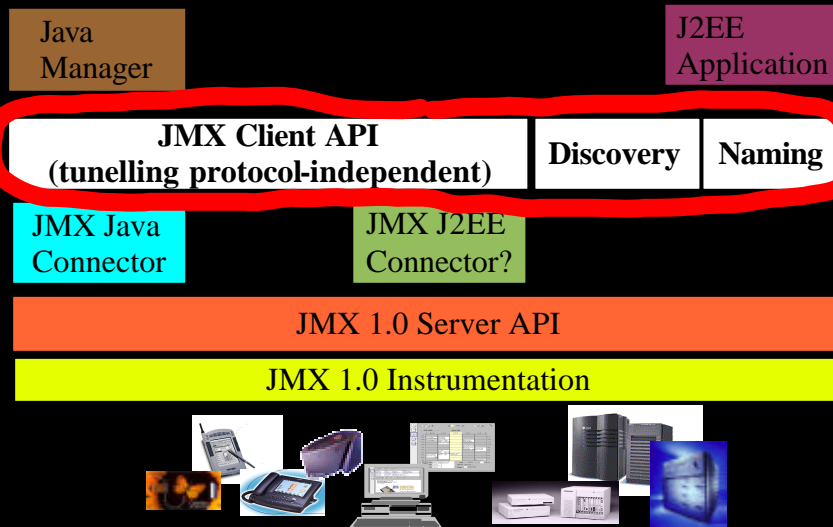- Should add permission checking

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? Insert any object implementing MBeanServer between connector and real MBean server

? Object can check permissions before forwarding operation

Java Connector		Java Connector
MBean server	——	Context checker
		MBean server
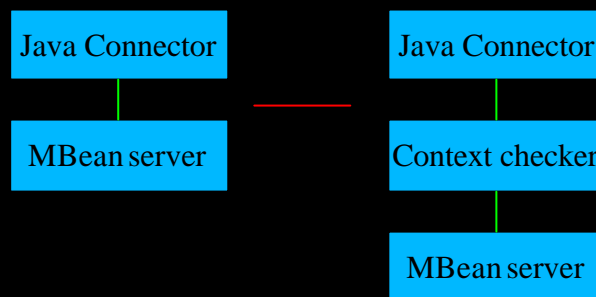
Need to define a Client interface for tunneling to the JMX MBean Server, in order to standardise the way a Java Manager (local or remote) can connect to a JMX Agent:

? Expose a single interface to client
? Hide the underlying tunneling protocol
? Provide Discovery and Naming

- Use the RemoteMBeanServer client API contribution as a basis
- Provide a Discovery mechanism based on a generic independent mechanism or JINI/JXTA
- Define Naming Conventions, for a manager to be able to access several managed applications simultaneously

Java Manager			J2EE Application
JMX Client API (tunelling protocol-independent)		**Discovery**	**Naming**
JMX Java Connector	JMX J2EE Connector?		
JMX 1.0 Server API			
JMX 1.0 Instrumentation			

JSR Scope

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Launch of a component market place, the JMXperience, for anybody to provide components around JMX to the community.
The component provider is free to choose format (source or binary) and licencing conditions (free or for a fee).

? Status
? JMX and Java environments
? JMX and Management environments
? Evolution
? Q & A