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# **Network Management Landscape And Agent Design Considerations**

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# Outline

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- **Systems Management -- Wishes and Promises**
- **Systems Management – Factions and Trends**
- **Framework, Model and Terminology**
- **Systems Management Tutorial (Separate Pres.)**
- **GDMO, Mgmt Functions & Functional Areas**
- **Agent Design Considerations**
- **The OCP Module Management Example**
- **Misc**
- **Recommendations and Suggestions**

# Systems Management Wishes and Promises

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## **Network Operators Wish:**

- **To Centrally and Consistently Manage Systems**
- **Choose Best Of Breed Systems From Different Vendors**
- **All Their Different Systems Be Managed Based On The Same Model Of Operation**
- **Management Of The Systems Be Simple and Intuitive**

**Vendors and Standards Have Been Promising All Of The Above!!!**

# Systems Management

## Wishes and Promises (Here and Now)

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**These Wishes and Promises have created a complicated landscape of standards, approaches and cultures, most Notably:**

- **The SNMP Camp**
- **The CMIP / X.700 Camp**
- **The Q Series (SS7 Camp)**
- **The Ad Hoc Bunch ( Vendor Specific)**

# Right Stuff From The Right Place It Makes A Difference

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## Heaven

- **Cook is French**
- **Policeman is English**
- **Mechanic is German**
- **ISP is American**
- **Tailor is Italian**

## Hell

- **Cook is English**
- **Policeman is German**
- **Mechanic is French**
- **ISP is Italian**
- **Tailor is American**

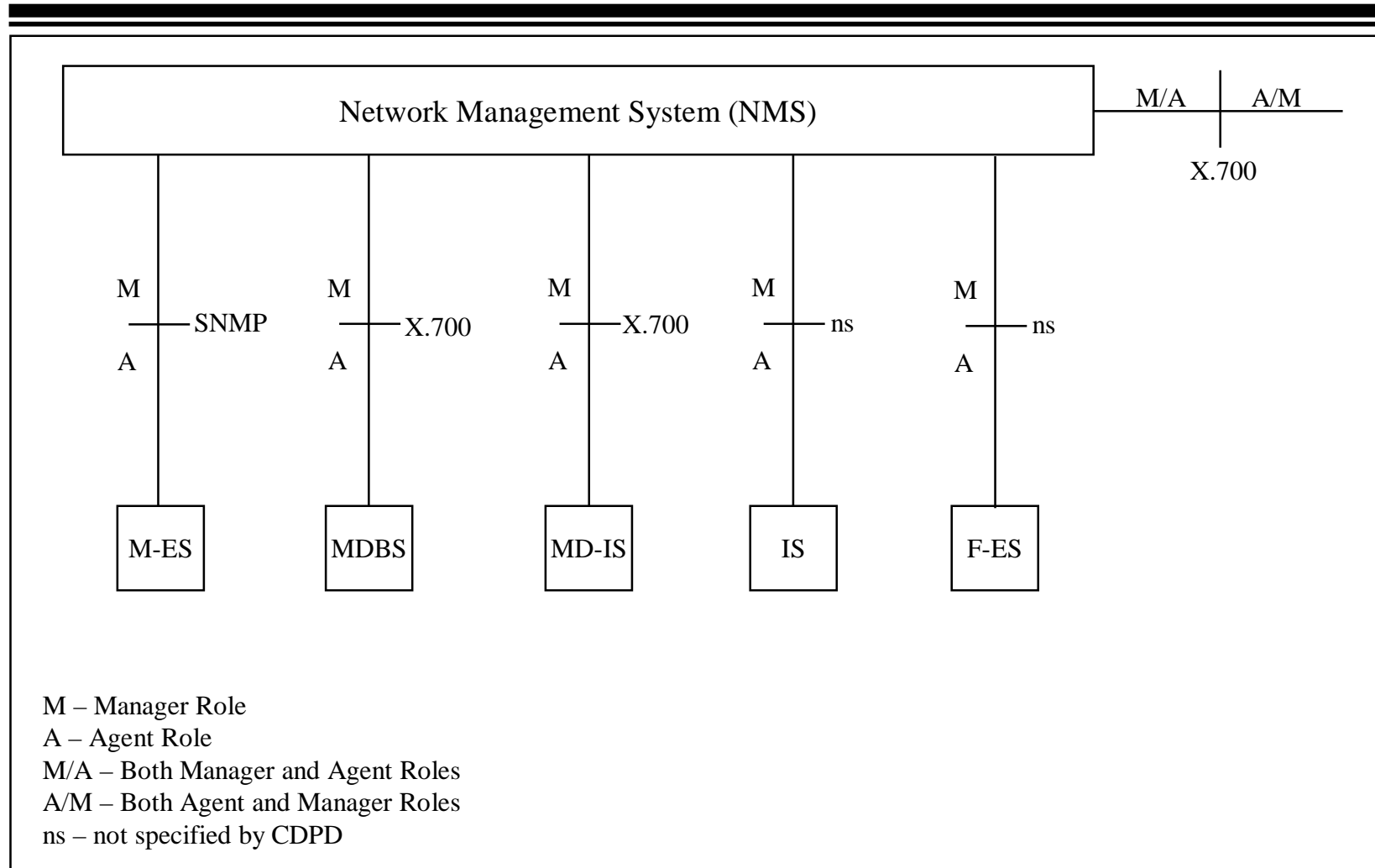
# Getting The Right Systems Management Pieces From The Right Places

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- **Get The Framework, Model, Concepts and Terminology From the OSI / X.700 Camp.**
- **Get the Protocols From the Internet Camp. The Simpler, the Better.**
- **Get your Customers from the SS7 Camp.**
- **Add your custom ad hoc interfaces where standards aren't enough.**

# Mixed Network Management Interfaces

## CDPD Spec. Examples



# Network Management Framework Specs.

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- ITU X.200 - Reference model of open systems interconnection for ITU applications, 1988. ISO/IEC 7498, Information processing systems - Open Systems Interconnection - Basic reference model, 1984
- ITU X.700 ISO/IEC 7498-4, Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 4: Management framework
- ITU X.701 ISO/IEC 10040, Information Technology - Systems Management Overview
- RFC-1411, Introduction to Version 2 of the Internet-standard Network Management Framework
- Forum Architecture. Forum 004, issue 1.0, January 1990. OSI/Network Management Forum, Bernardsville, N.J.



# General Concepts

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- ITU X.720 ISO/IEC 10165-1, Information Technology - Open Systems Interconnection - Structure of Management Information - Part 1: Management Information Model
- ITU X.734 ISO/IEC 10164-5, Information Technology - Open Systems Interconnection - Systems Management - Part 5: Event Report Management Function
- ITU X.735 ISO/IEC 10164-6, Information Technology - Open Systems Interconnection - Systems Management - Part 6: Log Control Function
- ITU X.730 ISO/IEC 10164-1, Information Technology - Open Systems Interconnection - Systems Management - Part 1: Object Management Function
- ITU X.731 ISO/IEC 10164-2, Information Technology - Open Systems Interconnection - Systems Management - Part 2: State Management Function
- ITU X.732 ISO/IEC 10164-3, Information Technology - Open Systems Interconnection - Systems Management - Part 3: Attributes for Representing Relationships
- ITU X.733 ISO/IEC 10164-4, Information Technology - Open Systems Interconnection - Systems Management - Part 4: Alarm Reporting Function

# Supporting Service Elements (1/2)

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- **Abstract Syntax Notation One (ASN.1)**
  - ITU X.208 ISO/IEC 8824, Specification of Abstract Syntax Notation One (ASN.1)
  - ITU X.209 ISO/IEC 8825, Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)
- **CMIP**
  - ITU X.710 ISO/IEC 9595, Common Management Information Service Definition
  - ITU X.711 ISO/IEC 9596-1, Common Management Information Protocol Specification1
- **CMIP over TCP/IP**
  - RFC 1189, CMOT: CMIP over TCP/IP
- **GDMO**
  - ITU X.721 ISO/IEC 10165-2, Information Technology - Open Systems Interconnection - Structure of Management Information - Part 2: Definition of Management Information
  - ITU X.722 ISO/IEC 10165-4, Information Technology - Open Systems Interconnection - Structure of Management Information - Part 4: Guidelines for the Definition of Managed Objects (GDMO)
- **ACSE**
  - ITU X.217, ISO/IEC 8649, Information processing systems - Open Systems Interconnection - Common Management Information Protocol – Service Definition for the Association Control Service Element
  - ITU X.227, ISO/IEC 8650, Information processing systems - Open Systems Interconnection - Common Management Information Protocol – Protocol specification for the Association Control Service Element, 1988

# Supporting Service Elements (2/2)

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- **ROSE**
  - ITU X.219, Remote Operations: Model, Notation, and Service Definitions, 1988
  - ITU X.229, Remote Operations: Protocol Specification, 1988
- **Directory Model**
  - ITU X.500, Information Technology - Open Systems Interconnection - The directory: Overview of Concepts, Models, and Services, 1993
  - ISO/IEC 9594-2, Information Technology - Open Systems Interconnection - The directory - Part 2: Models, 1988
- **CMIS**
  - ITU X.710, Common Management Information Service definition for ITU applications, 1991
  - ISO/IEC 9595, Information Technology - Open Systems Interconnection - Common Management Information Service definition, 1991

# System Management

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- ITU X.730 | ISO 10164-1 Information Technology - Open Systems Interconnection - Object Management Function
- ITU X.731 | ISO 10164-2 Information Technology - Open Systems Interconnection - State Management Function
- ITU X.732 | ISO 10164-3 Information Technology - Open Systems Interconnection - Attributes for Representing Relationships
- ITU X.733 | ISO 10164-4 Information Technology - Open Systems Interconnection - Alarm Management Function
- ITU X.734 | ISO 10164-5 Information Technology - Open Systems Interconnection - Event Management Function
- ITU X.735. ISO/IEC 10164-6. Information Technology - Open Systems Interconnection - Log Control Function
- ITU X.736 | ISO 10164-7 Information Technology - Open Systems Interconnection - Security Alarm Reporting Function
- ITU X.740 | ISO 10164-8 Information Technology - Open Systems Interconnection - Security Audit Trail Function
- ISO 10164-9 Information Technology - Open Systems Interconnection - Objects and Attributes for Access Control
- ISO 10164-10 Information Technology - Open Systems Interconnection - Usage metering function
- ISO 10164-11 Information Technology - Open Systems Interconnection - Metric Objects and attributes
- ISO 10164-12 Information Technology - Open Systems Interconnection - Test Management Function
- ISO 10164-13 Information Technology - Open Systems Interconnection - Summarization Function
- ISO 10164-14 Information Technology - Open Systems Interconnection - Confidence and Diagnostic Test categories
- ISO 10164-15 Information Technology - Open Systems Interconnection - Scheduling Function

# Telecommunication Management Network (TMN) Standards

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- ISO/ITU M.3010, Maintenance: Telecommunications Network. Principles for a Telecommunications Management Network, October 1992
- ISO/ITU M.3020, Maintenance: Telecommunications Network. TMN Interface Specification Methodology, October 1992
- ISO/ITU M.3180, Maintenance: Telecommunications Network. Catalogue of TMN Management Information, October 1992

# Internet Network Management Concepts (1/2)

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- **SNMP**
  - RFC 1351, SNMP Administrative Model, 1992
  - RFC1352, SNMP Security Protocols, 1992
  - RFC 1353, Secure SNMP - Release 2.0
  
- **SNMP Version 1**
  - RFC 1155, Structure and Identification of Management Information for TCP/IP-based Internets
  - RFC 1157, A Simple Network Management Protocol (SNMP Version 1)
  - RFC 1212, Concise MIB Definitions
  - RFC 1213, Management Information Base for Network Management of TCP/IP-based Internets: MIB-II
  - RFC 1215, A Convention for Defining Traps for use with SNMP

# Internet Network Management Concepts (2/2)

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- **SNMP Version 2**

- RFC 1442, Structure of Management Information for version 2 of the Simple Network Management Protocol
- RFC 1445, Introduction to version 2 of the Internet-standard Network Management Framework
- RFC 1448, Protocol Operations for version 2 of the Simple Network Management Protocol (SNMPv2)
- RFC 1445, Administrative Model for version 2 of the Simple Network Management Protocol
- RFC 1446, Security Protocols for version 2 of the Simple Network Management Protocol

- **SNMP Version 3**

- RFC 2570, Introduction to Version 3 of the Internet-standard Network Management Framework
- RFC 2571, An Architecture for Describing SNMP Management Frameworks
- RFC 2572, Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)
- RFC2576, Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework

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# **System Management Tutorial**

**Reference material is available at**

**<http://www.leapforum.org/presentations/jockEmbry/main.pdf>**



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# Basic Ingredients Of Systems Management

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- **Managed Objects**
- **The Protocols**
- **Management Functions**
- **Functional Areas**

Reference to *System Management Functions vs. Management Functional Area* paper is available at <http://www.leapforum.org/archives/index.html>

# GDMO Example: CDPD Accounting Distributor Managed Object Class

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-- Note that this replaces the definition of cdpdAccountingDistributor that was registered as  
-- {cdpd-objectClass 1} in CDPD Release 1.0.

```
cdpdAccountingDistributor MANAGED OBJECT CLASS
  DERIVED FROM cdpdAccountingDistributor-RO;
  CHARACTERIZED BY
    cdpdAccountingDistributorPkg;
  CONDITIONAL PACKAGES
    cdpdAccountingPerformancePkg PRESENT IF – See Section 3.1
      !performance monitoring is supported!,
    selfTestPkg PRESENT IF – See Section 3.13
      ! the Accounting Distributor supports self testing!;
  REGISTERED AS {cdpd-objectClass 26};

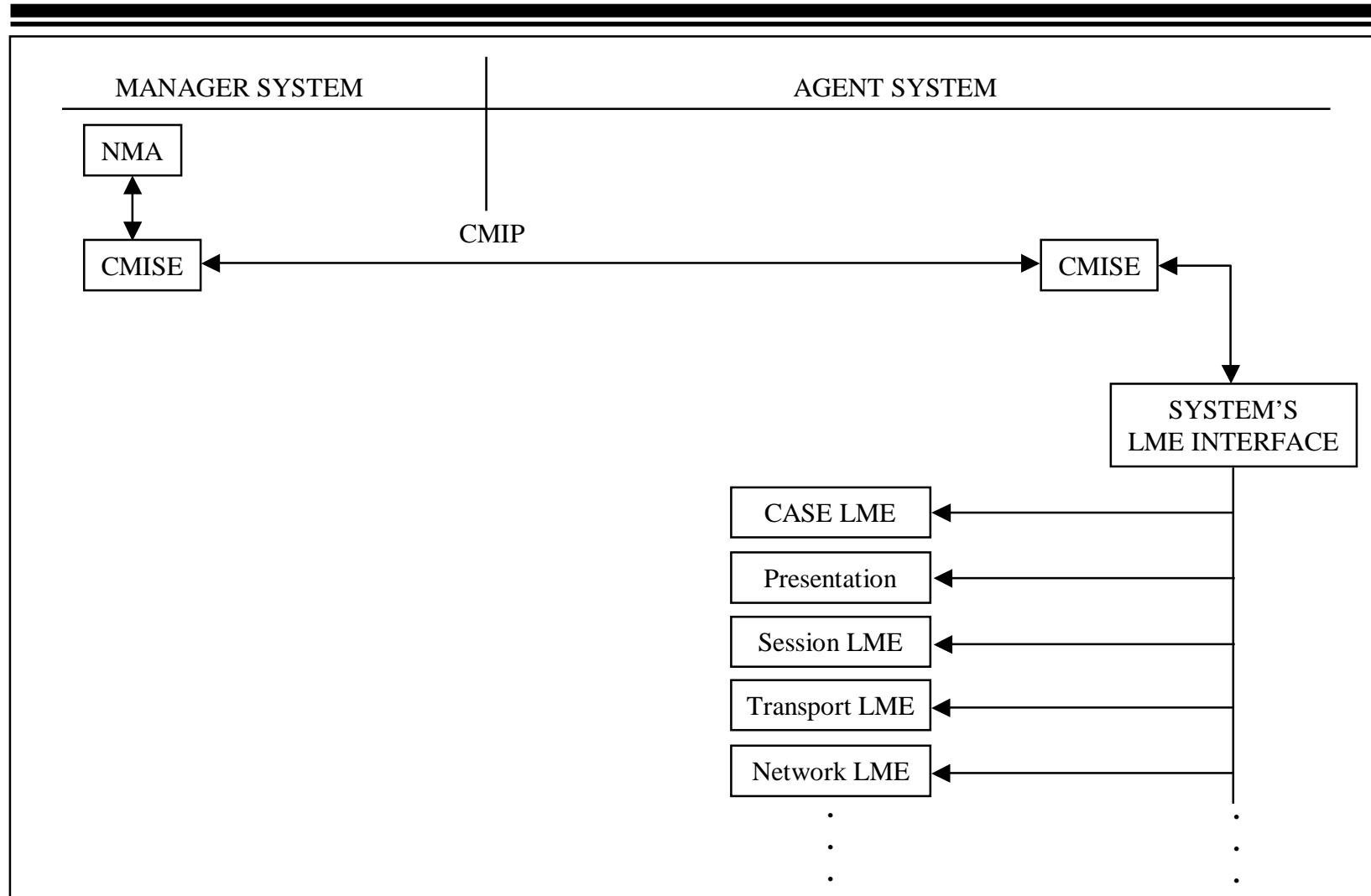
cdpdAccountingDistributorPkg PACKAGE
  BEHAVIOUR cdpdAccountingDistributorDefinition,
    cdpdAccountingDistributorBehaviour;
  ATTRIBUTES
    “Rec. X.721 | ISO/IEC 10165-2 : 1992”:administrativeState GET-REPLACE,
    cdpdAccountingCollectorAddress GET-REPLACE,
    cdpdAccountingDistributorAddress GET-REPLACE,
    cdpdAccountingInterval GET-REPLACE,
    cdpdAccountingNonDistributionTimeout GET-REPLACE;
  ACTIONS
    cdpdAccountingReport;
;
```

# Agent's Basic Elements

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- **Managed Objects**
- **Module/Layer Management Elements**
- **System's LME Interface**
- **System Management Protocol Engines**

# Network Management Architecture



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# The OCP Module Management Example

The *Open C Platform* paper is available at  
<http://www.mailmeanywhere.org/documents>  
(see Chapter 5: Module Management Architecture)

# Useful Managed Object Definitions

## ESRO Counters Example

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No	Counter name	Contents
1	esrop_pduRetranCounter	Number of PDU Retransmissions
2	esrop_completeOperationCounter	Number of Completed Operations
3	esrop_protocolErrorsCountered	Numbers of Protocol Errors
4.	esrop_opRefusedCounter	Number of Operations Refused
5.	udpSdu_rcvd	Number of UDP SDU's received
6.	udp_pdu_bad	Number of bad UDP PDU's

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# Recommendations And Suggestions (1/3)

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- **Don't worry about your choice of the management protocol. Put in place a design that can support either protocol.**
- **Design a simple Module Management structure and interface for the product.**
- **Identify useful and relevant managed objects (parameters, counters, notifications, ...).**
- **Stay focused on Managed Object definitions.**
- **Keep Functional Area considerations outside of Agent Design.**

# Recommendations and Suggestions (2/ 3)

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- **Pair up with a product partner's manager and optimize for that manager.**
- **Systems Management Functionality is Often A Nice Extra. Stay focused on the product.**
- **Don't let Systems Management considerations over complicate the product design.**

# Recommendations and Suggestions (3/ 3)

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- **Start Simple and Small, Add Management Functionality and more Managed Objects as you better understand the market, the product and systems management.**
- **Don't let system management fanatics over design.**