Network Management By Delegation

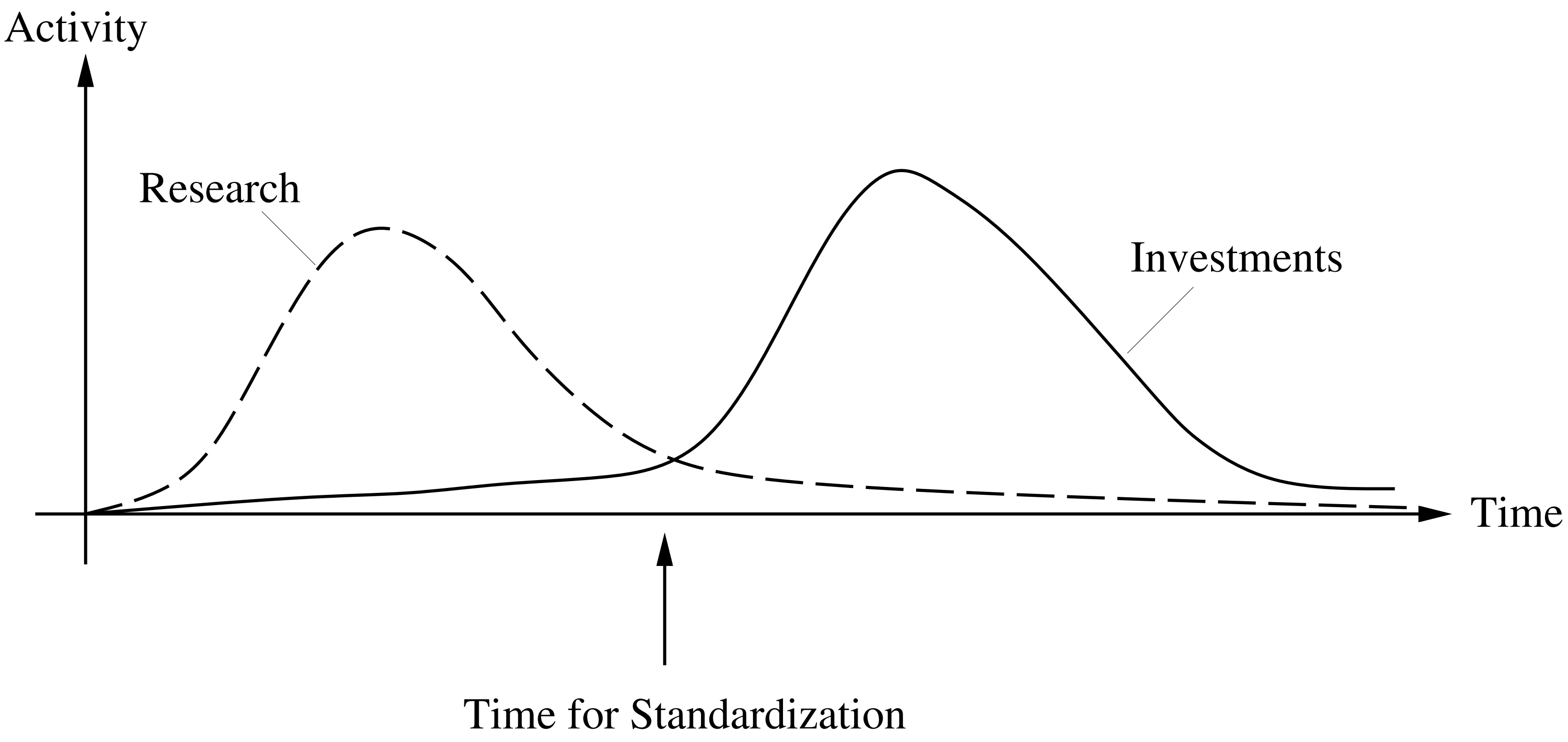
From Research Prototypes Towards Standards

Jürgen Schönwälder

Department of Computer Science
University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands

E-mail: schoenw@cs.utwente.nl

Theory of Standardization (David Clark, MIT)



From Research Prototypes ...

- 1991–1995: Management By Delegation (Columbia University)
- 1993–1995: Script Language & MLM MIB (SNMP Research)
- 1994–1996: NMP Stack Language (TU Vienna)
- 1995–1996: MbD with Security & Cooperation (TU Braunschweig)

... Towards Standards:

- 1996–199?: Script MIB (IETF DISMAN WG)
- 1996–199?: Command Sequencer (ISO 10164-21 WG)

Distributed Management in the OSI Architecture:

- Implementation of management functions as part of powerful agents: (e.g. Workload Monitoring Functions, Summarization Functions)
- Control and/or discriminator objects are used to parameterize management functions.

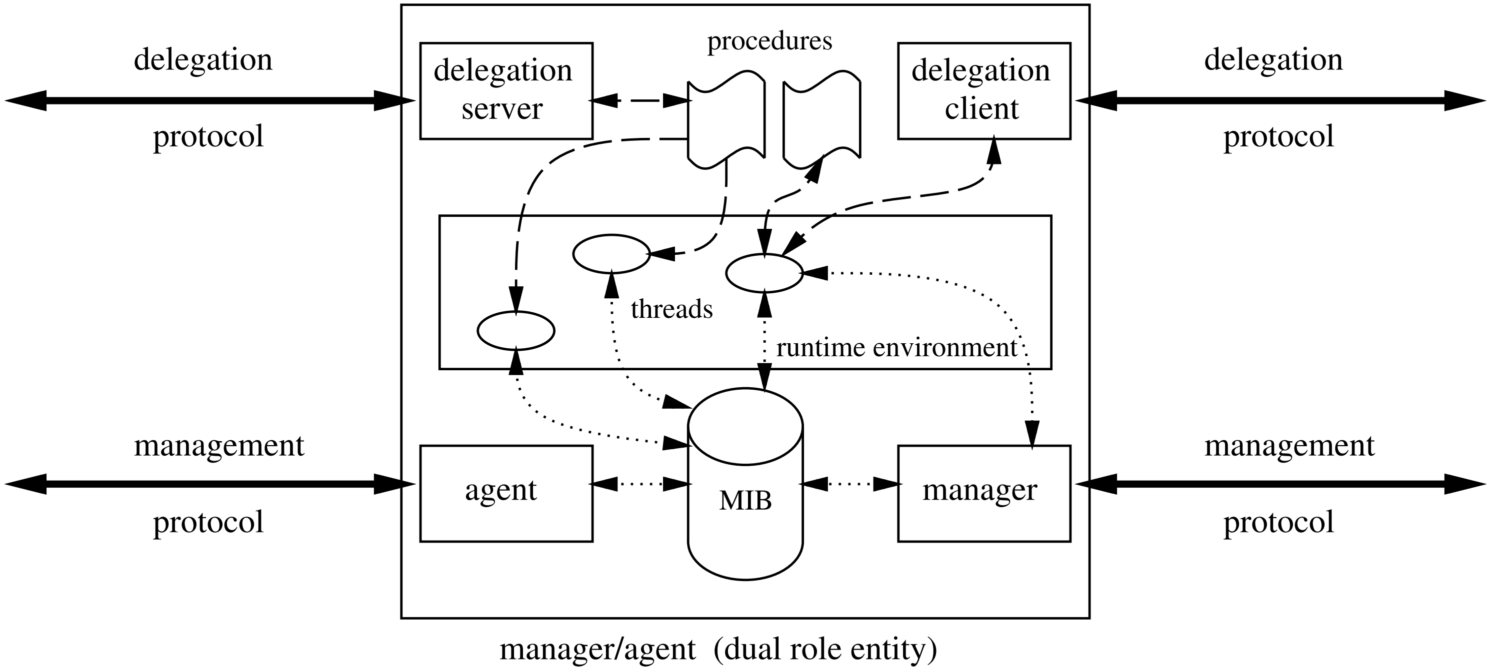
Distributed Management in the Internet Architecture:

- Specialized agents or management stations acting in a dual role: (e.g. Remote Network Monitoring (RMON), Manager-To-Manager MIB)
- Tables contain parameter sets to control the activities of an agent.
- Algorithms can be defined to interpret tables as rule sets (NeTraMet).

Management by Delegation (Yemini, Goldszmidt 1991)

- Smart agents with the ability to execute management scripts written in a management scripting language (MSL).
- Manager distributes management scripts to agents in order to expand their functionality at run-time (remote evaluation, mobile code).
- Delegated management scripts operate in local environments and reduce the amount of management information moved over (expensive) networks.
- Delegated scripts operate independent of the manager (self-managing or self-healing networks).
- Manager is concerned with the management of delegated scripts.

Internal Structure of an MbD Implementation



Design Issues

Delegation Protocol:

management protocol	$\longleftrightarrow$	special purpose protocol
manager "push" (procedures)	$\longleftrightarrow$	agent "pull" (procedures)
agent "push" (results)	$\longleftrightarrow$	manager "pull" (results)

Language:

interpreted language	$\longleftrightarrow$	compiled language
standard language	$\longleftrightarrow$	domain specific language

Procedures:

MIB object arguments and results	$\longleftrightarrow$	arbitrary argument and result types
activation by events/scheduler	$\longleftrightarrow$	activation by manager

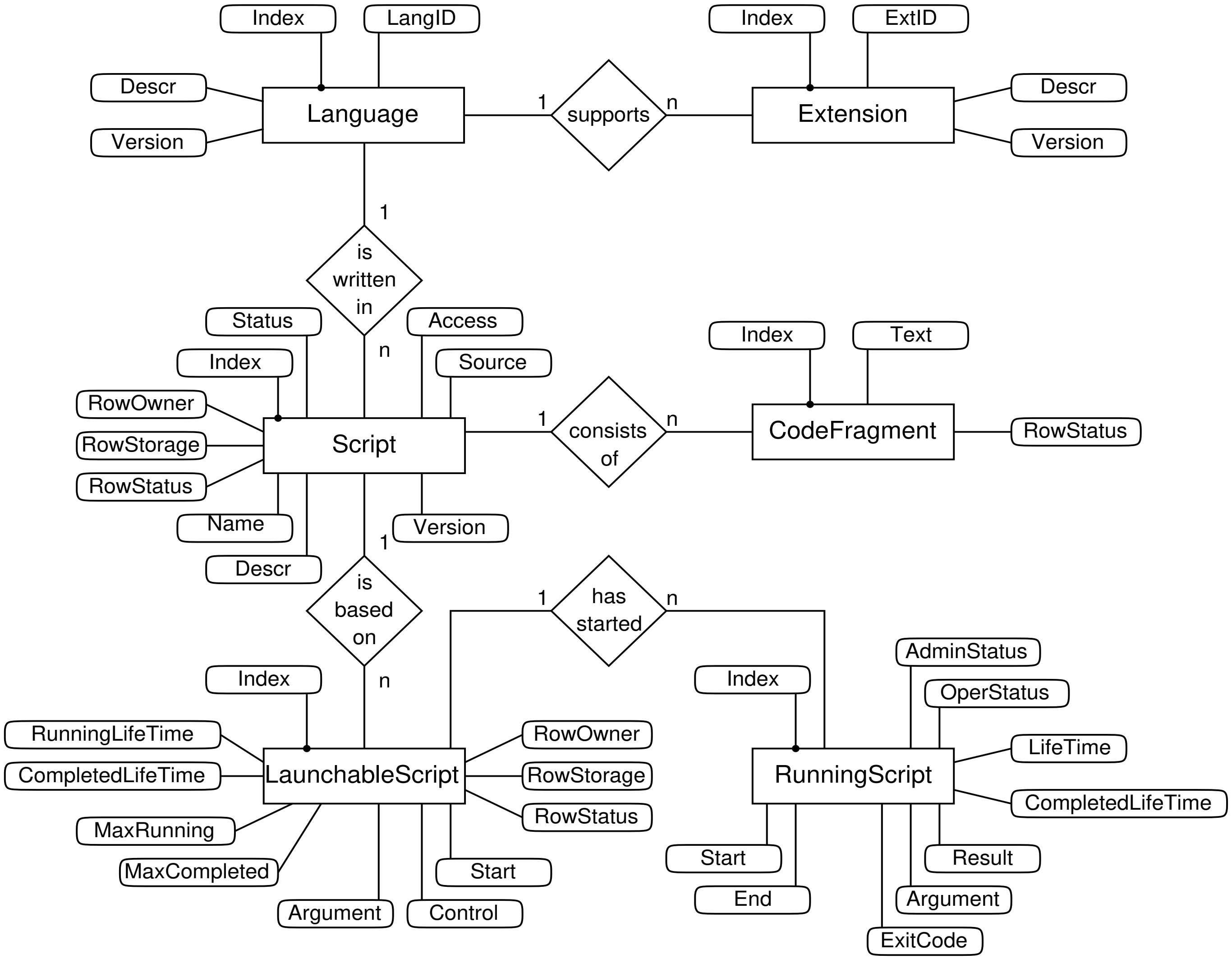
Runtime:

multiple manager, multiple languages	$\longleftrightarrow$	single manager, single language
multiple threads	$\longleftrightarrow$	event driven
error and status monitoring objects	$\longleftrightarrow$	notifications
multiple security profiles	$\longleftrightarrow$	no security

IETF Standardization (DISMAN WG)

DISMAN Services extend the Internet management framework:

Known Systems:	Access and configure the set of known systems.
Management Domains:	Derive target lists for management operations.
Scheduling:	Activate management operations.
Notifications and Logging:	Handling of received or emitted notifications.
Delegation Control:	Protect the DISMAN system and the network.
Scripting:	Download and control of management script.
Expression and Thresholds:	Computations on MIB objects.


Index
LangID
Index
ExtID
Descr
Language
1
supports
n
Extension
Descr
Version
Version
1
is
written
in
Status
Access
Index
n
Source
Index
Text
RowOwner
1
consists
of
n
RowStorage
Script
CodeFragment
RowStatus
RowStatus
Name
Version
1
Descr
is
based
on
1
has
started
n
AdminStatus
Index
n
Index
OperStatus
RunningLifeTime
RowOwner
LifeTime
CompletedLifeTime
LaunchableScript
RowStorage
RunningScript
RowStatus
CompletedLifeTime
MaxRunning
Start
Result
MaxCompleted
Start
End
Argument
Argument
Control
ExitCode

ISO Standardization (ISO 10164-21)

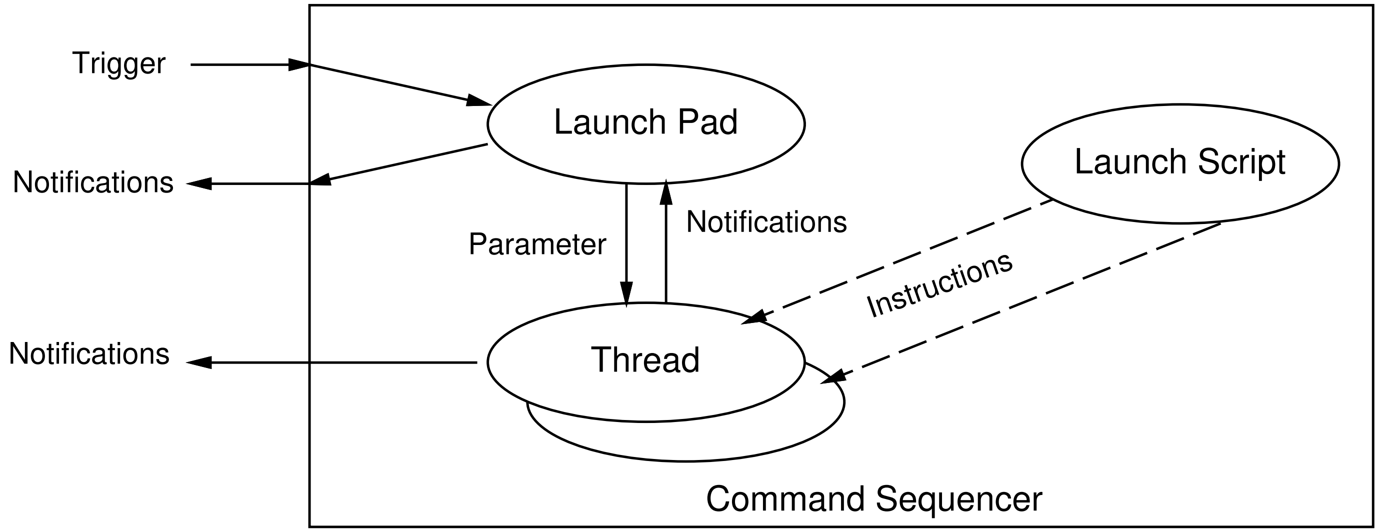
User Requirements:

- Allow the delegation of management activities.
- Reduce the amount of communication that between manager and agents.
- Allow delegated systems to operate when communication have been disrupted.
- Provide flexible control of management activities.
- Provide a scripting language which can describe management procedures.
- Allow delegated systems to execute CMIS operations in sequence.

Operational Requirements:

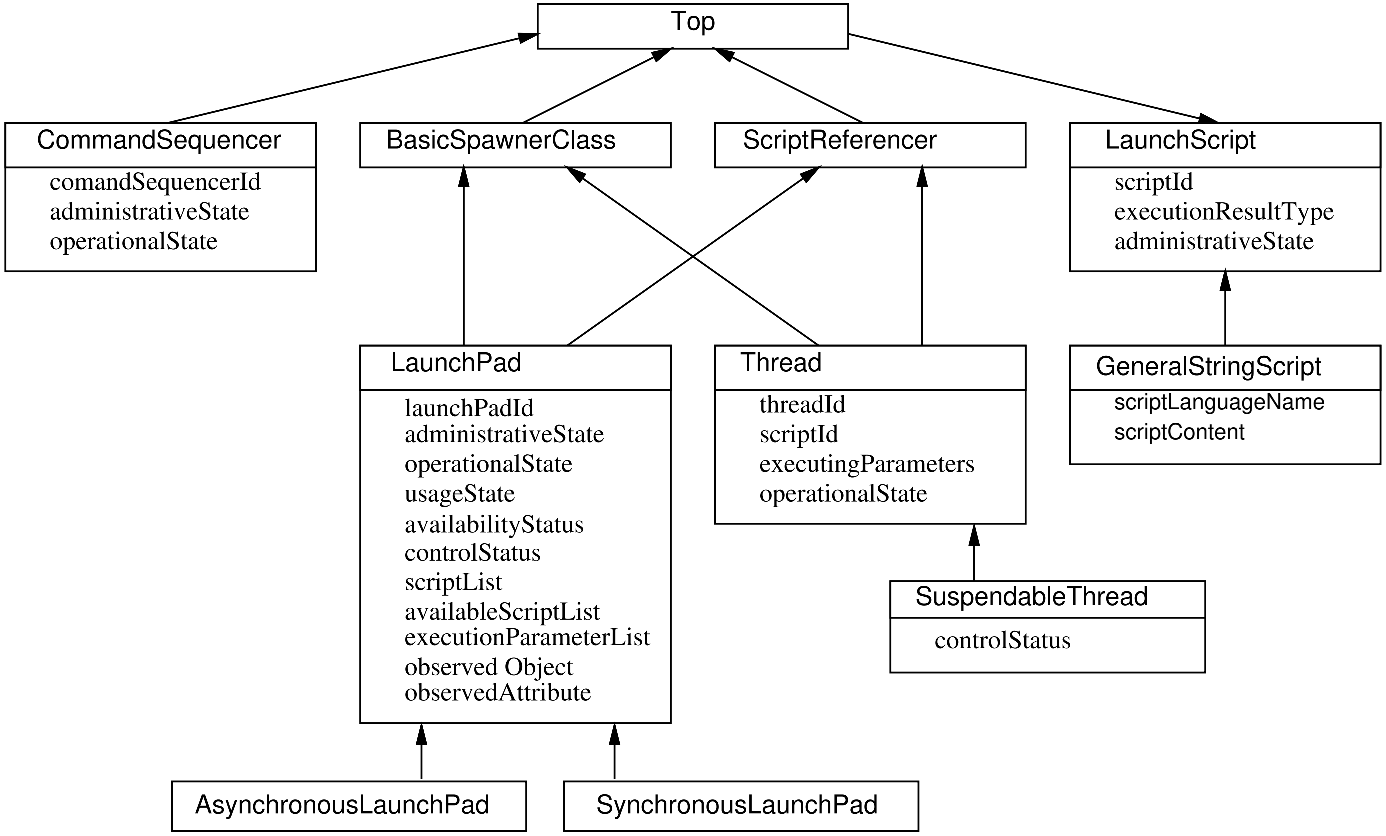
- Pre-scheduled or delayed execution of a systems management operation.
- Capabilities for modifying the request for pre-scheduled or delayed execution.
- Capabilities for initiating, suspending, resuming and terminating management operations based on time management actions or the occurrence of events.
- Capabilities for reporting/recording outcome of scheduled or delayed execution.
- The ability to send notifications when state changes occur.

ISO Command Sequencer Model



- Launch pad objects start the execution of lauch scripts on receiving a trigger.
- A trigger can be an external event or the result of a scheduling function.
- A script is executed by a launch pad by means of one or more thread objects.
- Synchronous launch pads return trigger results after thread termination.
- Asynchronous launch pads distinguish between trigger and execution results.

ISO Command Sequencer Classes



Current Status and Future

IETF Script MIB:

- Cleanup of the specification based on implementation experience.
- Open security and access control issues.
- Work on DISMAN scheduling services still left to be done.
- DISMAN work gets delayed due to the SNMPv3 effort.
- Probably submitted as a proposed standard to the IESG in autumn.

ISO Command Sequencer:

- Progressed to International Standard.
- Implementations?

Are you ready for investments?