

NETWORK MANAGEMENT

MANAGEMENT COMMUNICATION PATTERN

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- Management Communication Layer

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Transport
OSI layer transport : UDP/TCP/SSH etc

Remote Operations
offers three distinct functions that complement and perform important services for the Management Operations layer on top: association control, remote, operations support

- ❑ **Association control**, deals with how to establish and tear down management sessions—that is, management associations between managers and agents.
- ❑ **Remote operations**, support involves the mechanism that is used to wrap and delineate management requests and responses in communication exchanges.

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Information Retrieval : Polling and Polling-Based Management

- ❑ **Requests for Configuration Information**
 - Information about the logical and physical configuration of the device.
 - Changes to configuration information are initiated from the outside of the agent
- several advantages to this:
 - ❑ Management traffic over the network is reduced.
 - ❑ Load that is imposed on the device to respond to such queries is reduced.
 - ❑ Performance of the management application is improved.

Polling a managed device for operational data and state information is generally used in scenarios such as the following:

- ❑ **Device viewing** : A remote user wants to obtain a real-time view of a device, requiring a snapshot of the most current information.
- ❑ **Troubleshooting and diagnostics** : Erratic behavior has been observed in the network, and applications need to obtain current data from the device to determine the cause.
- ❑ **"Hot spot" polling** : A particular device is under routine and specific observation; its state information therefore is polled repeatedly over an extended period of time

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Information Retrieval : Polling and Polling-Based Management

- ❑ **Requests for Operational Data and State Information**
 - ❑ operational data and state information generally tend not to be represented in a management application's database.
 - ❑ it must poll it for the current snapshot of operational data and device state

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Information Retrieval : Polling and Polling-Based Management

condition

Not OK

OK

time

Poll: OK Poll: OK Poll: OK

value

time

Actual value

Coarse sampling (low load)

Fine sampling (high load)

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Information Retrieval : Polling and Polling-Based Management

Historical Data Collection on the Device as Opposed to Polling by a Manager

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Bulk Requests and Incremental Operations

- ❑ **Incremental Request (Incremental Operation)**
Get several pieces of management information, separate requests are sent.
- ❑ **Bulk Request**
Get several pieces of management information, on one requests.
ex: all operational data of a line card" or "all configuration information

A Scope Applied to a Management Information Tree in a MIB

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Historical Information

- ❑ typically performance data such as bandwidth utilization or packet drop rates that are taken at certain intervals in time.
- ❑ Collecting and analyzing these snapshots can reveal valuable information for network providers

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Configuration Operations
for example, configuring an interface, enabling or disabling a routing feature, changing access control lists that define firewall rules, or configuring where to send alarm messages.

Failure Recovery

Missing Response Scenarios

```
sequenceDiagram
    participant Manager
    participant Agent
    Manager->>Agent: Configuration request
    Agent-->>Manager: Response
    Note over Agent: Operation succeeds
    Manager->>Agent: Configuration request
    Note over Manager: No response received
    Manager->>Agent: Request? What request?
    Manager->>Agent: Configuration request
    Note over Manager: No response received
    Note over Agent: Operation failed
```

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Configuration Operations

Response Size and Request Scoping

- One small request can result in the return of a substantial amount of information.
- The size of the response is typically similar to the size of the request.
- The response includes a return code that indicates whether the request was successful and perhaps the new setting that is in effect as a result

Dealing with Configuration Files

- Preparing a configuration file that contains the configuration that is to take effect
- Downloading this configuration file on the device
- Explicitly telling the device to switch over from the current configuration to the new configuration in the new file

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Configuration Operations

Actions

A request is sent to perform the action, and a response is sent that indicates the outcome of the action or any errors that were encountered.

A Long-Running Request

```
sequenceDiagram
    participant Manager
    participant Agent
    Manager->>Agent: Request
    Note over Agent: Action takes long time to execute
    Agent-->>Manager: Response
    Note over Manager: Long time passes without response
    Note over Manager: "Did something happen?" "Should request be reissued?"
```

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Agent-Initiated Interactions: Events and Event-Based Management
example, the event message could be an alarm that indicates that the device is overheating or that it has been experiencing a failure

Event Taxonomy
Notifying managers of many different types of event occurrences. Accordingly, they can be classified into a number of categories. The most common ones are as follows:

- ❑ **Alarms** : Unexpected events indicating a condition that typically requires management attention.
- ❑ **Configuration-change events** : Events that inform of a configuration change that has taken effect at the device.
- ❑ **Threshold-crossing alerts** : Events that inform that a performance-related state variable has exceeded a certain value, pointing to conditions that might require management attention to prevent network and service degradation.

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Agent-Initiated Interactions: Events and Event-Based Management

- ❑ **Logging events** : Events that occur regularly and that are expected to occur during the operation of a network, that indicate what is currently going on in the network. In general, those events do not require an operator's attention but need to be logged (that is, written to a file or stored in a database) so that they are available for further analysis when needed. Logging events can be related to the following:
 - **Operator activity** : These events might be relevant for security purposes and provide trails of any commands that had earlier been directed at network devices.
 - **System activity** : These events provide for detailed execution traces. They can be useful in debugging a network but in general are simply turned off.
 - **Activity on the network and services** : These events record the occurrence of service-related events, such as the fact that a call was initiated, and can provide data used for accounting.

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Agent-Initiated Interactions: Events and Event-Based Management

- ❑ **Informational events** : Any other kind of event.
To be useful, any event includes at least the following information:
 - The system from which the event originated.
 - A time stamp of when the event occurred. (In some cases, applications receiving the event add a second time stamp to indicate when the event was actually received.)
 - The type of event that has occurred.
 - Event detail information.

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