International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

M.3704

(01/2010)

SERIES M: TELECOMMUNICATION MANAGEMENT, INCLUDING TMN AND NETWORK MAINTENANCE

Integrated services digital networks

Common management service – Performance management – Protocol neutral requirements and analysis

Recommendation ITU-T M.3704

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Recommendation ITU-T M.3704

Common management service – Performance management – Protocol neutral requirements and analysis

Summary

Recommendation ITU-T M.3704 provides the requirements and analysis for one of the common management services – performance management. The functional requirements for the performance management interface include the management functions for performance measurement jobs, performance threshold monitor and performance data files. In the analysis part, the detail information model supporting the above function across the management interface is provided.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T M.3704	2010-01-13	2

Keywords

Common management service, measurement job, performance management, PMIRP, threshold monitor.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Common management service – Performance management – Protocol neutral requirements and analysis

1 Scope

This Recommendation specifies the overall requirements and the analysis for performance management and defines the semantics of operations (and their parameters) visible across the management interface in a protocol and technology neutral way. It does not define the syntax or encoding of the operations and their parameters. The transferring of performance data file is outside the scope of this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T M.3020] Recommendation ITU-T M.3020 (2009), *Management interface specification methodology*.

[ITU-T M.3160] Recommendation ITU-T M.3160 (2008), *Generic, protocol-neutral management information model*.

[ITU-T M.3400] Recommendation ITU-T M.3400 (2000), *TMN management functions*.

[ITU-T M.3700] Recommendation ITU-T M.3700 (2010), *Common management services – Object management – Protocol neutral requirements and analysis*.

[ITU-T M.3701] Recommendation ITU-T M.3701 (2010), *Common management services – State management – Protocol neutral requirements and analysis*.

[ITU-T M.3702] Recommendation ITU-T M.3702 (2010), *Common management services – Notification management – Protocol neutral requirements and analysis*.

[ITU-T Q.822] Recommendation ITU-T Q.822 (1994), *Stage 1, Stage 2 and Stage 3 description for the Q3 Interface – Performance management*.

[ITU-T X.680] Recommendation ITU-T X.680 (2008) | ISO/IEC 8824-1:2008, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

[ITU-T X.721] Recommendation ITU-T X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open systems Interconnection – Structure of management information: Definition of management information*.

[ITU-T X.739] Recommendation ITU-T X.739 (1993) | ISO/IEC 10164-11:1994, *Information technology – Open Systems Interconnection – Systems Management: Metric objects and attributes*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 agent [ITU-T M.3020]: Encapsulates a well-defined subset of management functionality. It interacts with managers using a management interface. From the manager's perspective, the agent behaviour is only visible via the management interface.

3.1.2 information object class [ITU-T M.3020]: Describes the information that can be passed/used in management interfaces and is modelled using the stereotype "Class" in the UML meta-model. For a formal definition of information object class and its structure of specification, see Annex B of [ITU-T M.3020].

3.1.3 manager [ITU-T M.3020]: Models a user of agent(s) and it interacts directly with the agent(s) using management interfaces.

Since the manager represents an agent user, it gives a clear picture of what the agent is supposed to do. From the agent perspective, the manager behaviour is only visible via the management interface.

NOTE – Considered equivalent to IRPManager [b-3GPP TS 32.150].

3.2 Terms defined in this Recommendation

This Recommendation has no new definitions.

4 Abbreviations

This Recommendation uses the following abbreviations:

DN	Distinguished Name
EM	Element Manager
FS	Function Set
FTP	File Transfer Protocol
IOC	Information Object Class
IRP	Integration Reference Point
NE	Network Element
NM	Network Manager
PM	Performance Management
PMIRP	Performance Management Integration Reference Point
UML	Unified Modelling Language (OMG)

5 Conventions

This Recommendation follows the conventions defined in [ITU-T M.3020].

Usage of ProxyClass: a ProxyClass is a stereotype in UML repertoire described in [ITU-T M.3020], which can be used to represent other IOCs listed in the Note under the corresponding UML diagram.

6 Requirements

6.1 Concepts and background

The purpose for performance measurement is for the agent to provide functions to the manager to collect performance measurement data, and to monitor these collected measurement data by setting pre-defined thresholds, so that notifications can be generated and sent from the EMs or NEs to the NM in time.

In this Recommendation, the function for collecting performance measurement against network elements is achieved through creating measurement jobs, which can be used to specify the network entities to be measured, the corresponding performance parameters to be collected against them, and to control the generation of performance measurement data. The detailed performance measurement data will be generated into data files and transferred to the manager periodically. The monitoring of performance data is achieved from setting up threshold monitors, which can scan the collected measurement data against pre-defined thresholds on certain performance parameters, and threshold-crossing alarms can be generated and sent to the manager for processing.

6.2 Business-level requirements

6.2.1 Requirements

Performance measurement is one of the key functions of the network management interface. The manager should be able to request an agent to take measurements on the performance of certain network resources. The performance management requirements can be grouped into one of the following categories:

– Management of network performance measurements, e.g., create measurement job, suspend measurement job, resume measurement job, query measurement job, stop measurement job, delete measurement job, etc.

– Management of PM threshold-cross monitoring, e.g., create threshold monitor, delete threshold monitor, query threshold monitor, modify threshold monitor, suspend notification monitor, resume notification monitor, threshold-crossing alarm report, etc.

– Management of measurement files, e.g., performance data file preparation report, performance data file transfer, etc.

6.2.1.1 Management of network performance measurements

The manager shall be able to request the agent to:

REQ-PM-FUN-01 Collect specific performance measurements on specific network resources. The network resources, whose performance measurements are to be managed or collected, must have been modelled and must be visible via the management interface.

REQ-PM-FUN-02 Collect the performance measurements in a file. The data format of this file will depend on the network technology being measured.

REQ-PM-FUN-03 Emit a notification announcing the availability of file(s) in REQ-PM-FUN-02.

REQ-PM-FUN-04 Create a measurement job.

REQ-PM-FUN-05 Suspend a running or scheduled measurement job.

REQ-PM-FUN-06 Resume a running or scheduled measurement job.

REQ-PM-FUN-07 Stop a running or scheduled measurement job.

REQ-PM-FUN-08 Query the information and running status of one or more measurement jobs.

REQ-PM-FUN-09 Remove a measurement job. This means the complete set of the PM data files related to this measurement file can be removed from the IRP agent.

REQ-PM-FUN-10 Define a measurement job schedule, including the definition of the recording interval(s), job start time and job stop time.

It is noted that the agent can only derive or determine the value of a performance measurement at the end of a granularity period. The agent may also have to reset the value of a performance measurement at the beginning of a granularity period. The above agent behaviours are dependent on the nature of the performance measurement types (cumulative counter, gauge).

6.2.1.2 Management of PM threshold monitoring

The manager shall be able to request the agent to:

REQ-PM-FUN-11 Set threshold values to specific performance measurements of specific network resources.

REQ-PM-FUN-12 Query the threshold values that are set to specific performance measurements of specific network resources.

REQ-PM-FUN-13 Modify the threshold values that are set to specific performance measurements of specific network resources.

REQ-PM-FUN-14 Suspend a threshold monitor on specific network resources.

REQ-PM-FUN-15 Resume a threshold monitor on specific network resources.

REQ-PM-FUN-16 Remove a threshold monitor on specific network resources.

REQ-PM-FUN-17 Emit an alarm notification (including clearing) when the threshold value(s) have been crossed and not just reached, as defined in [ITU-T Q.822].

The manager shall be able to:

REQ-PM-FUN-18 Subscribe to notifications that carry threshold-cross alarms and information on the availability of performance measurement data files.

6.2.1.3 Management of measurement files

The agent shall be able to allow the manager to:

REQ-PM-FUN-19 Manage the transfer of data files containing performance measurement data.

REQ-PM-FUN-20 Request a list of available files, including the specification of filter.

6.2.2 Actor roles

The capabilities described in this Recommendation are available and relevant to all agents and managers.

6.2.3 Telecommunication resources

The performance management functionality is applicable to all types of telecommunication resources.

6.2.4 High-level use case diagrams

The performance management function set contains: Performance measurement management function set, performance threshold management function set, and query history performance data function.

Performance measurement is the activity whereby the agent periodically collects the performance data from physical equipment as well as logical entities and reports them to the manager. Performance measurement management function set is provided to the manager to manage the parameters related to performance measurement, through which performance data can be reported by the agent according to the requests of the manager.

Performance measurement management function set (FS) contains the following functions: Create measurement job, Delete measurement job, Stop measurement job, Suspend measurement job, Resume measurement job, Query measurement jobs, and Performance data report. Figure 6-2 shows the details.

NOTE – The modify measurement job function can actually be achieved by deleting the existing measurement job and creating a new measurement job.

Performance measurement management FS in this Recommendation relates to the functions involving PM data collection and reporting specified in clauses 5.3.4, "Performance administration function set"; and 5.2.9, "Performance monitoring data accumulation function set", of [ITU-T M.3400].

The manager can set up performance threshold monitors, through which a corresponding threshold-crossing alarm may be emitted whenever a performance threshold is crossed. Performance threshold management FS contains the following functions: Create threshold monitor, Delete threshold monitor, Modify threshold monitor, Query threshold monitor, Suspend threshold monitor, Resume threshold monitor and threshold-cross alarm report. Figure 6-3 shows the details.

Performance threshold management function set in this Recommendation relates to the functions involving threshold management specified in clauses 5.3.4, "Performance administration function set"; and 5.4.9 "NE(s) performance characterization function set", of [ITU-T M.3400].

Measurement data are network technology dependent and are thus outside the scope of this Recommendation.

The following three diagrams show the functions involved in the performance management FS. Figure 6-1 illustrates the overview use case diagram of performance management FS, Figure 6-2 shows the performance measurement management FS use-case diagram, and Figure 6-3 shows the threshold management FS use-case diagram.

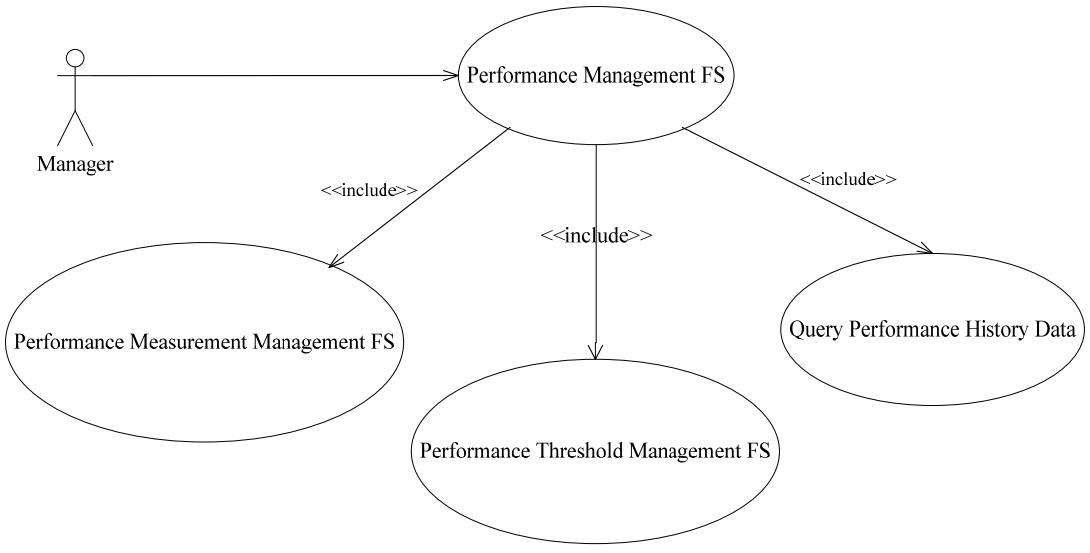

Figure 6-1 – Performance management FS overview

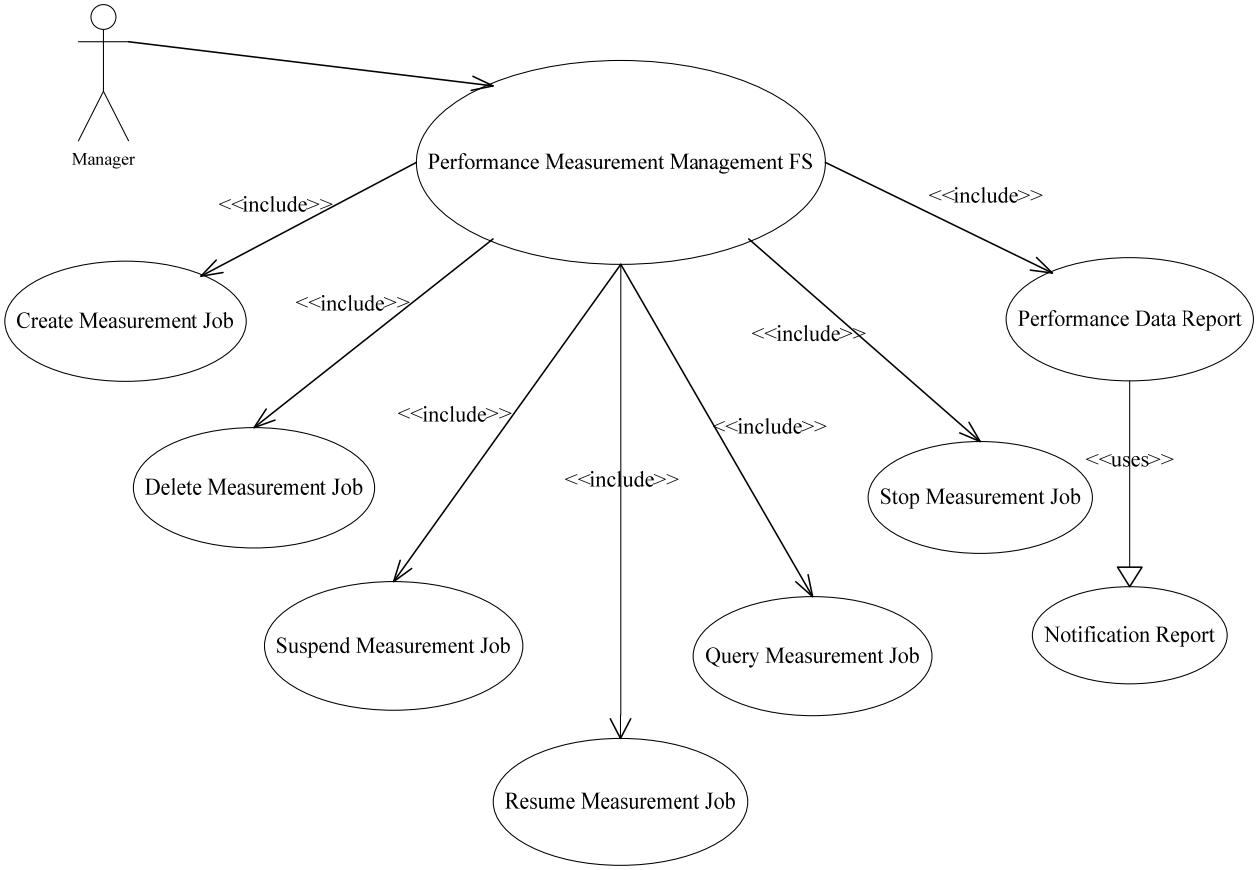

Figure 6-2 – Performance measurement management FS

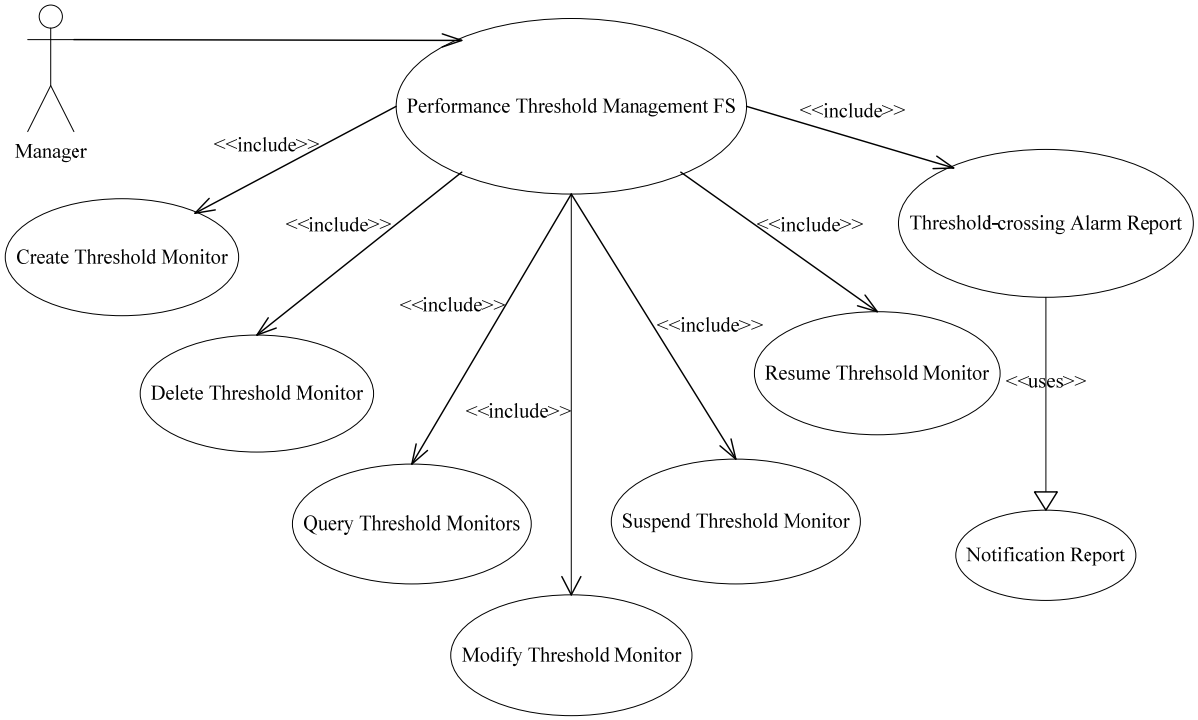

Figure 6-3 – Performance threshold management FS

6.3 Specification-level requirements

6.3.1 Requirements

There are no specification-level requirements.

6.3.2 Actor roles

See clause 6.2.2.

6.3.3 Telecommunication resources

See clause 6.2.3.

6.3.4 Use cases

The general exceptions (e.g., Communication error, Processing error) related to all use cases will not be described in the following use cases, and will only be handled in design phases.

6.3.4.1 Create a measurement job

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to create a performance measurement job through the management interface	
Actor and roles	The manager invokes operation on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	–	
Begins when	The manager sends a request to the agent to start a measurement job for collecting performance data from one or more managed entity instances.	
Step 1	The manager sends a request to the agent to start a performance measurement job. The parameters may contain: – the ID or criteria for the managed entities in which performance data will be collected, – the start time of the collection task (optional), – the stop time of the collection task (optional), – the collection interval of the job, – the report interval of the job, – the schedule of the job (optional), – and the performance parameters to be collected (optional).	
Step 2.1	If the measurement job is started successfully, the job ID will be returned to the manager, and the agent will start the performance collection on the specified network resources according to the parameters of the request. Performance data files are stored in files, and on each reporting interval, the file information will be reported to the manager.	
Step 2.2	Otherwise, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	Invalid parameter	
Post conditions	A measurement job is started on request, and it starts to collect and report the corresponding performance data according to their intervals, respectively. The agent may send an object creation notification to the manager.	
Traceability	REQ-PM-FUN-01, REQ-PM-FUN-02, REQ-PM-FUN-04, REQ-PM-FUN-10	

6.3.4.2 Suspend a measurement job

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to suspend a performance measurement job through the management interface.	
Actor and roles	The manager invokes an operation on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified measurement job exists in the agent and it is not suspended.	
Begins when	The manager sends a request to suspend a measurement job.	
Step 1	The manager sends a request to the agent to suspend a performance measurement job. The request parameter is the identifier of the measurement job.	
Step 2	If the operation succeeds, the measurement job will no longer collect and report the corresponding performance data until resumed.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	– unknown measurement job; – measurement job already suspended.	
Post conditions	The specified measurement job is suspended on request. The agent may send a state change notification to the manager.	
Traceability	REQ-PM-FUN-05	

6.3.4.3 Resume a measurement job

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to resume a suspended performance measurement job through the management interface.	
Actor and roles	The manager invokes an operation on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified measurement job exists in the agent and it is suspended.	
Begins when	The manager sends a request to resume a measurement job.	
Step 1	The manager sends a request to the agent to resume a performance measurement job. The request parameter is the identifier of the measurement job.	
Step 2.1	If the operation succeeds, the measurement job will continue collecting and reporting the corresponding performance data specified for this job.	
Step 2.2	If the operation fails, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	

Use case stage	Evolution/Specification	<<Uses>> Related use
Exceptions	– unknown measurement job; – measurement job not suspended.	
Post conditions	The specified measurement job is resumed on request, and it continues to collect and report performance measurement data. The agent may send a state change notification to the manager.	
Traceability	REQ-PM-FUN-06	

6.3.4.4 Query measurement jobs

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to query the parameter values of one or more performance measurement job(s) through the management interface.	
Actor and roles	The manager invokes operations on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified measurement job exists in the agent.	
Begins when	The manager sends a request to query the information of a measurement job.	
Step 1	The manager sends a request to the agent to query the parameters of a performance measurement job, which include: – the job ID(s), – the identifier(s) for the managed objects in which performance data are collected, – the start time and stop time of the measurement job, – the collection interval of the job, – the report interval of the job, – the schedule for the job, – the administrative state, – the performance parameters to be collected.	
Step 2.1	If the operation succeeds, the agent will return the attribute information of the performance measurement job.	
Step 2.2	If the operation fails, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	Unknown measurement job.	
Post conditions	The corresponding attribute information is returned by the agent as requested.	
Traceability	REQ-PM-FUN-08	

6.3.4.5 Stop a measurement job

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to permanently stop a performance measurement job through the management interface. When a measurement job is stopped, it does not collect performance data any more, but it still holds the performance data files.	
Actor and roles	The manager invokes an operation on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified measurement job exists in the agent.	
Begins when	The manager sends a request to stop a measurement job.	
Step 1	The manager sends a request to the agent to stop a performance measurement job.	
Step 2.1	If the operation succeeds, the specified measurement job will stop working and the agent will return success information.	
Step 2.2	Otherwise, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	– unknown measurement job; – measurement job already stopped.	
Post conditions	The measurement job is stopped on request but the measurement data files are still maintained by this measurement job, which can be retrieved by the manager. The agent may send a state change notification to the manager.	
Traceability	REQ-PM-FUN-07	

6.3.4.6 Delete a measurement job

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to delete a performance measurement job through the management interface. When a measurement job is deleted, the associated measurement data files are not required to be maintained in the agent.	
Actor and roles	The manager invokes an operation on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified measurement job exists in the agent and it is stopped or suspended. The history performance data files related to the job in the agent will no longer be used.	
Begins when	The manager sends a request to delete a measurement job.	

Use case stage	Evolution/Specification	<<Uses>> Related use
Step 1	The manager sends a request to the agent to delete a performance measurement job. The request parameter is the identifier of the measurement job.	
Step 2.1	If the operation succeeds, the specified measurement job will stop working and the related collecting resources, including the data files, will be released, and the agent will return success information.	
Step 2.2	Otherwise, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	– unknown measurement job; – measurement job not suspended or stopped.	
Post conditions	The specified measurement job is deleted on request. The agent may send an object deletion notification to the manager.	
Traceability	REQ-PM-FUN-09	

6.3.4.7 Performance data report

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	Performance data are stored in files. At each report interval, the corresponding performance data file(s) will be prepared by the agent and a "Bulk Data Transfer Ready" notification will be sent to the manager, and then the prepared files will be transferred from the agent to the manager using FTP service. Performance data report may use the functions provided in the "bulk data transfer FS", which is outside the scope of this Recommendation.	
Actor and roles	The agent sends file preparation notifications to the manager.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	A measurement job has been created in the agent.	
Begins when	The agent prepares the performance data file at the end of a report interval, or on the request of a manager.	
Step 1	The agent prepares the performance data file.	
Step 2.1	If the performance data file(s) are ready, a notification "Bulk Data Transfer Ready" will be sent to the manager.	Notification report
Step 2.2	If some errors occurred during the preparation of the performance data file(s), a notification "Bulk Data Preparation Error" will be sent to the manager.	
Ends when	Either "Bulk Data Transfer Ready" or "Bulk Data Preparation Error" is sent to the manager.	
Exceptions	–	
Post conditions	The "Bulk Data Transfer Ready" or "Bulk Data Preparation Error" notification is received by the manager.	
Traceability	REQ-PM-FUN-03	

6.3.4.8 Create a threshold monitor

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to create a performance threshold monitor through the management interface. The manager can monitor some performance measurement parameters collected from managed entities in order to know whether or not there are any performance degradation or service-related performance problems in time.	
Actor and roles	The manager invokes an operation on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The measurement job(s) containing the measurement parameters to be monitored have been started.	
Begins when	The manager sends a request to create a threshold monitor.	
Step 1	The manager sends a request to the agent to create a performance threshold monitor. The input parameters in the request contain: – the ID or criteria for the managed entities to be monitored, – the monitoring granularity period, – a set of the sequence of names of the measurement parameters, – corresponding threshold value, – the notifyOnOff switch of alarm notifications, – the related alarm severity (optional).	
Step 2.1	If the creation succeeds, the agent will return success information, and the output parameter is: – threshold monitor ID.	
Step 2.2	If the operation fails, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	Invalid parameter.	
Post conditions	A performance threshold monitor is created by the agent on request, and an object creation notification may be reported to the manager. The agent starts to monitor the performance parameters according to the specified threshold values. When a threshold value is crossed, a threshold-cross alarm will be raised.	
Traceability	REQ-PM-FUN-11	

6.3.4.9 Delete a threshold monitor

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to delete a performance threshold monitor through the management interface.	
Actor and roles	The manager invokes operations on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	

Use case stage	Evolution/Specification	<<Uses>> Related use
Preconditions	The specified threshold monitor exists in the agent and it is suspended.	
Begins when	The manager sends a request to delete a threshold monitor.	
Step 1	The manager sends a request to the agent to delete a performance threshold monitor. The parameter is the identifier of the performance threshold monitor. According to the request, the agent will delete the specified performance threshold monitor.	
Step 2.1	If the deletion succeeds, the agent will return success information and no longer monitor the corresponding performance parameters.	
Step 2.2	If the operation fails, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	– unknown threshold monitor; – threshold monitor not suspended.	
Post conditions	The specified performance threshold monitor is deleted by the agent on request, and an object deletion notification may be reported to the manager. The agent will no longer monitor the corresponding performance parameters. If the operation fails, it will return error information to the manager.	
Traceability	REQ-PM-FUN-16	

6.3.4.10 Suspend a threshold monitor

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to suspend a performance threshold monitor through the management interface. When the manager temporarily does not want the threshold monitor to raise any threshold-cross alarms for the performance parameters, or the manager needs to change some attribute values of the monitor, this function can be invoked.	
Actor and roles	The manager invokes operations on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified threshold monitor exists in the agent and it is not suspended.	
Begins when	The manager sends a request to suspend a threshold monitor.	
Step 1	In this use case, the manager sends a request to suspend a performance threshold monitor, and the input parameter is the threshold monitor id.	
Step 2.1	If the suspension succeeds, the agent will return success information and the performance threshold monitor will not act on the corresponding performance parameters and no threshold-cross alarms on the performance parameters will be raised.	
Step 2.2	If the operation fails, it will return error information to the manager.	

Use case stage	Evolution/Specification	<<Uses>> Related use
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	– unknown threshold monitor; – threshold monitor already suspended.	
Post conditions	The performance threshold monitor is suspended on request, and it does not monitor the corresponding performance parameters until resumed. A state change notification may be sent to the manager.	
Traceability	REQ-PM-FUN-14	

6.3.4.11 Resume a threshold monitor

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to resume a suspended performance threshold monitor through the management interface. When the manager needs a threshold monitor to act on the performance parameters again, this function can be invoked.	
Actor and roles	The manager invokes operations on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified threshold monitor exists in the agent and it is suspended.	
Begins when	The manager sends a request to resume a threshold monitor.	
Step 1	In this use case, the manager sends a request to resume a suspended performance threshold monitor, and the input parameter is the threshold monitor id.	
Step 2.1	If the resumption succeeds, the agent will return success information and the performance threshold monitor will continue to act on the corresponding performance parameters.	
Step 2.2	If the operation fails, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	– unknown threshold monitor; – threshold monitor not suspended.	
Post conditions	The performance threshold monitor is resumed on request, and it continues to monitor the corresponding performance parameters. A state change notification may be sent to the manager.	
Traceability	REQ-PM-FUN-15	

6.3.4.12 Modify a threshold monitor

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to modify the attribute values of a performance threshold monitor through the management interface. When the manager needs to change the attribute values of a threshold monitor in the agent, such as the threshold value and the threshold-cross alarm severities, this function can be invoked.	
Actor and roles	The manager invokes operations on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	The specified threshold monitor exists in the agent and it is suspended.	
Begins when	The manager sends a request to modify a threshold monitor.	
Step 1	The manager sends a request to the agent to modify the attribute values of a performance threshold monitor. The following attributes can be modified: – the ID or criteria for the managed objects to be monitored, – the monitoring granularity period, – the sequence of the name of the measurement parameters, – the corresponding threshold value, – the notifyOnOff switch of alarm notification, – the related alarm severity According to the request, the agent will modify the performance threshold monitor.	
Step 2.1	If the modification succeeds, the agent will return success information.	
Step 2.2	If the modification fails, it will return error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	– unknown threshold monitor; – threshold monitor not suspended; – invalid parameter.	
Post conditions	The performance threshold is modified on request. An attribute value change notification may be sent to the manager.	
Traceability	REQ-PM-FUN-13	

6.3.4.13 Query threshold monitors

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to query the information of a performance threshold monitor through the management interface.	
Actor and roles	The manager invokes operations on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	

Use case stage	Evolution/Specification	<<Uses>> Related use
Preconditions	The specified threshold monitor exists in the agent.	
Begins when	The manager sends a request to query a threshold monitor.	
Step 1	The manager sends a request to the agent to query the attribute information of the threshold monitor in the agent. The information includes: – the identifier of the performance threshold monitor, – the ID or criteria for the managed objects to be monitored, – the monitoring granularity period, – the sequence of names of the measurement parameter, – the corresponding threshold value, – the notifyOnOff switch of alarm notification, – the related alarm severity.	
Step 2.1	If the operation succeeds, the agent will return the requested information.	
Step 2.2	If the operation fails, the agent will send error information to the manager.	
Ends when	Requested information or an exception is returned to the manager, or the operation is cancelled by the manager.	
Exceptions	Unknown threshold monitor.	
Post conditions	The requested information of the performance threshold monitor is returned by the agent according to the request.	
Traceability	REQ-PM-FUN-12	

6.3.4.14 Threshold-crossing alarm report

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	When the value of a monitored performance measurement parameter crosses the associated performance threshold value, the agent will trigger a corresponding threshold-cross alarm, which will be reported to the manager if it passes the filtering criteria in the notification IRP.	
Actor and roles	The agent sends threshold-crossing alarm notifications to the manager.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available.	
Preconditions	A threshold monitor has been created in the agent.	
Begins when	The value of a monitored performance parameter crosses the pre-defined threshold value.	
Step 1	The ThresholdMonitor compares the collected performance data against its pre-defined thresholds.	

Use case stage	Evolution/Specification	<<Uses>> Related use
Step 2	If the value of some performance data exceeds the pre-defined threshold, a threshold-crossing alarm notification will be emitted to the manager. This alarm should contain the following information: – the name of the performance parameter that has been crossed, – the corresponding value of the performance parameter, and – the alarm severity. If the alarm severity is specified in the associated performance threshold monitor, the severity of the threshold-crossing alarm should refer to the specified value; otherwise the original severity is assigned by the agent.	Notification report
Ends when	A "threshold crossing alarm" notification is sent to the manager.	
Exceptions	None	
Post conditions	The "threshold crossing alarm" notification is received by the manager.	
Traceability	REQ-PM-FUN-17	

6.3.4.15 Query history performance data files

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The manager can request the agent to query history performance data files on a specified measurement job through the management interface. On receiving this request, the agent will prepare the history data in file format. When the files are ready, the manager will be notified and will then retrieve those performance data files using some bulk data transfer mechanisms, e.g., FTP.	
Actor and roles	The manager invokes an operation on the agent.	
Telecom resource	All types of telecommunication resources.	
Assumptions	The communication between the manager and the agent is available. The agent supports the FTP service.	
Preconditions	The specified measurement job exists in the agent.	
Begins when	The manager sends a request to the agent to query history performance data on a specified measurement job.	
Step 1	The manager sends a request to the agent to query history performance data on a specified measurement job. The input parameters contain: – the identifier of the performance measurement job; – the start time of the performance data files to be queried (optional); and – the end time of the performance data files to be queried (optional).	
Step 2	The agent returns the list of appropriate files information to the manager.	
Ends when	The requested history performance data file information or an exception is returned to the manager.	
Exceptions	Unknown measurement job.	
Post conditions	The agent starts a file preparation task on the request of the manager. When the preparation is finished, the agent will send a "Bulk Data Transfer Ready" notification to the manager.	
Traceability	REQ-PM-FUN-20	

7 Analysis

7.1 Concepts and background

The system contexts for performance management service are shown in Figures 7-1 and 7-2.

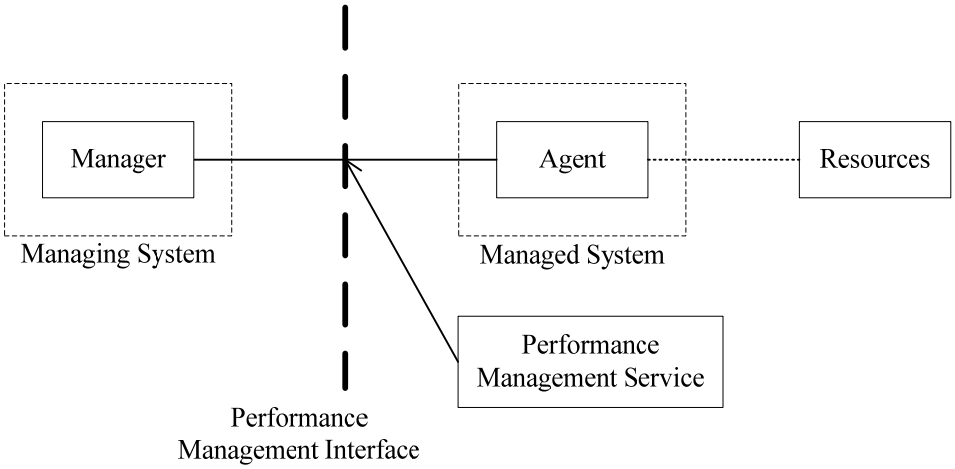

Figure 7-1 – System context A for performance management service

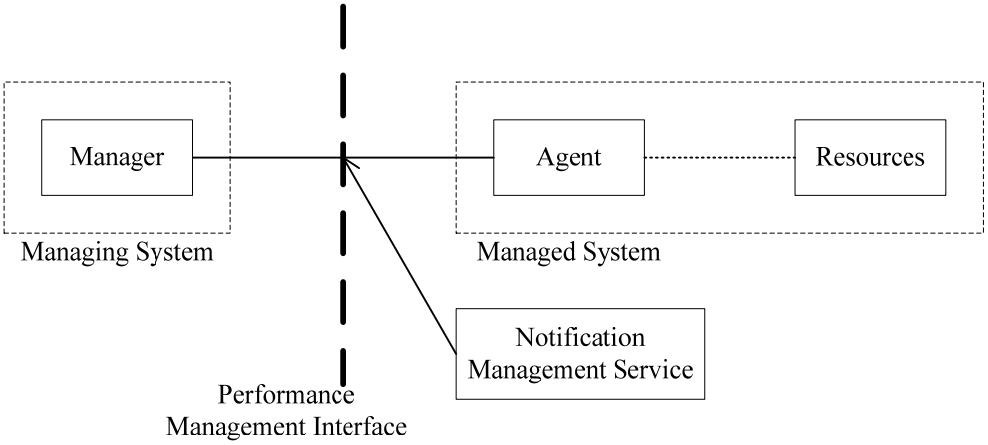

Figure 7-2 – System context B for performance management service

7.2 Information object classes

7.2.1 Information entities imported and local label

Label reference	Local label
[ITU-T M.3702], information object class, NotificationIRP	NotificationIRP
[ITU-T M.3160], information object class, Top	Top
[ITU-T M.3160], information object class, Network	Network

7.2.2 Class diagram

This clause introduces the set of IOCs that encapsulate information within the agent. The intent is to identify the information required for the performance management agent implementation of its operations and notification emission. This clause provides the overview of all support object classes in UML. Subsequent clauses provide more detailed specification of various aspects of these support object classes.

7.2.2.1 Attributes and relationships

As shown below, Figure 7-3 shows the class containment relationships of the performance management related information object classes.

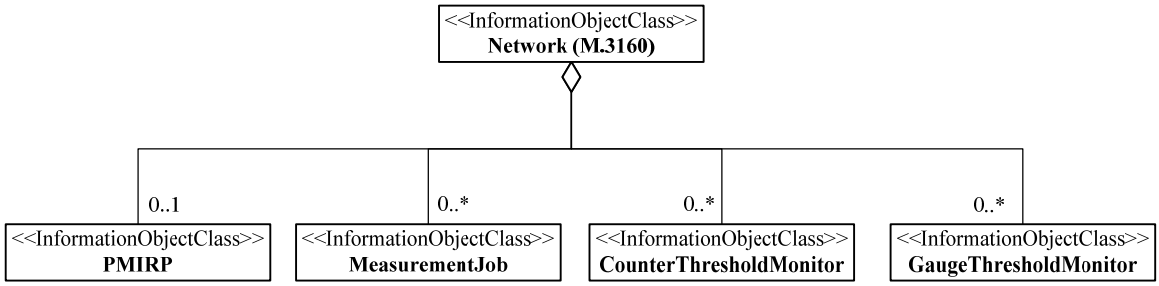

Figure 7-3 – Containment diagram of performance management IOCs

As shown below, Figure 7-4 shows the detailed class diagram of the information object class PMIRP, MeasurementJob, ThresholdMonitor, and the association relationships among them and the managed entities whose performance measurement attributes are to be collected and monitored.

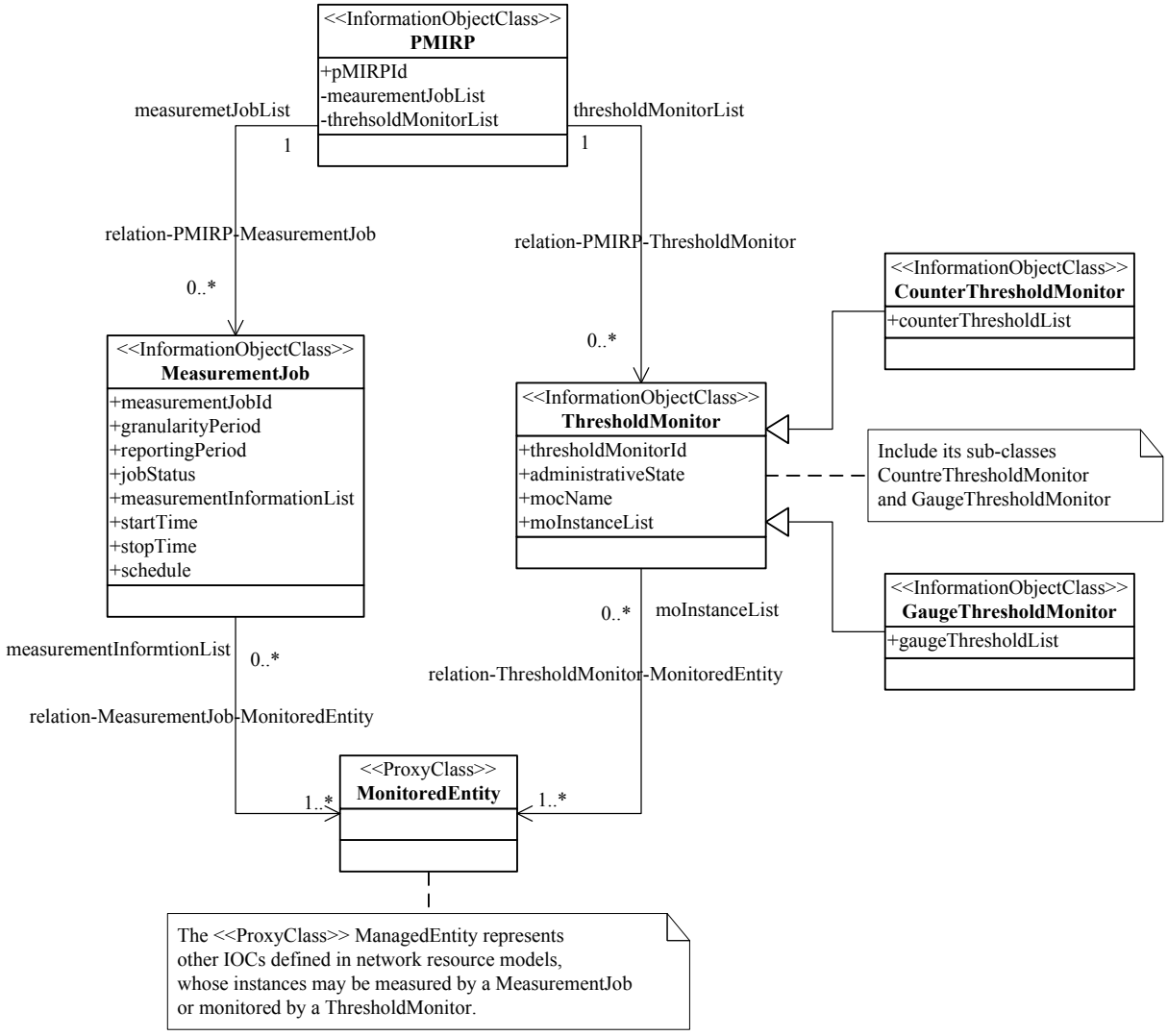

Figure 7-4 – Performance measurement information object classes

7.2.2.2 Inheritance

Figure 7-5 is the inheritance diagram of performance management IOCs.

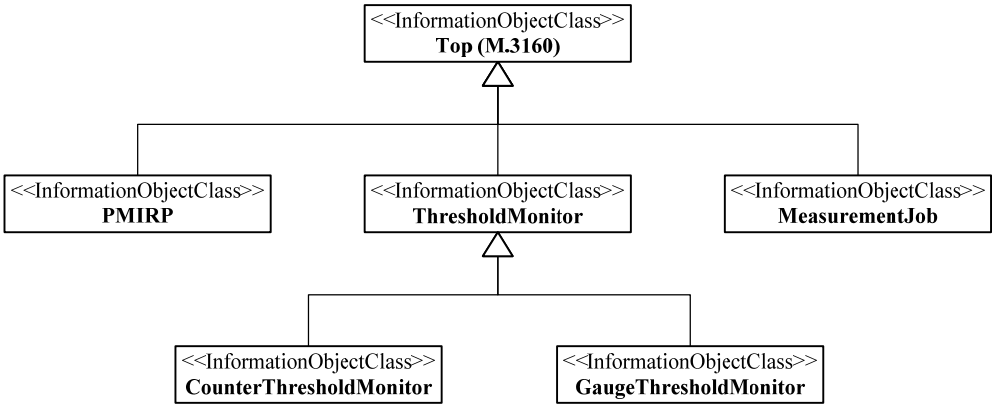

Figure 7-5 – Performance measurement IOCs inheritance

7.2.3 Information object class definitions

Class name	Qualifier	Requirement IDs
PMIRP	M	REQ-PM-FUN-04, REQ-PM-FUN-08, REQ-PM-FUN-09, REQ-PM-FUN-10, REQ-PM-FUN-11, REQ-PM-FUN-12, REQ-PM-FUN-16.
MeasurementJob	M	REQ-PM-FUN-01, REQ-PM-FUN-02, REQ-PM-FUN-03, REQ-PM-FUN-05, REQ-PM-FUN-06, REQ-PM-FUN-07, REQ-PM-FUN-08. REQ-PM-FUN-20.
ThresholdMonitor	M	REQ-PM-FUN-12, REQ-PM-FUN-13, REQ-PM-FUN-14, REQ-PM-FUN-15, REQ-PM-FUN-17.

7.2.3.1 PMIRP

7.2.3.1.1 Definition

PMIRP serves as the agent that performs the main performance management functions. Through PMIRP, the manager can create or delete a MeasurementJob or a ThresholdMonitor, suspend or resume a MeasurementJob or a ThresholdMonitor, and list the information of one or more MeasurementJobs or ThresholdMonitors, etc.

7.2.3.1.2 Attributes

Attribute name	Support qualifier	Read qualifier	Write qualifier	Requirement IDs
pMIRPId	M	M	–	REQ-PM-FUN-01
measurementJobList	O	–	–	REQ-PM-FUN-04, REQ-PM-FUN-09
thresholdMonitorList	O	–	–	REQ-PM-FUN-11, REQ-PM-FUN-16

7.2.3.2 MeasurementJob

7.2.3.2.1 Definition

This IOC represents a measurement job which is used to control the collection of the measurement parameters for one or more managed object instances. Zero or more instances of this managed entity exist in an instance of a derived class of `network`.

7.2.3.2.2 Attributes

Attribute name	Support qualifier	Read qualifier	Write qualifier	Requirement IDs
measurementJobId	M	M	–	REQ-PM-FUN-01
moClass	M	M	–	REQ-PM-FUN-01
moInstanceList	M	M	–	REQ-PM-FUN-01
granularityPeriod	M	M	–	REQ-PM-FUN-01
reportingPeriod	M	M	–	REQ-PM-FUN-01
startTime	M	M	–	REQ-PM-FUN-01
stopTime	M	M	–	REQ-PM-FUN-01
performanceParameter List	M	M	–	REQ-PM-FUN-01
schedule	M	M	–	REQ-PM-FUN-01
jobStatus	M	M	–	REQ-PM-FUN-01

7.2.3.2.3 Notifications

Name	Qualifier	Notes
objectCreation	O	
objectDeletion	O	
stateChange	O	

7.2.3.2.4 State diagram

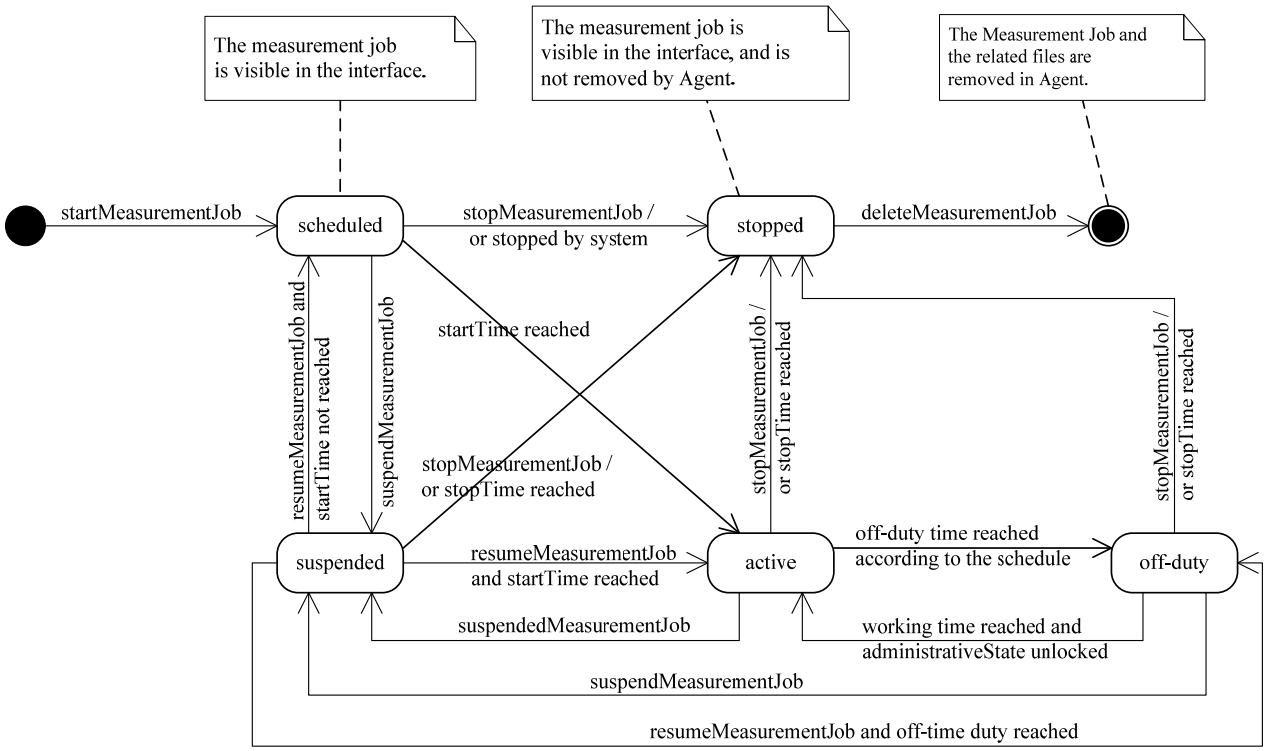

Figure 7-6 – MeasurementJob state diagram

7.2.3.3 ThresholdMonitor

7.2.3.3.1 Definition

This IOC is used for the manager to set thresholds on some performance measurement parameters. When the value of a specified measurement parameter crosses some threshold value, a thresholdCrossingAlarm will be emitted by this ThresholdMonitor. This entity also provides the controlling functions of the threshold information. This IOC is defined only for inheritance purpose.

7.2.3.3.2 Attributes

Attribute name	Support qualifier	Read qualifier	Write qualifier	Requirement IDs
thresholdMonitorId	M	M	–	REQ-PM-FUN-11
moClass	M	M	–	REQ-PM-FUN-11
moInstanceList	M	M	M	REQ-PM-FUN-11
administrativeState	M	M	M	REQ-PM-FUN-11
monitorGranularityPeriod	M	M	M	REQ-PM-FUN-11

7.2.3.3.3 Notifications

Name	Qualifier	Notes
objectCreation	O	
objectDeletion	O	
attributeValueChange	O	
stateChange	O	
threshold-CrossingAlarm	M	

7.2.3.3.4 State diagrams

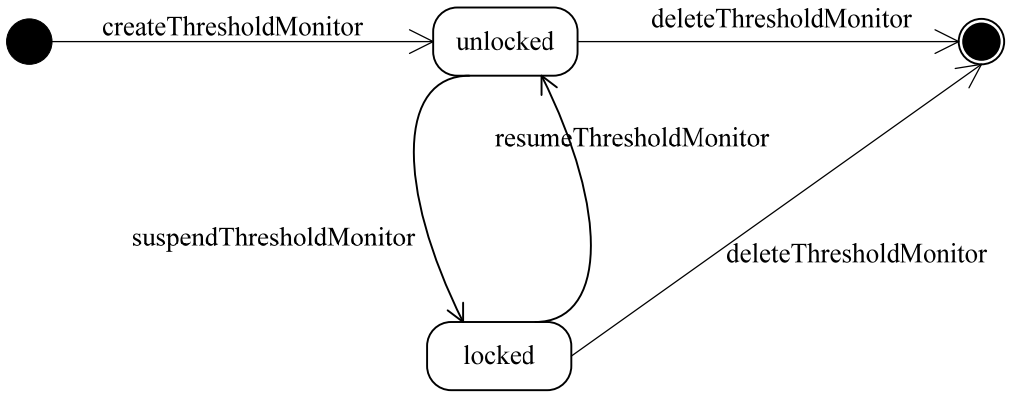

Figure 7-7 – ThresholdMonitor state diagram

7.2.3.4 CounterThresholdMonitor

7.2.3.4.1 Definition

The IOC CounterThresholdMonitor is used to represent a derived class of ThresholdMonitor, which only monitors counter-typed measurement parameters. See [ITU-T X.721] for the semantics of counter.

7.2.3.4.2 Attributes

Attribute name	Support qualifier	Read qualifier	Write qualifier	Requirement IDs
counterThresholdList	M	M	M	REQ-PM-FUN-11
NOTE – Other common attributes inherited from IOC ThresholdMonitor are not listed in this table.				

7.2.3.4.3 Notifications

The same as the notifications that can be sent by ThresholdMonitor.

7.2.3.4.4 State diagrams

The same as the notifications that can be sent by ThresholdMonitor.

7.2.3.5 GaugeThresholdMonitor

7.2.3.5.1 Definition

The IOC GaugeThresholdMonitor is used to represent a derived class of ThresholdMonitor, which only monitors gauge-typed measurement parameters, see [ITU-T X.721] for the semantics of gauge. See [ITU-T X.721] for the semantics of counter.

7.2.3.5.2 Attributes

Attribute name	Support qualifier	Read qualifier	Write qualifier	Requirement IDs
gaugeThresholdList	M	M	M	REQ-PM-FUN-11
NOTE – Other common attributes inherited from IOC ThresholdMonitor are not listed in this table.				

7.2.3.5.3 Notifications

The same as the notifications that can be sent by ThresholdMonitor.

7.2.3.5.4 State diagrams

The same as the notifications that can be sent by ThresholdMonitor.

7.2.4 Information relationships definition

Relationship	Support qualifier	Requirement IDs
relation-PMIRP-MeasurementJob	M	REQ-PM-FUN-04, REQ-PM-FUN-09
relation-PMIRP-ThresholdMonitor	M	REQ-PM-FUN-11, REQ-PM-FUN-16
relation-MeasurementJob-MonitoredEntity	M	REQ-PM-FUN-01,
relation-ThresholdMonitor-MonitoredEntity	M	REQ-PM-FUN-17

7.2.4.1 relation-PMIRP-MeasurementJob (M)

7.2.4.1.1 Definition

This represents a unidirectional relation from the IOC `PMIRP` to the IOC `MeasurementJob`.

The role of the relation shall be mapped to a reference attribute of the IOC. The name of the reference attribute shall be the role name.

7.2.4.1.2 Role

Name	Definition
measurementJobList	This role represents the `PMIRP` capability to identify the list of one or more MeasurementJobs which are created through this PMIRP. When this role is present, the `PMIRP.measurementJobList` shall carry the list of DNs of the IOC `MeasurementJob`.

7.2.4.1.3 Constraint

There is no constraint for this relationship.

7.2.4.2 relation-PMIRP-ThresholdMonitor (M)

7.2.4.2.1 Definition

This represents a unidirectional relation from the IOC `PMIRP` to the IOC `ThresholdMonitor` (including its subclasses, `CounterThresholdMonitor` and `GaugeThresholdMonitor`).

The role of the relation shall be mapped to a reference attribute of the IOC. The name of the reference attribute shall be the role name.

7.2.4.2.2 Role

Name	Definition
thresholdMonitorList	This role represents the `PMIRP` capability to identify the list of one or more ThresholdMonitors which are created through this PMIRP. When this role is present, the `PMIRP.thresholdMonitorList` shall carry the list of DNs of the IOC `ThresholdMonitor`.

7.2.4.2.3 Constraint

There is no constraint for this relationship.

7.2.4.3 relation-MeasurementJob-MonitoredEntity (M)

7.2.4.3.1 Definition

This represents a unidirectional relation from the IOC `MeasurementJob` to the ProxyClass `MonitoredEntity`.

The role of the relation shall be mapped to a reference attribute of the IOC. The name of the reference attribute shall be the role name.

7.2.4.3.2 Role

Name	Definition
moInstanceList	This role represents the `MeasurementJob` capability to identify the list of one or more `MonitoredEntities` to be measured. When this role is present, the `MesurementJob.moInstanceList` shall carry the list of DNs of the ProxyClass `MonitoredEntities`.

7.2.4.3.3 Constraint

There is no constraint for this relationship.

7.2.4.4 relation-ThresholdMonitor-MonitoredEntity (M)

7.2.4.4.1 Definition

This represents a unidirectional relation from the IOC `ThresholdMonitor` (including its subclasses `CounterThresholdMonitor` and `GaugeThresholdMonitor`) to the ProxyClass `MonitoredEntity`.

The role of the relation shall be mapped to a reference attribute of the IOC. The name of the reference attribute shall be the role name.

7.2.4.4.2 Role

Name	Definition
moInstanceList	This role represents the `ThresholdMonitor` capability to identify the list of one or more `MonitoredEntities` to be monitored. When this role is present, the `ThresholdMonitor.moInstanceList` shall carry the list of DNs of the ProxyClass `MonitoredEntities`.

7.2.4.4.3 Constraint

There is no constraint for this relationship.

7.2.5 Information attribute definition

7.2.5.1 Definition and legal values

Name	Definition	Information type/ Legal values
measurementJobId	This is the unique identifier of the managed entity.	`INTEGER`
moClass	This attribute specifies the class name of managed object instances on which the performance data are collected.	`String`
moInstanceList	This parameter specifies the MO instances on which the performance data are collected. When this attribute is empty, it indicates all the instances of the same MO class specified in "moClass" parameter.	`SET OF Name`

granularityPeriod	This attribute specifies the time interval of the measurement period for collection of performance data.	`PeriodType ::= SEQUENCE {`
		`  value INTEGER,`
		`  units ENUMERATED {minutes, hours, days}`
		`}`

reportingPeriod	This attribute specifies the time interval of the reporting period for performance data, which shall be one or multiple times the granularity period.	`PeriodType`
startTime	This attribute specifies the start time when this performance measurement job takes effect. When empty, it indicates the task will start immediately.	`GeneralizedTime` NOTE – The semantics of Generalized time specified in [ITU-T X.680] shall be used in this Recommendation.

Name	Definition	Information type/ Legal values
stopTime	This attribute specifies the end time of this performance measurement job. When empty, it indicates there is no automatic stop time for this task, unless it is stopped by another operation.	`GeneralizedTime`
performanceParameterList	This attribute specifies the performance parameters to be measured.	`SET OF AttributeName` `AttributeName ::= String`

schedule	This attribute indicates the detailed schedule for this collection task on daily or weekly basis. See [ITU-T X.721] for details.	`ScheduleType ::= CHOICE {`
		`dailySchedule IntervalsOfDay,`
		`weeklySchedule WeekMask`
		`}`
		
		`IntervalsOfDay ::= SET OF SEQUENCE{`
		`intervalStart Time24,`
		`intervalEnd Time24`
		`}`
		`Time24 ::= SEQUENCE {`
		`hour INTEGER (0..23),`
		`minute INTEGER (0..59)`
		`}`
		`WeekMask ::= SET OF SEQUENCE {`
		`daysOfWeek BIT STRING {sunday(0), monday(1), tuesday(2), wednesday(3), thursday(4), friday(5), saturday(6)} (SIZE(7)),`
		`intervalsOfDay IntervalsOfDay`
		`}`

jobStatus	This attribute is used to indicate the running status of a measurement job.	`JobStatusType ::= ENUMERATED { scheduled, active, off-duty, suspended, stopped } /` "scheduled": the job is created, but the start time is not reached yet, "active": the job is running actively, "off-duty": the job is off-duty according to the schedule, "suspended": this job is suspended, "stopped": the job has been stopped by the manager or the stop time has been reached (When more than one value is acceptable for the job status, the latter one in the order of the above list has the highest priority.)
thresholdMonitorId	This is the unique identifier of the managed entity.	`INTEGER`

Name	Definition	Information type/ Legal values
moClass	This attribute specifies the class name of managed object instances on which the performance data are collected.	`String`
moInstanceList	This attribute specifies the MO instances on which the performance data are collected. An empty list means it is applicable for any instance of the managed object class specified in "moClass" attribute.	`SET OF Name`

counterThresholdList	This attribute contains a set of threshold settings for performance attributes of the counter type (e.g., errored seconds). Each threshold setting consists of the attribute identifier, the threshold value and (optionally) the severity of the threshold-exceeded event.	`CounterThresholdListType ::= SET OF SEQUENCE {`
		`  attributeId String,`
		`  severityIndicatingThreshold SeverityIndicatingThresholdType`
		`}`
		`SeverityIndicatingThresholdType ::= SEQUENCE {`
		`  threshold CHOICE {`
		`  integer INTEGER,`
		`  real REAL},`
		`  notifyOnOff BOOLEAN,`
		`  severityIndication Severity OPTIONAL`
		`}`
		`Severity ::= ENUMERATED {indeterminate, critical, major, minor, warning, cleared}`
		
		The description of `threshold`, `notifyOnOff` and `severityIndication` can be found in [ITU-T X.739].

gaugeThresholdList	This attribute contains a set of threshold settings for performance attributes of the gauge type. Each threshold setting consists of the attribute identifier, the threshold values (it may have multiple levels) and (optionally) the severity of the threshold-exceeded event for each level.	`GaugeThresholdListType::= SET OF SEQUENCE {`
		`  attributeId AttributeId,`
		`  severityIndicatingGaugeThreshold SEQUENCE OF SEQUENCE {`
		`  notifyLow SeverityIndicatingThresholdType,`
		`  notifyHigh SeverityIndicatingThresholdType`
		`  }`
		`}`
		The Type "SeverityIndicatingThresholdType" can be found in the above row, and the concepts of "notifyLow" and "notifyHigh" can be found in [ITU-T X.739].

Name	Definition	Information type/ Legal values
administrativeState	This attribute is used to activate (lock) or deactivate (unlock) this ThresholdMonitor. When the threshold monitor is locked, no threshold-crossingAlarm will be emitted from it.	`AdministrativeStateType ::= ENUMERATED {locked, unlocked} /` locked: the thresholdMonitor is suspended; unlocked: the thresholdMonitor is not suspended. The detailed definitions for administrativeState can be found in [ITU-T M.3701].
monitorGranularityPeriod	This attribute specifies the time period for this ThresholdMonitor instance to check whether the specified performance parameters have crossed the corresponding threshold values.	`PeriodType`

7.2.5.2 Constraints

Name	Affected attribute(s)	Definition
inv_measurementJobId	measurementJobId	measurementJobIds shall be chosen to be unique across all measurement jobs of a particular agent.
inv_thresholdMonitorId	thresholdMonitorId	thresholdMonitorIds shall be chosen to be unique across all threshold monitors of a particular agent.

7.3 Interface definition

7.3.1 Class diagram

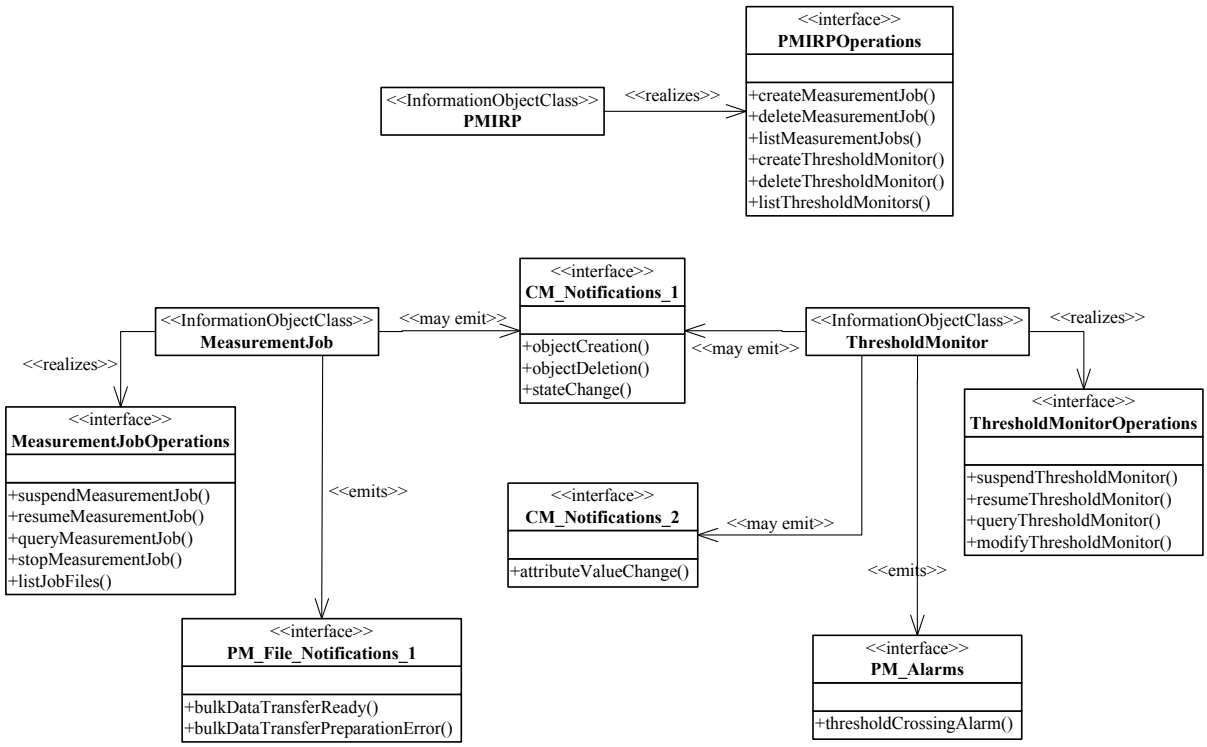

Figure 7-8 – Interface PMIRP class diagram

7.3.2 Generic rules

Rule 1: Each operation with at least one input parameter supports a pre-condition valid_input_parameter which indicates that all input parameters shall be valid with regard to their information type. Additionally, each such operation supports an exception operation_failed_invalid_input_parameter which is raised when pre-condition valid_input_parameter is false. The exception has the same entry and exit state.

Rule 2: Each operation with at least one optional input parameter supports a set of pre-conditions supported_optional_input_parameter_xxx where "xxx" is the name of the optional input parameter and the pre-condition indicates that the operation supports the named optional input parameter. Additionally, each such operation supports an exception operation_failed_unsupported_optional_input_parameter_xxx which is raised when (a) the pre-condition supported_optional_input_parameter_xxx is false and (b) the named optional input parameter is carrying information. The exception has the same entry and exit state.

Rule 3: Each operation shall support a generic exception operation_failed_internal_problem which is raised when an internal problem occurs and the operation cannot be completed. The exception has the same entry and exit state.

7.3.3 Interface PMIRPOperations (M)

Operation name	Qualifier	Requirement IDs
createMeasurementJob	M	REQ-PM-FUN-01, REQ-PM-FUN-02
deleteMeasurementJob	M	REQ-PM-FUN-09
listMeasurementJobs	M	REQ-PM-FUN-08

Operation name	Qualifier	Requirement IDs
createThresholdMonitor	M	REQ-PM-FUN-11
deleteThresholdMonitor	M	REQ-PM-FUN-16
listThresholdMonitors	M	REQ-PM-FUN-12

7.3.3.1 Operation createMeasurementJob (M)

7.3.3.1.1 Definition

This function is used to create an instance of performance measurement job. If the creation succeeds, the agent will start to collect and report the performance data according to the request. A measurement job may contain multiple measurement parameters of multiple managed object instances.

7.3.3.1.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
moClass	M	`String`	This attribute specifies the class name of managed object instances on which the performance data are collected.
moInstanceList	M	`SET OF Name`	This parameter specifies the MO instances on which the performance data are collected. When this attribute is empty, it indicates all the instances of the same MO class specified in "moClass" parameter.
granularityPeriod	M	`PeriodType`	This parameter specifies the time interval of a measurement period for collection of performance data.
reportingPeriod	M	`PeriodType`	This parameter specifies the time interval of the reporting period for performance data, which shall be one or multiple times of the granularity period.
startTime	M	`GeneralizedTime`	This parameter specifies the start time when this performance measurement job takes effect. When empty, it indicates the task will start immediately.
stopTime	M	`GeneralizedTime`	This parameter specifies the end time of this performance measurement job. When empty, it indicates there is no automatic stop time for this task, unless it is stopped by another operation.
measurementInformationList	M	`SET OF AttributeName` `AttributeName ::= String`	This parameter specifies the performance parameters to be measured.

Name	Qualifier	Information type/ Legal values	Comment
schedule	M	`ScheduleType`	This indicates the detailed schedule for this collection task on daily or weekly basis. See [ITU-T X.721] for details.
administrativeState	O	`AdministrativeStateType`	This parameter specifies the initial administrative state of the measurement job. The default value should be unlocked.

7.3.3.1.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
measurementJobId	M	`MeasurementJob.measurementJobId`	This parameter specifies the identifier of the performance measurement job.
status	M	`ReturnStatusType ::= ENUMERATED {operationSucceeded, operationFailed} /` "operationSucceeded": measurementJobCreated is true. "operationFailed": operation_failed is true.	

7.3.3.1.4 Pre-condition

moInstanceListExists.

Assertion name	Definition
moInstanceListExists	The ManagedEntity instances list specified by the moInstanceList exist.

7.3.3.1.5 Post-condition

measurementJobCreated.

Assertion name	Definition
measurementJobCreated	A measurement job is successfully created based on the specified information.

7.3.3.1.6 Exceptions

Name	Definition
invalid_parameter	Condition: At least one of the input parameters is invalid. Returned Information: the name of the input parameter which is invalid. Exit state: Entry state.

7.3.3.2 Operation deleteMeasurementJob (M)

7.3.3.2.1 Definition

This function is used to delete an instance of performance measurement job. If the operation succeeds, the agent will no longer collect the performance data for the specified managed objects. When a measurement job is deleted, all the history data files related to this measurement job are not required to be maintained in the agent.

7.3.3.2.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
measurementJobId	M	`Name`	This parameter specifies the identifier of the performance measurement job.

7.3.3.2.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
measurementJobId	M	`MeasurementJob.measurementJobId`	This parameter specifies the identifier of the performance measurement job.
status	M	`ReturnStatusType` / "operationSucceeded": MeasurementJobExists is true. "operationFailed": operation_failed is true.	

7.3.3.2.4 Pre-condition

MeasurementJobExists

Assertion name	Definition
MeasurementJobExists	The ManagedEntity instance specified by the measurementJobId parameter exists in the agent.

7.3.3.2.5 Post-condition

None.

7.3.3.2.6 Exceptions

Name	Definition
unknown_measurement_job	Condition: The specified measurement job identified by the "measurementJobId" input parameter does not exist in the agent. Returned Information: "Unknown MeasurementJob". Exit state: Entry state.

7.3.3.3 Operation listMeasurementJobs (M)

7.3.3.3.1 Definition

This function is used to list all the measurementJobs that are created within the PMIRP in the agent. If the operation succeeds, the agent will return the list of MeasurementJobIds to the manager.

7.3.3.3.2 Input parameters

None.

7.3.3.3.3 Output parameters

Name	Qualifier	Information type/ Legal values	Comment
measurementJobIdList	M	`SET OF Name`	This parameter specifies the list of identifiers of the performance measurement job in the agent.
status	M	`ReturnStatusType` / "operationSucceeded": "operationFailed": operation_failed is true.	

7.3.3.3.4 Pre-condition

None.

7.3.3.3.5 Post-condition

None.

7.3.3.3.6 Exceptions

None.

7.3.3.4 Operation createThresholdMonitor (M)

7.3.3.4.1 Definition

This function is used to create an instance of performance threshold monitor through the management interface.

7.3.3.4.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
moClass	M	`String`	This parameter specifies the class name of managed object instances on which the performance data are collected.

Name	Qualifier	Information type/ Legal values	Comment
moInstanceList	O	`SET OF Name`	This parameter specifies the MO instances on which the performance data are collected. An empty list means it is applicable for any instance of the managed object class specified in "moClass" parameter.
thresholdInfoList	M	`ThresholdInfoListType ::= CHOICE {counterThresholdList CounterThresholdListType, gaugeThresholdList GaugeThresholdListType }`	This parameter is a list of the thresholds for measurement parameters. It can be either a list of counter-typed thresholds, or a list of gauge-typed thresholds. The detailed description and type definition can be found in the description of the IOC "ThresholdMonitor".
administrativeState	M	`AdministrativeStateType`	This parameter specifies the initial value of administrative state.
monitorGranularityPeriod	M	`PeriodType`	This parameter specifies the period for checking threshold-crossing events.

7.3.3.4.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
thresholdMonitorId	M	`Name`	This parameter specifies the identifier of the threshold monitor.
status	M	`ReturnStatusType` / "operationSucceeded": thresholdMonitorCreated is true. "operationFailed": operation_failed is true.	

7.3.3.4.4 Pre-condition

None.

7.3.3.4.5 Post-condition

thresholdMonitorCreated.

Assertion name	Definition
thresholdMonitorCreated	A threshold monitor is successfully created based on the specified information.

7.3.3.4.6 Exceptions

Name	Definition
invalid_parameter	Condition: At least one of the input parameters is invalid. Returned Information: the name of the input parameter which is invalid. Exit state: Entry state.

7.3.3.5 Operation deleteThresholdMonitor (M)

7.3.3.5.1 Definition

This function is used to delete an instance of threshold monitor.

7.3.3.5.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
thresholdMonitorId	M	`Name`	This parameter specifies the identifier of the threshold monitor to be deleted.

7.3.3.5.3 Output parameters

Name	Qualifier	Information type	Comment
status	M	`ReturnStatusType` / "operationSucceeded": ThresholdMonitorExists is true. "operationFailed": operation_failed is true.	

7.3.3.5.4 Pre-condition

ThresholdMonitorExists

Assertion name	Definition
ThresholdMonitorExists	The ManagedEntity instance specified by the thresholdMonitorId parameter exists in the agent.

7.3.3.5.5 Post-condition

None.

7.3.3.5.6 Exceptions

Name	Definition
unknown_threshold_monitor	Condition: The specified threshold monitor identified by the "thresholdMonitorId" input parameter does not exist in the agent. Returned Information: "Unknown Threshold Monitor". Exit state: Entry state.

Name	Definition
threshold_monitor_not_suspended	Condition: The threshold monitor is not suspended before it is deleted. Returned Information: "Threshold Monitor Not Suspended". Exit state: Entry state.

7.3.3.6 Operation listThresholdMonitors (M)

7.3.3.6.1 Definition

This function is used to list all the ThresholdMonitors that are created within the PMIRP in the agent. If the operation succeeds, the agent will return the list of thresholdMonitorIds to the manager.

7.3.3.6.2 Input parameters

None.

7.3.3.6.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
thresholdMonitorList	M	`SET OF Name`	This parameter specifies the list of identifiers of the threshold monitors in the agent.
status	M	`ReturnStatusType` / "operationSucceeded": "operationFailed": operation_failed is true.	

7.3.3.6.4 Pre-condition

None.

7.3.3.6.5 Post-condition

None.

7.3.3.6.6 Exceptions

None.

7.3.4 Interface MeasurementJob operations (M)

Operation name	Qualifier	Requirement IDs
suspendMeasurementJob	M	REQ-PM-FUN-05
resumeMeasurementJob	M	REQ-PM-FUN-06
queryMeasurementJob	M	REQ-PM-FUN-08
stopMeasurementJob	M	REQ-PM-FUN-07
listJobFiles	M	REQ-PM-FUN-20

7.3.4.1 Operation suspendMeasurementJob (M)

7.3.4.1.1 Definition

This function is used to suspend a performance measurement job.

7.3.4.1.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
measurementJobId	M	`Name`	This parameter specifies the identifier of the performance measurement job.

7.3.4.1.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
status	M	`ReturnStatusType` / "operationSucceeded": jobStatusSuspended is true. "operationFailed": operation_failed is true.	

7.3.4.1.4 Pre-condition

MeasurementJobExists

Assertion name	Definition
MeasurementJobExists	The ManagedEntity instance specified by the measurementJobId parameter exists in the agent.

7.3.4.1.5 Post-condition

jobStatusSuspended.

Assertion name	Definition
jobStatusSuspended	The jobStatus attribute value of the MeasurementJob identified by measurementJobId input parameter has been set to or kept as "suspended".

7.3.4.1.6 Exceptions

Name	Definition
unknown_measurement_job	Condition: The specified Measurement Job identified by the "measurementJobId" input parameter does not exist in the agent. Returned Information: "Unknown MeasurementJob". Exit state: Entry state.
measurement_job_already_suspended	Condition: The specified measurement job has already been suspended. Returned Information: "Measurement Job Already Suspended". Exit state: Entry state.

7.3.4.2 Operation resumeMeasurementJob (M)

7.3.4.2.1 Definition

This function is used to resume a suspended performance measurement job.

7.3.4.2.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
measurementJobId	M	`Name`	This parameter specifies the identifier of the performance measurement job.

7.3.4.2.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
status	M	`ReturnStatusType` / "operationSucceeded": jobStatusNotSuspended is true. "operationFailed": operation_failed is true.	

7.3.4.2.4 Pre-condition

MeasurementJobExists

Assertion name	Definition
MeasurementJobExists	The ManagedEntity instance specified by the measurementJobId parameter exists in the agent.

7.3.4.2.5 Post-condition

jobStatusNotSuspended.

Assertion name	Definition
jobStatusNotSuspended	The jobStatus attribute value of the MeasurementJob identified by the "measurementJobId" input parameter will not be "suspended", it can be any of other values based on other conditions.

7.3.4.2.6 Exceptions

Name	Definition
unknown_measurementJob	Condition: The specified Measurement Job identified by the "measurementJobId" input parameter does not exist in the agent. Returned Information: "Unknown Measurement Job". Exit state: Entry state.
measurement_job_not_suspended	Condition: The specified measurement job is not suspended. Returned Information: "Measurement Job Not Suspended". Exit state: Entry state.

7.3.4.3 Operation queryMeasurementJob (M)

7.3.4.3.1 Definition

This function is used to query the parameter values of a performance measurement job.

7.3.4.3.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
measurementJobId	M	Name	This parameter specifies the identifier of the performance measurement job.

7.3.4.3.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
jobInfo	M	JobInfoType::= SEQUENCE { jobId INTEGER, moClass String, moInstanceList SET OF Name, granularityPeriod PeriodType, reportingPeriod PeriodType, startTime GeneralizedTime, stopTime GeneralizedTime, parameterList SET OF String, schedule ScheduleType, jobStatus JobStatusType, administrativeState AdministrativeStateType }	This parameter specifies the information of the specified measurement job, which will be described by the type name JobInfoType
status	M	ReturnStatusType / "operationSucceeded": MeasurementJobExists is true. "operationFailed": operation_failed is true.	

7.3.4.3.4 Pre-condition

MeasurementJobExists

Assertion name	Definition
MeasurementJobExists	The ManagedEntity instance specified by the measurementJobId parameter exists in the agent.

7.3.4.3.5 Post-condition

None.

7.3.4.3.6 Exceptions

Name	Definition
unknown_measurement_job	Condition: The specified measurement job identified by the "measurementJobId" input parameter does not exist in the agent. Returned Information: "Unknown MeasurementJob". Exit state: Entry state.

7.3.4.4 Operation stopMeasurementJob (M)

7.3.4.4.1 Definition

This function is used to stop a performance measurement job. If the operation succeeds, the agent will no longer collect the performance data for the specified managed objects. When a measurement job is stopped, all the history data files related to this measurement job shall still be maintained in the agent.

7.3.4.4.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
measurementJobId	M	`Name`	This parameter specifies the identifier of the performance measurement job.

7.3.4.4.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
status	M	`ReturnStatusType` / "operationSucceeded": jobStatusStopped is true. "operationFailed": operation_failed is true.	

7.3.4.4.4 Pre-condition

MeasurementJobExists

Assertion name	Definition
MeasurementJobExists	The ManagedEntity instance specified by the measurementJobId parameter exists in the agent.

7.3.4.4.5 Post-condition

jobStatusStopped

Assertion name	Definition
jobStatusStopped	The jobStatus of the MeasurementJob identified by the "measurementJobId" input parameter is set to "stopped".

7.3.4.4.6 Exceptions

Name	Definition
unknown_measurement_job	Condition: The specified measurement job identified by the "measurementJobId" input parameter does not exist in the agent. Returned Information: "Unknown MeasurementJob". Exit state: Entry state.

7.3.4.5 Operation listJobFiles (M)

7.3.4.5.1 Definition

This function is used for the manager to query the list of performance history data files. Through this operation, the manager can specify the startTime and endTime of the data files.

7.3.4.5.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
measurementJobId	M	`Name`	This parameter specifies the identifier of the performance measurement job.
startTime	O	`GeneralizedTime`	This parameter indicates the start time of the PM data files to be listed. If this parameter is absent, it indicates the start time will be the earliest time.
endTime	O	`GeneralizedTime`	This parameter indicates the end time of the PM data files to be listed. If this parameter is absent, it indicates the end time will be the current time.

7.3.4.5.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
fileInfoList	M	`FileInfoListType ::= SET OF SEQUENCE { fileDirectory String, fileInfoList SET OF SEQUENCE { fileName String, fileSize INTEGER, fileCompression String, fileCreationTime GeneralizedTime, fileDeletionTime GeneralizedTime } }`	All information pertaining to the files are provided in this parameter. It is a structure containing fileDirectory and a list of fileName, fileSize, fileCompression, fileCreationTime, and estimated fileDeletionTime.
status	M	`ReturnStatusType` / "operationSucceeded": MeasurementJobExists is true. "operationFailed": operation_failed is true.	

7.3.4.5.4 Pre-condition

MeasurementJobExists

Assertion name	Definition
MeasurementJobExists	The ManagedEntity instance specified by the measurementJobId parameter exists in the agent.

7.3.4.5.5 Post-condition

None.

7.3.4.5.6 Exceptions

Name	Definition
unknown_measurement_job	Condition: The specified Measurement Job identified by the "measurementJobId" input parameter does not exist in the agent. Returned Information: "Unknown MeasurementJob". Exit state: Entry state.

7.3.5 Interface ThresholdMonitor Operations (M)

Operation name	Qualifier	Requirement IDs
suspendThresholdMonitor	M	REQ-PM-FUN-14
resumeThresholdMonitor	M	REQ-PM-FUN-15
queryThresholdMonitor	M	REQ-PM-FUN-12
modifyThresholdMonitor	M	REQ-PM-FUN-13

7.3.5.1 Operation suspendThresholdMonitor (M)

7.3.5.1.1 Definition

This function is used to suspend a threshold monitor.

7.3.5.1.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
thresholdMonitorId	M	`Name`	This parameter specifies the identifier of the threshold monitor to be suspended.

7.3.5.1.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
status	M	`ReturnStatusType` / "operationSucceeded": administrativeStateLocked is true. "operationFailed": operation_failed is true.	

7.3.5.1.4 Pre-condition

ThresholdMonitorExists

Assertion name	Definition
ThresholdMonitorExists	The ManagedEntity instance specified by the thresholdMonitorId parameter exists in the agent.

7.3.5.1.5 Post-condition

administrativeStateLocked

Assertion name	Definition
administrativeStateLocked	The administrativeState of the ThresholdMonitor identified by the "thresholdMonitorId" input parameter has been set to or kept as "locked".

7.3.5.1.6 Exceptions

Name	Definition
unknown_threshold_monitor	Condition: The specified threshold monitor identified by the "thresholdMonitorId" input parameter does not exist in the agent. Returned Information: "Unknown Threshold Monitor". Exit state: Entry state.
threshold_monitor_already_suspended	Condition: The threshold monitor has already been suspended. Returned Information: "Threshold Monitor Not Suspended". Exit state: Entry state.

7.3.5.2 Operation resumeThresholdMonitor (M)

7.3.5.2.1 Definition

This function is used to resume a suspended threshold monitor.

7.3.5.2.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
thresholdMonitorId	M	`Name`	This parameter specifies the identifier of the threshold monitor to be resumed.

7.3.5.2.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
status	M	`ReturnStatusType` / "operationSucceeded": administrativeStateUnlocked is true. "operationFailed": operation_failed is true.	

7.3.5.2.4 Pre-condition

ThresholdMonitorExists

Assertion name	Definition
ThresholdMonitorExists	The ManagedEntity instance specified by the thresholdMonitorId parameter exists in the agent.

7.3.5.2.5 Post-condition

administrativeStateUnlocked

Assertion name	Definition
administrativeStateUnlocked	The administrativeState of the ThresholdMonitor identified by the "thresholdMonitorId" input parameter has been set to or kept as "unlocked"

7.3.5.2.6 Exceptions

Name	Definition
unknown_threshold_monitor	Condition: The specified threshold monitor identified by the "thresholdMonitorId" input parameter does not exist in the agent. Returned Information: "Unknown Threshold Monitor". Exit state: Entry state.
threshold_monitor_not_suspended	Condition: The threshold monitor has already been suspended. Returned Information: "Threshold Monitor Not Suspended". Exit state: Entry state.

7.3.5.3 Operation queryThresholdMonitor (M)

7.3.5.3.1 Definition

This function is used to query parameter values of a threshold monitor.

7.3.5.3.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
thresholdMonitorId	M	`Name`	This parameter specifies the identifier of the threshold monitor to be queried.

7.3.5.3.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
thresholdMonitorInfo	M	`ThresholdMonitorInfoType ::= SEQUENCE { moClass String, moInstanceList SET OF Name, thresholdInfoList ThresholdInfoListType, administrativeState AdministrativeStateType, monitorGranularityPeriod PeriodType }` NOTE – The details for PeriodType can be found in the definition of attributes for "ThresholdMonitor" in clause 7.2.5.1, and the details for ThresholdInfoListType can be found in clause 7.3.3.4.2.	This parameter specifies the information of the specified threshold monitor, which includes the following information: – moClass: the class name of MO instances on which the performance data are collected. – moInstanceList: the MO instances on which the performance data are collected. An empty list means it is applicable for any instance of the managed object class specified in "moClass" parameter. – thresholdInfoList: The list of the threshold for measurement parameters. It can be either a list of counter-typed thresholds, or a list of gauge-typed thresholds. – administrativeState: The administrative state of the threshold monitor. – monitorGranularityPeriod: The period for checking threshold-crossing events.
status	M	`ReturnStatusType` / "operationSucceeded": ThresholdMonitorExists is true "operationFailed": operation_failed is true.	

7.3.5.3.4 Pre-condition

ThresholdMonitorExists

Assertion name	Definition
ThresholdMonitorExists	The ManagedEntity instance specified by the thresholdMonitorId parameter exists in the agent.

7.3.5.3.5 Post-condition

None.

7.3.5.3.6 Exceptions

Name	Definition
unknown_threshold_monitor	Condition: The specified threshold monitor identified by the "thresholdMonitorId" input parameter does not exist in the agent. Returned Information: "Unknown Threshold Monitor". Exit state: Entry state.

7.3.5.4 Operation modifyThresholdMonitor

7.3.5.4.1 Definition

This function is used to modify the parameter values of a threshold monitor.

7.3.5.4.2 Input parameters

Name	Qualifier	Information type/ Legal values	Comment
thresholdMonitorId	M	`Name`	This parameter specifies the identifier of the threshold monitor to be modified.
moInstanceList	M	`SET OF Name`	This parameter specifies the MO instances on which the performance data are collected. An empty list means it is applicable for any instance of the managed object class specified in "moClass" attribute.
thresholdInfoList	M	`ThresholdInfoListType`	This parameter is a list of the thresholds for measurement parameters. It can be either a list of counter-typed thresholds, or a list of gauge-typed thresholds. The description and types for this parameter can be found in clause 7.3.3.4.2.
monitorGranularityPeriod	M	`PeriodType`	This parameter specifies the period for checking threshold-crossing events.

7.3.5.4.3 Output parameters

Name	Qualifier	Matching information/ Information type/ Legal values	Comment
thresholdMonitorInfo	M	`ThresholdMonitorInfoType`	This parameter specifies the information of the specified threshold monitor. See clause 7.3.5.3.3 for details.
status	M	`ReturnStatusType` / "operationSucceeded": thresholdMonitorUpdated is true "operationFailed": operation_failed is true.	

7.3.5.4.4 Pre-condition

ThresholdMonitorExists

Assertion name	Definition
ThresholdMonitorExists	The ManagedEntity instance specified by the thresholdMonitorId parameter exists in the agent.

7.3.5.4.5 Post-condition

thresholdMonitorUpdated

Assertion name	Definition
thresholdMonitorUpdated	Either the moInstanceList, thresholdInfoList, or monitorGranularityPeriod attribute value(s) of the ThresholdMonitor identified by the thresholdMonitorId input parameter have been set to the value of the corresponding input parameter.

7.3.5.4.6 Exceptions

Name	Definition
unknown_threshold_monitor	Condition: The specified threshold monitor identified by the "thresholdMonitorId" input parameter does not exist in the agent. Returned Information: "Unknown Threshold Monitor". Exit state: Entry state.
threshold_monitor_not_suspended	Condition: The threshold monitor specified in the request is not suspended before it is modified. Returned Information: "Threshold_Monitor_Not_Suspended". Exit state: Entry state.
invalid_parameter	Condition: At least one of the input parameters is invalid. Returned Information: The names of the input parameter which is invalid. Exit state: Entry state.

7.3.6 Interface PM_File_Notifications (M)

Notification name	Qualifier	Requirement IDs
bulkDataTransferReady	M	REQ-PM-FUN-03, REQ-PM-FUN-19
bulkDataTransferPreparationError	M	REQ-PM-FUN-03, REQ-PM-FUN-19

7.3.6.1 Notification bulkDataTransferReady (M)

7.3.6.1.1 Definition

This notification is used to inform the manager that the requested performance data files are prepared and ready for transfer.

7.3.6.1.2 Input parameters

Parameter name	Qualifiers	Matching information/ Information type/ Legal values	Comment
transferId	M	`INTEGER`	This is the transfer identifier for this file transfer transaction.
jobId	M	`INTEGER`	This parameter is used to specify the measurement job.
fileInfoList	M	`FileInfoListType`	All information pertaining to the files are provided in this parameter. See clause 7.3.4.5.3 for details.
ipAddress	O	`String`	The IP address of the host machine where the files are located.
userName	O	`String`	The user name to be used in FTP.
password	O	`String`	The password to be used in FTP.

NOTE – All the common attributes defined in the Notification Header as described in clause 7.3.5 of [ITU-T M.3702] will also be included, when this notification is instantiated.

7.3.6.1.3 Triggering event

7.3.6.1.3.1 From state

dataFilePreparationStarted

Assertion name	Definition
dataFilePreparationStarted	At the end of a report interval of a performance data file, or on the request of a manager, the agent will start preparing the performance data file.

7.3.6.1.3.2 To state

dataFilePreparationFinishedSuccessfully.

Assertion name	Definition
dataFilePreparationFinished Successfully	The requested data file(s) is prepared successfully.

7.3.6.2 Notification bulkDataTransferPreparationError (M)

7.3.6.2.1 Definition

This notification is used to inform the manager that an error occurred while the agent was preparing the requested performance data files.

7.3.6.2.2 Input parameters

Parameter name	Qualifiers	Matching information/ Information type/ Legal values	Comment
transferId	M	`INTEGER`	This is the transfer identifier for this file transfer transaction.
jobId	M	`INTEGER`	This parameter is used to specify the measurement job.
probableCause	M	`INTEGER`	This indicates error reason why bulk data transfer preparation failed. The possible probable cause is defined in [ITU-T X.721].
perceivedSeverity	M	`ENUMERATED {major, minor, warning} /` "major": the severity is high "minor": the severity is low "warning": the severity is very low	This indicates the severity of the error, can be one of the following: major, minor, warning.
additionalText	O	`String`	This parameter may be used to specify additional information about this error.

NOTE – All the common attributes defined in the Notification Header as described in clause 7.3.5 of [ITU-T M.3702] will also be included, when this notification is instantiated.

7.3.6.2.3 Triggering event

7.3.6.2.3.1 From state

dataFilePreparationStarted.

Assertion name	Definition
dataFilePreparationStarted	At the end of a report interval of a performance data file, or on the request of a manager, the agent will start preparing the performance data file.

7.3.6.2.3.2 To state

dataFilePreparationFinishedUnsuccessfully.

Assertion name	Definition
dataFilePreparationFinished Unsuccessfully	The requested data file(s) is not prepared successfully, and some errors occurred during the preparation procedure.

7.3.7 Interface PM_Alarms (M)

Notification name	Qualifier	Requirement IDs
thresholdCrossingAlarm	M	REQ-PM-FUN-17

7.3.7.1 Notification thresholdCrossingAlarm (M)

7.3.7.1.1 Definition

This notification is used to inform the manager that the value of a monitored performance measurement parameter crosses the associated performance threshold value.

The value of a monitored performance parameter crosses the pre-defined threshold.

The thresholdMonitor compares the collected performance data against its pre-defined thresholds.

If the value of some performance data exceeds the pre-defined threshold, a threshold-crossing alarm notification will be emitted to the manager. This alarm should contain the following information:

– the name of the performance parameter that has been crossed;

– the corresponding value of the performance parameter; and

– the alarm severity.

If the alarm severity is specified in the associated performance threshold monitor, the severity of the threshold-crossing alarm should refer to the specified value; otherwise the original severity is assigned by the agent.

7.3.7.1.2 Input parameters

Parameter name	Qualifiers	Matching information/ Information type/ Legal values	Comment
alarmId	M	`INTEGER`	This attribute identifies this alarm.
parameterName	M	`String`	This attribute indicates the name of the performance parameter that has been crossed.
parameterValue	M	`CHOICE {integer INTEGER, real REAL}`	This attribute indicates the corresponding value of the performance parameter.
perceivedSeverity	M	`ENUMERATED { indeterminate, critical, major, minor, warning, cleared}`	This attribute indicates the perceived severity of this alarm.

NOTE – All the common attributes defined in the Notification Header as described in clause 7.3.5 of [ITU-T M.3702] will also be included, when this notification is instantiated.

7.3.7.1.3 Triggering event

7.3.7.1.3.1 From state

monitoredPerformanceParameterNotCrossedThreshold.

Assertion name	Definition
monitoredPerformanceParameterNotCrossedThreshold	The value of the monitor performance parameter does not cross the pre-defined threshold value specified in a thresholdMonitor.

7.3.7.1.3.2 To state

monitoredPerformanceParameterCrossedThreshold.

Assertion name	Definition
monitoredPerformance ParameterCrossedThreshold	The value of the monitor performance parameter crossed the pre-defined threshold value specified in a thresholdMonitor.

7.3.8 Interface CM_Notifications_1 (O)

Notification name	Qualifier	Requirement IDs
objectCreation	M	
objectDeletion	M	
stateChange	M	

The detailed definitions for the above three notifications can be found in [ITU-T M.3700].

7.3.9 Interface CM_Notifications_2 (O)

Notification name	Qualifier	Requirement IDs
attributeValueChange	M	

The detailed definitions for the above notification can be found in [ITU-T M.3700].

7.4 Scenarios

Figure 7-9 is the sequence diagram of performance measurement management, and Figure 7-10 is the sequence diagram of performance threshold management.

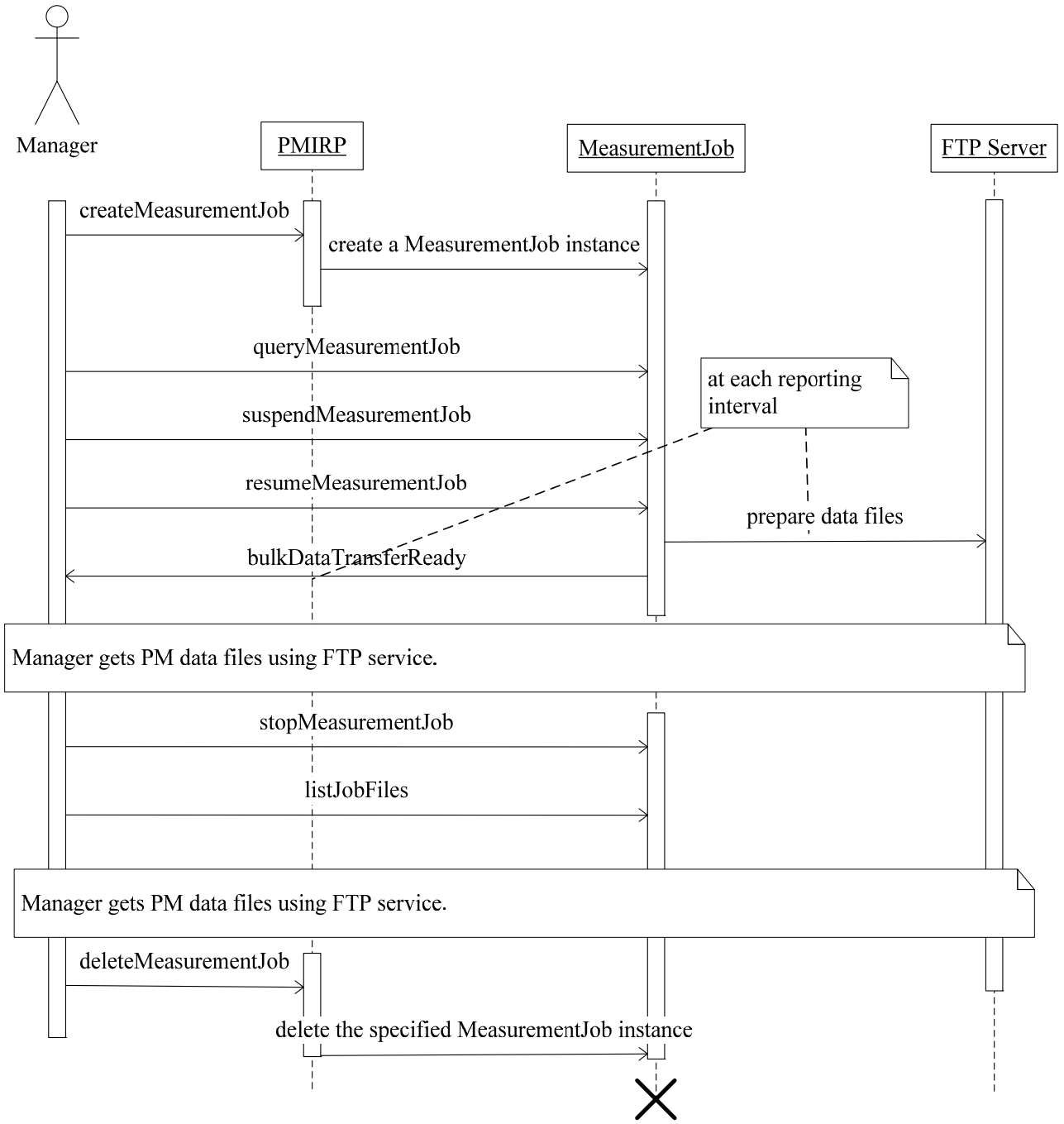

Figure 7-9 – Sequence diagram of performance measurement management

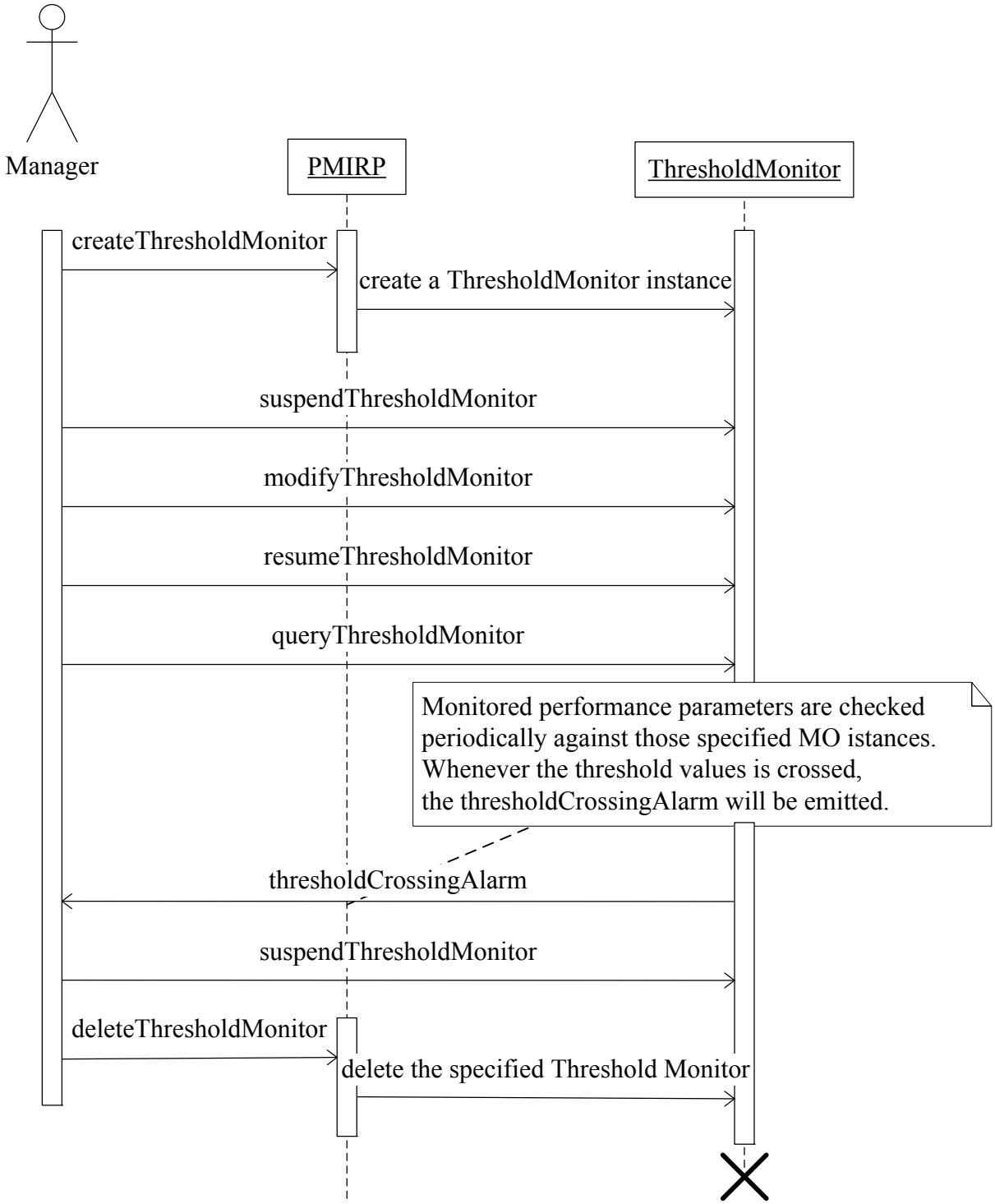

Figure 7-10 – Sequence diagram of performance threshold management

Bibliography

The following documents have been used in the production of this Recommendation:

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Printed in Switzerland
Geneva, 2010