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GSOC OPEN MANAGEMENT SUBSSYSTEM
INTEGRATED OPEN MANAGEMENT OF CONTROL CENTRE NETWORK AND TASKS

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1 ABSTRACT

For control centres the surveillance of both hardware and software systems is of paramount importance. In this context ‘hardware’ means devices, computers and network components while ‘software’ relates to all applications or processes which are of operational significance. Normally several different tasks communicating via various protocols with the specific elements under control have to be utilized and often these tasks run on different computer systems.

With regards to networks this situation has changed substantially as Open Network Management Systems based on standard protocols (CMIP or SNMP) have improved the supervision of networks. The utilisation of such commercial off-the-shelf network management products is improving the quality of network monitoring & control and cutting down the operational costs. But these standard management systems support no real management of the tasks running on the control centre computers.

This paper describes the GSOC Open Management Subsystem (GOMS) . The idea of the GOMS is to realize an integrated open management of Control Centre Network and Tasks. The GOMS offers full integrated network and task management using a standard management protocol (SNMP). It is able to manage all operational devices and processes, and supports the management of the complete control centre as well as mission or system specific management functions.

Key Words are:

Application Management, Open Standards, Network Management, SNMP, UNIX and TCP/IP

2 Background

Within space agencies, the trend is toward larger, more complex systems supporting more and more applications and more users. This is even increased during missions that require inter-agency sharing of resources or cross-support. The complexity of such systems dictates the use of automated management-tools for various reasons:

- A large system cannot be put together and managed by human effort alone
- The availablity of the network and its associated resources and distributed applications has become indispensable to the agencies
- The number of system components is growing as the tendency to higher data rates and distributed mission environments leads to a continuous procurement of more and more system elements.
- The heterogeneity of the system increases day by day.

Cost and performance are the decisive factors which dwarf all other considerations. With larger installations the costs for management of network and configuration of the system are rising and with specific management solutions for each specific system component the overall performance decreases in terms of service ability and flexibility.

As mission budgets are reduced it is necessary to control costs also in the network management area. Generic tools are needed that can be used across the broad spectrum of HW and SW elements that are utilized in a control centre.

3 Goals

The high level goals of the GOMS are to improve the control centre environment in the following areas:

- ease of supervision
- reduction of manpower
- introduction of a consistent view to system managers, project leaders and users.
- increase of the control centre’s multi mission capabilities
- management of software entities as well as hardware entities
- management of legacy software

4 Strategy

It is evident that a complete design and development of such a tool is not practicable. From the point of view of time and cost aspects there remains only one choice: the selection of a customizeable product which already offers essential capabilities and is available on the market.

Suitable products which nearly correspond to the above mentioned goals are Open Network Management Systems based on standard protocols (CMIP or SNMP). These standard management systems have improved the supervision of networks, but they allow no real management of the tasks running on the control centre computers. The German Spacecraft Operating Centre (GSOC) sees the need for the management of operational applications. As there is no standard available the following proceeding was defined:

- Utilization of a commercial available open standard tool for the management of the network components.
- Integration of application management according to the following considerations:
  - user transparent embedding into the commercial system
  - utilization of the same management protocol standards
  - open interface to the managed applications

5 Network management with NetView

In the area of network management different vendors and associations have found solutions for the above mentioned problems. The NetView Association, which was established by IBM and Digital, promotes the "Manager on NetView" as network management tool.

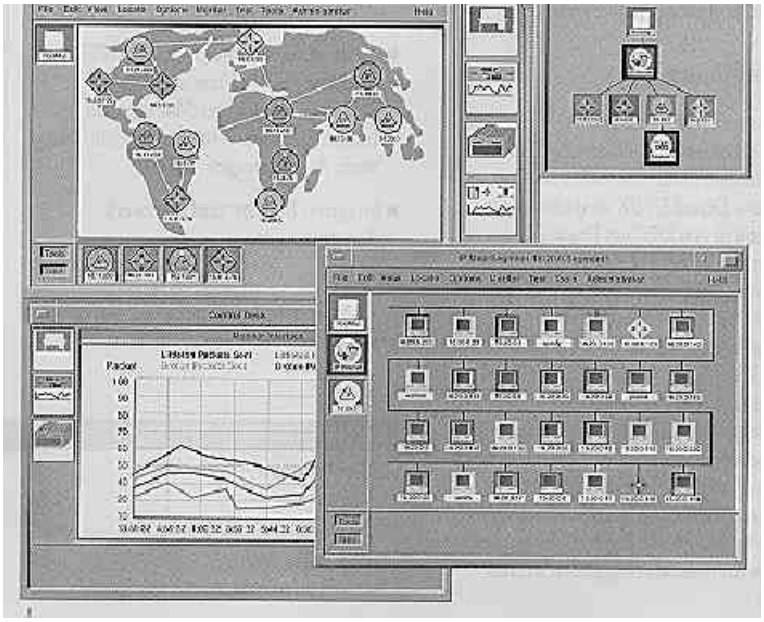


Figure 1: NetView Graphical User Interface

NetView as a commercial off-the-shelf product offers the entire functionality of a modern network management tool. In addition a further advantage is the provison of ready-to-use API's for access to the SNMP-protocol stack, to the data repository and to the graphical user-interface. Thus the GOMS management applications are - from the point of view of the user - totally integrated into NetView Graphical User Interface (see figure 1). No additional tools or licences for implementation of the graphical application manager are necessary.

Based on this tool and on the above mentioned considerations the following concept for application management was decided:

- Management of all relevant operational applications using SNMP
- Modelling of the management aspects of the applications by extensions to the standard MIB-II.
- Performance of the management by using a COTS Network Management Framework
- Provision of an API to interface applications to the management system.

6 Management Architecture

The following picture (figure 2) shows the basic structure of the GOMS. It reflects as closely as possible the structure used for most distributed network-management systems now on the market. Closest to the users are the management clients. These give users access to management services and information and provide an easy-to-use graphic interface. Depending on access privileges, a client workstation may access one or more management servers. The management servers are the heart of the system. Each server supports a set of management applications and a management information base. They also store common management-data models and route management information to applications and clients. Those devices to be managed that share the same network-management protocol as the management servers contain agent software and are managed directly by one or more management servers. For other devices, management servers can only reach the resources through a vendor-specific element manager, or proxy.

The lower part of the picture shows the GOMS-relevant difference to the regular structure. The management agents of the end-systems are extended to allow the management of operational applications which are running on these computers. The applications communicate with the extended agents via an Application Programming Interface for a Managed Application (MAAPI).

Thus the flexibility and scalability of the distributed management model are preserved. As more resources are added to the configuration, each is equipped with agent software, linked to a proxy or bund with an Managed Application API. Furthermore, the growth of the overall configuration can occur in a structured way (e.g. adding a number of workstations with applications for a new project); the growth of the management system mirrors this underlying resource growth, with servers and clients added where the new resources are located.

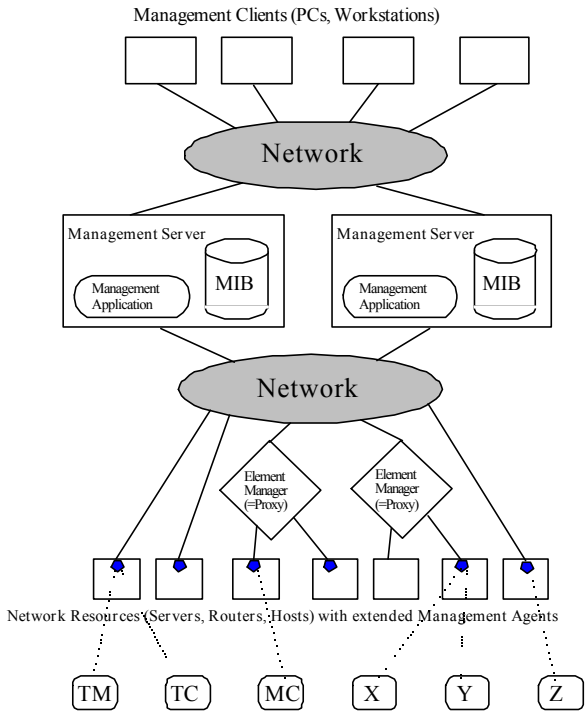


Figure 2: GSOC Open Management System Architecture

7 GOMS Components

7.1 GOMS Manager Components

For the realisation of the management subsystem POLYCENTER NetView running under Digital-UNIX was chosen as management system. Figure 3 shows the manager components developed in the scope of the project:

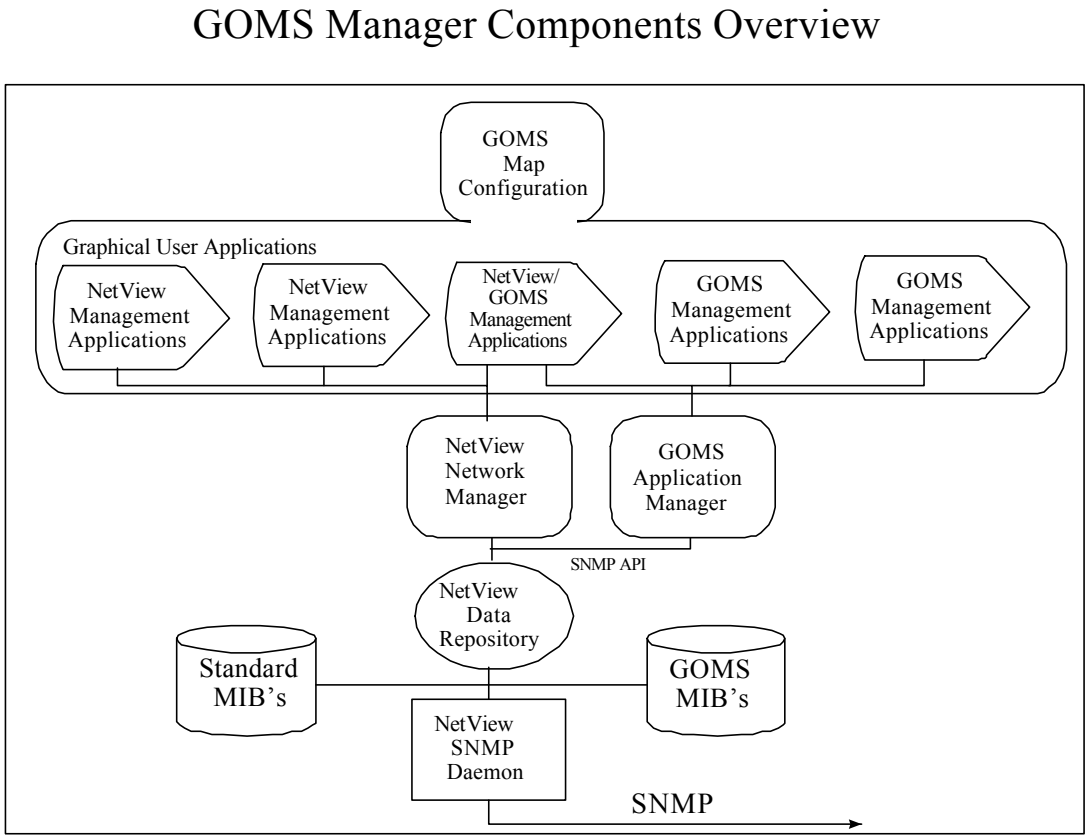


Figure 3 GOMS Manager Overview

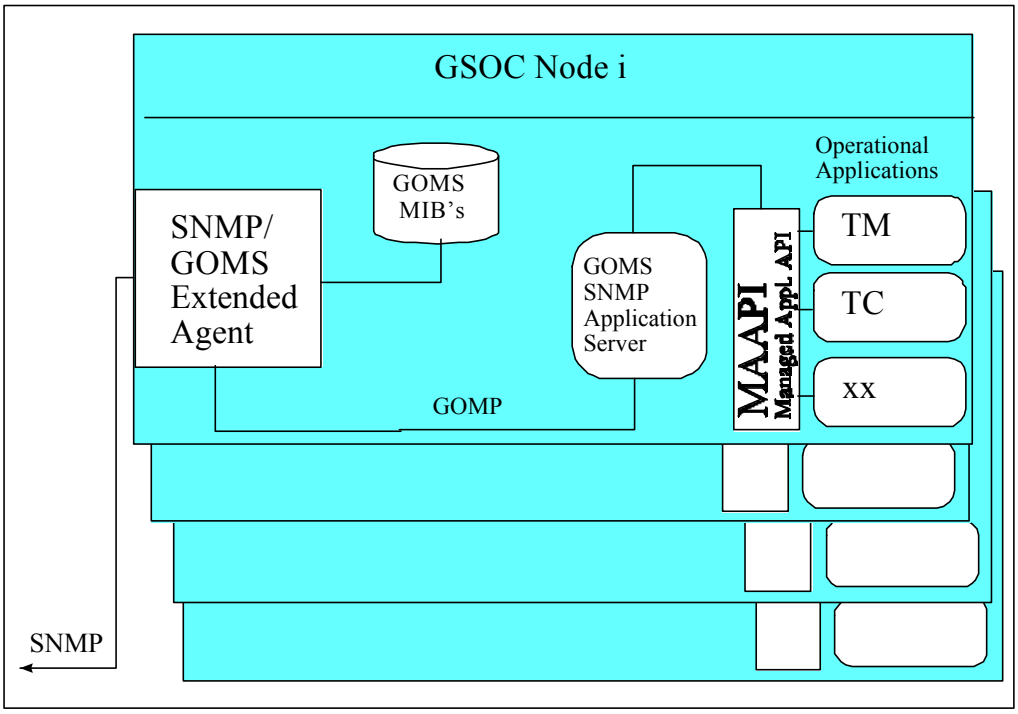
- A map configuration tool as utility-program running directly under the PolyCenter Netview program for the automatic generation of mission/projects submaps.
- The GOMS application manager running directly under the PolyCenter Netview program for the integrated management of operational tasks.
- The GOMS-MIB. As there is no MIB available which seems adequate to the operational constraints, a MIB for applications (e.g. telemetry) was defined.

7.2 GOMS Agent Components

Figure 4 shows the components which were developped for the communication with the managed applications.

- The GOMS SNMP agent/proxy to be able to manage tasks which run on computers without TCP/IP communication.
- The GOMS SNMP Application Server (SAS) task that interfaces both to the SNMP agent and the application tasks.
- The GOMS Managed Application Programming Interface (MAAPI) to allow the interfacing of the tasks.

GSOC Open Management Subsystem
GOMS Agent Components Overview



8 GOMS System Overview

Applications that are to be managed are first modelled by extensions to the standard MIB-II tree. Such extensions are functional in nature. For instance, one subtree is specific to telemetry, another to telecommand, etc. The elements of these subtrees are all tables with each entry corresponding to a specific application instance. Each application belongs to a particular application type, e.g. telemetry, telecommand and is expected to handle the whole of the corresponding MIB subtree. The idea of this relationship between MIB subtree and application type is that applications are specified as generic as possible to avoid specialisations which are not supported. If a new application (e.g. a telemetry processor) is implemented which provides additional capabilities with respect to a generic telemetry processor then it must be modelled by a new type.

The extended MIB provides the starting point for the extension of the existing end-system agent by use of a suitable toolkit. This provides the following services:

- generates data structures to represent the managed objects
- provides means to read and set values in these representations
- handles the communication between manager and agent
- performs the encoding/decoding necessary when sending/receiving
- generates skeleton code that is invoked on an object instance basis
- generates skeleton code that is invoked at regular intervals (for trap polling)
- provides utilities for sending notification messages to the manager

All manager requests result in a a specific routine within the agent process being invoked. It is then the business of this routine to perform the desired action with respect to an object instance. In this case the object instance is a particular application task.

Since:

- there is no access point within the agent task with which an application task can communicate
- the agent cannot locate dynamic application instances

the strategy of GOMS is to employ an SNMP Application Server (SAS) task that interfaces both to the SNMP agent and to the application tasks. Applications can register with the server and can then be referenced by the agent. This server task is at a 'well known' location so that it can be found by the agent and the application tasks. It also provides following the necessary asynchronity:

- applications can register independently of SNMP requests
- notifications can be buffered until they are retrieved by the agent trap polling mechanism

The agent thus communicates with the SAS to:

- manage information contained within the SAS, e.g. application registration table
- pick up buffered traps
- relay an SNMP request to an application and to pick up the response

The messages which are passed between:

- agent / SAS
- SAS / application

together with their mode of employment are defined as the GSOC Open Management Protocol (GOMP).

9 GOMS FUNCTIONALITY

The GOMS offers the integrated management of all operational GSOC network, computers and operational applications from one operator position. The functionality for management of the network and the computers is provided by NetView. The management of the applications allows the following functionality:

- Application Configuration (e.g. ProcessModes: Halt/Go; Prime/Backup; in fact any configurable parameter can be shown via GOMS, but only specific parameters are allowed to be set)

- Mission Specific Monitoring (e.g. S/C subsystem states; in case of TM-applications all S/C parameters are accessible; for performance reasons only surveillance relevant parameters are polled)

- Application Specific Monitoring (e.g. process and communication stati; the GOMS user has the full view whether applications are running correctly and whether they receive or send data)

- Combined Application and Mission Surveillance (predefined derived parameters allow the combination of summary alarm parameters; e.g. in case of TM, the user is informed by a single graphic icon whether S/C and TM application are behaving normally or not)

For all missions the GOMS map configuration tool provides the graphical maps representing all missions and their related network, computers and applications. These maps are hierarchically structured (see figure 5) from the multi mission point of view to the single element view. This means that the highest map shows the multi mission overview, each mission is represented by an icon showing the overall state of each mission and the overall state of the complete control centre. Clicking on a mission icon reveals the view for this mission, a map showing all mission related units, i.e. one icon for each node representing the combined state of the computer and the operational applications running there. The next lower level applies to the applications itself while the lowest map level allows the monitoring and control of specific parameters.

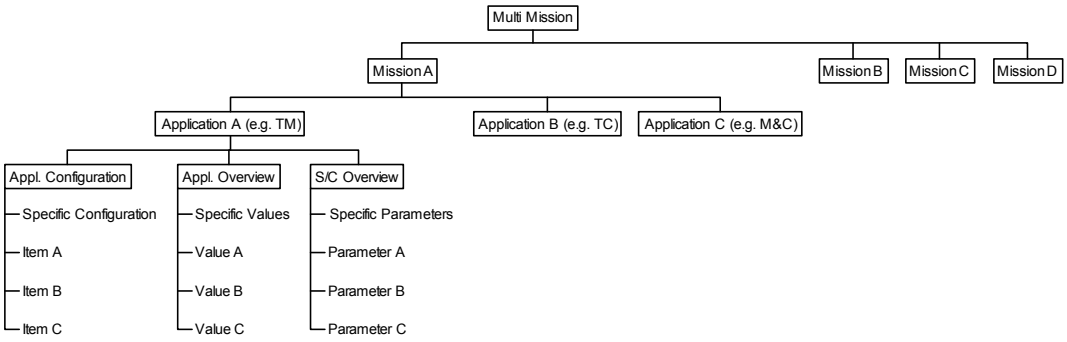


Figure 5: GOMS Graphical Interface Structure

10 CONCLUSION

From the multi mission point of view the GOMS is more than a simple combination of network and application management. The integrated surveillance capability of both ground operations system and flight

element introduces new capabilities for real missions. Thus the GSOC will be capable of reducing mission costs and simultaneously introducing a significantly higher level of operational control.

Also the cross support point of view is of paramount importance. Here the GOMS can offer an open interface for the management of cross support services.