MORE EFFECTIVE OPERATION OF THE BROADBAND NETWORK

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ABSTRACT

The traditional tree-and-branch one-way broadband networks have evolved into sophisticated hybrid-fiber-coax networks carrying advanced new interactive services. In order to realize the HFC network's full potential for increased quality and reliability, the operation and management practices of these networks need to evolve with them. Operational Support Systems (OSS) need to be put in place, concurrent with new work processes.

Rogers has gained significant experience from implementing an Integrated Network Management System (INMS) throughout its fiber and coaxial network. Rogers has also launched a high speed data service, WAVE, with enormous success, and gained considerable operational experience from the trial period. INMS was instrumental in the successful deployment of WAVE. This paper describes some of the initiatives and plans that Rogers Cablesystems is currently working on.

BACKGROUND

The cable television industry has been lagging behind other telecommunication carriers in adopting automation tools to operate and manage their networks. Since the inception of cable television in the 1950's, the industry has largely relied on the customer to be the network watch-dog and report any problems. Except for a few isolated ventures into status monitoring, few operators within the industry have any experience with comprehensive network management. Similar comments could be made regarding the operation of two-way systems. Computer-Aided Design and Drafting (CADD) systems have been in use for many years, but they have remained in the domain of the design and engineering departments, and consequently the information and data they contain has not been readily accessible to others. Computer-aided dispatch systems have been tried by a few operators, but not widely adopted as a customer service tool.

Most operators can share horror stories of uncoordinated construction and maintenance plant changes that remain undocumented and result in prolonged outages. Also typical are random interruptions of service for routine maintenance that go unreported and generate service calls. The recent frenzy of activity with high speed two-way data services for Internet access and work-from-home has raised the awareness within the cable TV industry that a new operations mindset and discipline are badly needed. A combination of competition in the marketplace that gives the consumer new choices, regulatory pressures for improved levels of service, and rapid technology changes are forcing operators to rethink the way they are operating their networks. New and innovative ways of managing the broadband network are required.

MANAGING THE NETWORK

Implementing network management systems is a first crucial step in this process. Software systems that manage network elements (i.e. trunk amps, fiber nodes, modems, etc.) are currently available from equipment vendors. The problem is that each manufacturer has developed proprietary protocols to communicate with their own devices, and standard interfaces between the systems do not exist. This does not mean that a "wait and see" attitude is necessary. At the very least, individual element management systems do provide a wealth of data about that part of the network. Different philosophies exist as to whether monitoring should extend to the ends-of-lines, to trunk amplifiers, or just to fiber hubs. Regardless of the decision, it is important to implement the element management systems early in network deployment. These systems will not only provide more immediate network information, but they also start to instill a new mindset about pro-active network management within the organization.

Most end-of-line and trunk status monitoring systems use two-way data modems to communicate with the amplifiers. The activation of these systems is not only a good training ground for two-way operation, but they also indicate the condition of the plant for carrying data. If the status monitoring system cannot operate reliably, it is almost certain that new data services will not operate as well. Once data services are deployed, status monitoring systems, and particularly those with bridger switching capabilities, are extremely useful in isolating return path problems and isolating faults so that they do not affect the rest of the network. Manpower savings using these tools can be substantial, and service restoration times are greatly improved.

New network management "umbrella" systems are also available which will facilitate the integration of several element management systems into a comprehensive network view. These systems also allow the scripting of user-defined "rules" that facilitate alarm correlation when numerous alarms flood in due to single fault. The

"rules" sort through the alarms and report only one problem rather than a long list. "Expert" systems that "learn" from previous experiences are becoming available and will be able to shorten the diagnosis times for problems.

CADD systems typically provide only a graphic representation of the network and are simple tools to automate the drafting process. New Automated Mapping and Facilities Management (AM/FM) systems attach useful data to the graphic elements, and they provide a connectivity model of the network, from the primary hub out to each customer. This plant data can be sorted, queried, and dynamically linked to other systems. AM/FM technology, combined with network management systems, can provide a powerful set of tools to manage network performance.

MANAGING WORK PROCESSES

It is quite clear that the old "wait for the customer to call" scenario is no longer viable in the new competitive environment. Network management centers need to be created providing 24 hour, 7 day per week monitoring of the network. With modern software and network connectivity, these centers can be established regionally or even nationally. This network management center becomes the clearing house for all activity on the network. Not only equipment alarms, but physical changes, equipment configuration changes, network access security and network performance measurement fall under the responsibility of the network management center. Fault management starts with the detection of network events. These events are then correlated into a single fault which is then diagnosed and repaired. Centralized technical equipment experts can guide field crews to the specific cause of the problem and eliminate the tedious task of finding network problems from a truck. The network management system brings the problem to the expert, rather than dispersing scarce experts into the field.

During this process, network recovery may be taking place as redundant equipment or routes are switched into operation. Trouble ticketing and tracking systems log the sequence of events including the dispatching to field crews, right up to problem resolution and closure. Configuration and change management employs element management software and an outside plant database to log all reconfigurations, upgrades or physical plant changes during routine maintenance. Performance management is responsible for measuring key network indicators, compiling statistics, and generating reports of network performance against standards. Performance management is necessary to fine tune network operation and procedures. Security management involves the configuration and monitoring of security elements to prevent unauthorized network usage and restrict access to physical plant such as equipment enclosures and hub sites.

MANAGING NEW SERVICES

New services such as high speed data and video-on-demand are being deployed on microprocessor-based hardware with intelligent agents. While it is crucial that the physical network is managed effectively, it is equally important to manage the logical connections to the customer. In the case of high speed data services and Internet access this would include the file servers, bridges, routers, modems, that make up the connectivity with the customer. Similar functionality to physical network management is required, in order to manage alarms, configuration, performance and security. However, a whole new set of parameters need to be managed at the service level, including IP address allocation, session management, software distribution and version control, cable modem control, network usage metering, email ID allocation, bit-error testing, etc.

In the case of video-on-demand, the virtual channel to the customer needs to be established through coordination of video file servers, switches, channel modulators and box controllers. The session needs to be established and discontinued at predetermined times, with appropriate information sent to the billing system. It would be ludicrous to set up and bill for a video-on-demand session only to find out after the fact that the network feeding the customer had been down during the session.

Linkages between the physical network management system and the logical network management system must be established.

MANAGING INFORMATION

Work processes and software tools must be put in place to manage the gathering, storage, manipulation and access to network and customer information. A typical information relationship structure is shown in Figure 1.

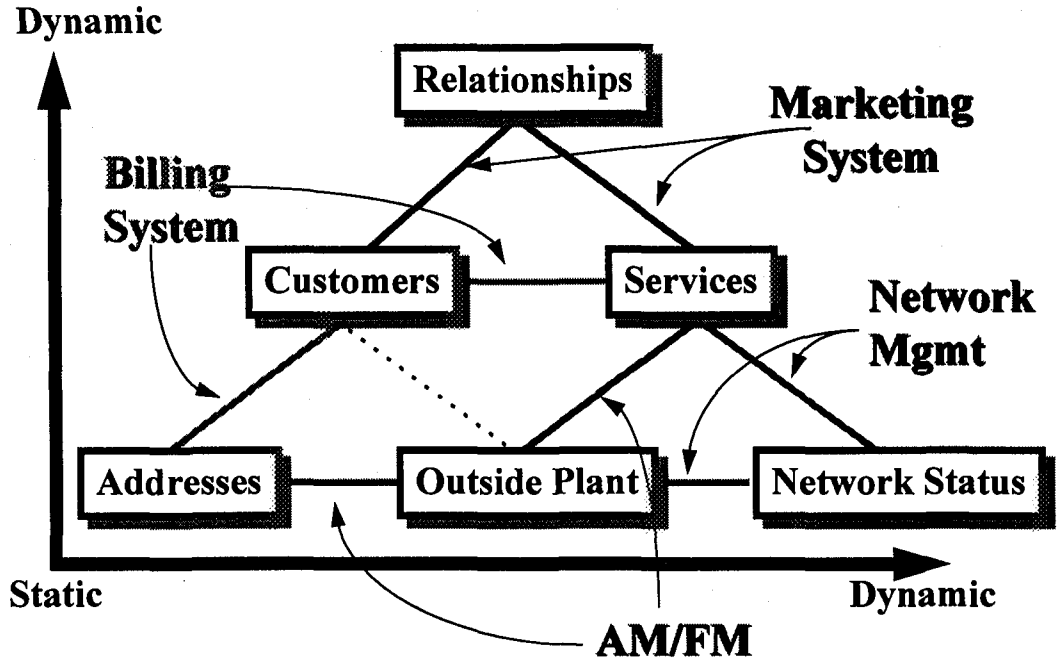

Figure 1

Different operational support systems are better suited to manage the different and diverse types of data. The key concepts are that data should be stored once, the data should be entered as close to its source as possible, and the data should be linked dynamically to the other systems that need it. Certain data such as customer addresses are very static and change infrequently, if at all. Customers occasionally change addresses, and physical outside plant changes occur due to rebuilds or maintenance. However, the most dynamic changes occur in network status and the provisioning of services delivered to customers. These are areas where real-time systems are needed to track and manage information. The ability to manage these data interrelationships effectively will translate into a significant competitive advantage in the deployment of new service offerings.

OPERATIONAL SUPPORT SYSTEMS

To support the work processes, a number of software tools will be required as depicted in Figure 2.

The tools will include a Network Management "Integrator" which bridges several element management systems into a comprehensive system. This is linked to the Workforce Management System which maintains an inventory of the workforce available at all times, the skill sets of each technician and the truck inventory of spare parts. The network management integrator has a facility for the user to script "rules" into the alarm messages. For example, if a string of sequential trunk amp alarms arrive at the same time as an alarm for their parent fiber node, the rule base would recognize the entire set of alarms as a fiber node outage and report it as such. The network management operator is buffered from the flood of alarms and presented with only one. Consequently, only one trouble ticket is opened and only one technician is dispatched directly to the problem. Without this capability, several technicians might have been dispatched to what appeared to be a number of different problems.

ROGERS CABLESYSTEMS
OPERATIONS SUPPORT SYSTEMS
ARCHITECTURE

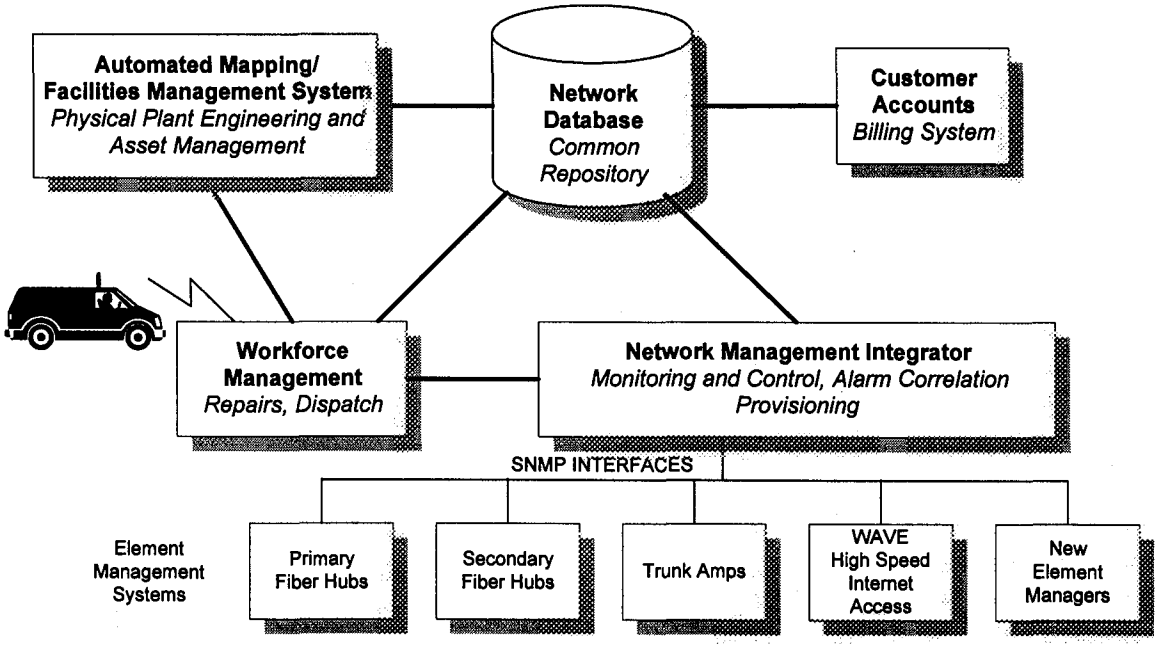

Figure 2.

As alarms are correlated and confirmed on the network management system, they are uploaded to the Workforce Management System. The appropriate fields are automatically populated on a new trouble ticket. The

trouble ticket is assigned to the technician with the appropriate skills and spare parts who is closest to the problem. It is then dispatched electronically to the vehicle and appears on a laptop computer. The technician can query the network management system from his laptop for further information or access the facilities management system for schematics or wiring layouts. As the technician proceeds through the repair task, he updates the system regularly, and each update is automatically time stamped and reported back to the dispatch system. If the fault is not repaired within a predetermined time, the problem is escalated to a supervisor for intervention to determine if additional help or resources are required. Once the repair is completed, the entire sequence of transactions are stored in the database for future analysis and reporting. Equipment failure rates will be analyzed, and a knowledge base is built up based on past repair experience. The next time that similar problems occur, technicians can query the database for previous fixes and speed up repair time. Any changes that are made in the physical plant, either temporary or permanent, are uploaded to the AM/FM system and logged. This eliminates the problem of "phantom" changes to the network since all occurrences are logged, dated and time stamped. While outages are in progress, the customer database is updated with the affected equipment locations. Any customer inquiries during the outage can be dealt with efficiently since the CSRs are fully aware of the outside plant status at all times.

"RETHINKING" THE WAY WE MANAGE THE BROADBAND NETWORK

It is clear that if we are to offer new and innovative services, with better quality and reliability than ever before, the industry must evolve to a more pro-active customer-centric approach to managing the broadband network. A number of initiatives need to be taken to achieve this vision:

- provision network equipment with monitoring and control functionality
- initiate centralized network management centers that operate 7 days a week, 24 hours per day
- deploy new services with terminal devices (i.e. modems, DVC boxes) that can be remotely managed and configured under software control
- "re-engineer" work processes to layer on new operations support technology and to look for weaknesses in currently practices
- plan for and build an information infrastructure to support the new work processes
- start training both field and office staff to think like telecommunications providers

The provisioning and delivery of high speed data services, video-on-demand, and telephony will demand that the broadband network be operated and managed with more sophisticated surveillance, workforce management, and database tools. Operators need to start long range planning for these tools and, more importantly, start deploying the infrastructure for them now. The software and hardware systems are a challenge in themselves, but the bigger challenge will be the establishment of new work processes and attitudes within the workforce that will make the systems pay off in better levels of quality and reliability.