MANAGING THE HIGH-SPEED CATV DATA NETWORK

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Abstract

Setting up and running high-speed data services over cable will require changes in the way services are currently provisioned and supported over a CATV *network. Such changes will involve evaluating the way different groups within the cable organization interact with each other, as well as generating efficient service provisioning and problem resolution procedures. The overall goal will be to maintain the highest level of service availability through efficient service support and fast resolution of any network related problems. The building of the required expertise to provide and support the next generation of high-speed data services may involve the creation of new technical groups, and also the modification of existing operational procedures to accommodate needs specific to the new products. This paper describes the work Rogers Cablesystems has done to date to achieve these objectives.*

INTRODUCTION

The support of high speed data services over two-way cable plant requires a cable operator to commit to offering the highest levels of quality and reliability. Potential users of high-speed data services will have a very low tolerance to service outages. Even a few seconds of service interruption during high-speed data delivery, which may not be considered serious by a typical cable TV customer, can induce unacceptably high loss rates during data transfers. High loss rates in turn can lead to unacceptable delays in the delivery of desired information as perceived by the end data customer.

This paper will discuss the service goals Rogers has initially defined as the minimum requirements that must be met to properly support high-speed data services. The Rogers™ WAVE™ service recently launched in the Newmarket, Ontario licensed cable area is the first one of such services. Next, the roles of the different groups within the Rogers cable organization in supporting this new service will be described. Lastly, the different processes that have been defined for service provisioning, problem resolution, and change control will be explained. Finally, next steps planned to improve the overall process will be discussed.

DEFINING SERVICE GOALS

Achievable targets for the desired level of service were defined from the outset. For Rogers™ WAVE™, these targets are as follows:

- Resolution of all cable outages within 6 hours of being reported. This applies for outages in both the forward and reverse directions.
- No reported field problems developing into outages.
- No detected data routing and modem response problems developing into customer calls.
- Achieve a 99.90% initial service

availability the first year after service introduction, or a maximum 8.75 hours of outage time per user per year as per the Canadian Cable Television Association (CCTA) service quality guidelines, with the eventual goal of reaching a 99.99% availability level.

These targets will evolve as the level of technical expertise increases, and all groups involved better understand their role in maintaining the desired levels of service quality and reliability.

ORGANIZING THE HIGH-SPEED SERVICE SUPPORT GROUPS

Service support is provided by a number of groups within the Rogers cable organization. Some of those groups have been recently created to specifically support Rogers™ WAVE™ services, and work closely with traditional cable TV personnel.

Figure 1 illustrates the various groups within Rogers and the division of responsibilities among them: the Technical Action Center (TAC), the data network group, and field technical support groups. Not shown in this picture, but still very much an integral part of the organization, is the Technical Service Representative (TSR) group. More specific descriptions for each of these groups are provided in subsequent sections of this paper.

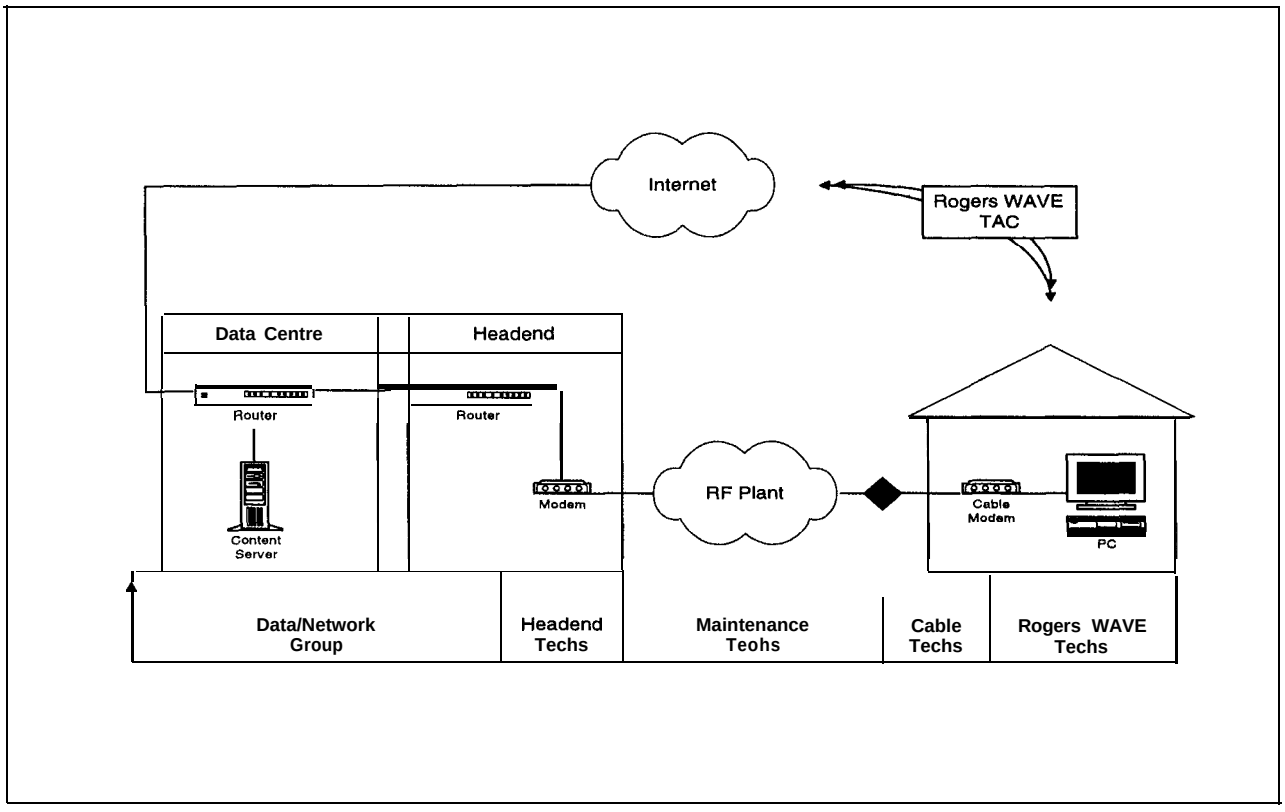

Figure 1. Rogers™ WAVE™ Service Support Groups

Technical Service Representatives (TSR)

The TSR is the first point of contact for all Rogers™ WAVE™ customers. Customers will contact a TSR for one of the following reasons:

- A general inquiry
- A Rogers™ WAVE™ equipment problem
- A software-related problem
- A third-party problem, e.g.: failure to connect to an on-line service provider
- Request for new service connection

TSRs are the focal point of contact between customers and the other technical groups. TSRs trained for the Rogers™ WAVE™ service have built an extensive knowledge base that enables them to quickly address the most commonly encountered hardware and software configuration problems. In addition, it is their responsibility to collect as much information as possible on reported problems they are unable to solve over the phone prior to escalating to the second level of customer support.

Technical Action Center (TAC)

The TAC primary functions can be summarized as follows:

- Continuous monitoring of both the cable and data portions of the Rogers™ WAVE™ network for outages
- Continuous monitoring of the of Rogers™ WAVE™ data connections. Information is derived from the round trip propagation time of test data packets sent to all data host terminals. The percentage of successfully returned packets and their average return trip time are captured in a log and plotted on a regular basis. The obtained plots provide a trend of the overall functioning of the Rogers™ WAVE™ connections, and the percentage of time when hosts have been unreachable
- Acting as second level support for the TSRs, and taking ownership of reported problems after escalation from other groups
- Isolating the cause of an outage, or any other reported problem, and escalating to the appropriate technical group responsible for its resolution, i.e.: On-call data analysts, cable headend supervisors, cable maintenance and construction, or other
- Tracking, in coordination with those cable divisions where Rogers™ WAVE™ services are offered, of all work done that can potentially affect the integrity of the cable and data networks supporting WAVE,.. This includes upgrades, physical network re-configuration, planned outages, etc.
- Updating appropriate logs to reflect changes in the Rogers™ WAVE™ network
- Maintaining an updated problem log of all pending trouble calls and their resolution

- Service provisioning support role in terms of overseeing the mapping of potential customers to the physical cable plant, and to the logical data network

- Maintaining an on-call schedule during off-hours of operation

To help TAC carry out these tasks, they have been given access to a number of resources:

Rogers Integrated Network Management System (INMS)

The INMS is the primary tool used for the remote monitoring and control of the cable distribution network, including RF coaxial distribution amplifiers. For each distribution trunk station in the Rogers cable plant, the INMS provides two important functions:

- Control over reverse bridger switching and thus control over which service areas can feed signal back to the main cable headend. This is extremely useful in isolating problem feeder areas from the rest of the return system

- Control over the use of a 6-dB attenuation pad to help find the approximate location of reverse noise sources on trunk and feeder in conjunction with bridger switches

The INMS is augmented by the availability at the TAC of a remote video feed from a headend spectrum analyzer, which allows constant monitoring of reverse noise levels for any service areas supporting Rogers™ WAVE™ services.

SunNet Manager

Currently, monitoring and control of all SNMP devices, including the current generation of Zenith cable modems, are performed through a SunNet manager station. The main function of this station is to perform polling of all network devices. Device availability status is constantly updated based on the polled information.

All devices monitored by the SunNet manager are grouped by level of functionality on a network map to allow quick visual alerting when unreachable network devices are detected and alarms are generated.

Plans are under consideration to evolve either the existing SunNet management platform, or an alternate one, to allow full access to control functions as well as monitoring of all SNMP manageable devices in the network. Extensive work is still required to reach the level of a truly intelligent system that not only allows collection of network statistics, but can also perform continuous analysis and generation of appropriate traffic analysis and other network performance reports.

Billing and Trouble Call Tracking System Terminals

Customer billing and service information is stored in Supersystem which is the billing system developed by Rogers for CATV services. The TAC can quickly access the above information through Supersystem terminals, and can also look at notification screens providing CATV outage information for all system service areas.

In addition, the TAC has developed its own database and trouble log system to keep track of various reported problems and their resolution. Use of a database assists in the generation of trend analysis and problem summary reports. This database has also evolved into a repository of all information pertaining to any customer terminal

equipment deployed in the field or at cable headends.

Additional Tools

Two other tools extensively used for troubleshooting are data network analyzers and vendor-supplied utilities for the control of various operational parameters of deployed cable modems. The latter allows the TAC remote control over certain cable modem functions such as frequency tuning and power output level setting. Remote tuning is an extremely valuable feature as it allows the switching of field operating frequencies should the original reverse frequencies become impaired by reverse noise problems.

Data Network Group

A network group has been established to look after all data networking and service issues related to the Rogers™ WAVE™ service. Their responsibilities fall within the following three areas:

Data Routing and Internet Access

The main function in this area is the design and implementation of a high-speed data network architecture for the provision of Rogers™ WAVE™ service. This includes establishing minimum performance levels to assist with proper network service provisioning, and to define a standard network design that can properly scale to large customer bases, e.g.: 100,000 homes passed from a single cable headend.

Activities in this area also include the provisioning of Internet access links and the monitoring of the traffic over those links that will determine bandwidth expansion strategy. A related task is the provisioning of high-speed data links between individual cable headends and their corresponding Internet access nodes.

Network Management

The major responsibility in this area is the ongoing tracking of network performance by cable data segment. This is achieved through the collection and analysis of cable modem and other network elements' SNMP statistics such as broadband segment utilization, collisions, errored packets, transmitted and received packets, etc.

In addition to collection and analysis of SNMP statistics, additional scripts have been created to track the availability of cable modems and other network elements. This is done through pinging which involves transmission of test packets to all active devices and keeping track of the number of packets successfully returned by the device.

Rogers™ WAVE™ Network Servers

Major responsibilities in this area are the setup, operation and maintenance of Web, E-mail, and Internet News servers. This role has expanded to include any additional servers required to offer new services under Rogers™ WAVE™ such as remote server content mirroring, personal Web space, multiple E-mail accounts, and others. Server maintenance includes the monitoring of server resource usage required to properly provision for additional hardware to accommodate any increase in the number of customers accessing a service.

These responsibilities also include the generation, issuing, and enforcement of server usage guidelines for Rogers™ WAVE™ technical maintenance personnel.

Field Technical Support

Field technical support for Rogers™

WAVE™ services is provided by the following groups: headend technicians, who look after headend cable modem equipment installation and maintenance as part of their daily responsibilities; maintenance technicians, who look after regular maintenance and troubleshooting of two-way cable plant; cable installation technicians, who also look after installation of the cable modem and drop at the customer premises; and lastly, the Rogers™ WAVE™ technicians.

The Rogers™ WAVE™ technicians look after installation and configuration of both PC Ethernet adapter cards and installation of Internet access software. In addition, they perform on-site troubleshooting of cable modems and PC hardware when necessary, and are notified by the TAC or TSRs through cable dispatch of pending service orders for new installations or equipment replacement.

DEFINING REQUIRED SERVICE SUPPORT PROCEDURES

The establishment of procedures to facilitate the provisioning and management of the new generation of high-speed data services is critical to the success of the cable operator. Having a proper process in place may even be considered by some to be more important than having a working cable modem technology. It is not enough to be able to transmit data bits between the customer and the headend. The cable organization must also be capable of provisioning the new services in a fast and efficient manner, of troubleshooting and resolving any potential problems before they affect data customers, and of managing network changes in a way that minimizes any service disruptions.

The model that Rogers has followed to achieve the above objectives is based on having a central entity whose main task is to coordinate the activities of the various groups responsible for the support of data services. The Rogers Technical Action Center (TAC) has become such an entity. Figure 2 illustrates this model and the central role the TAC plays. The remainder of this paper takes a closer look at what Rogers has done to address each of the above requirements.

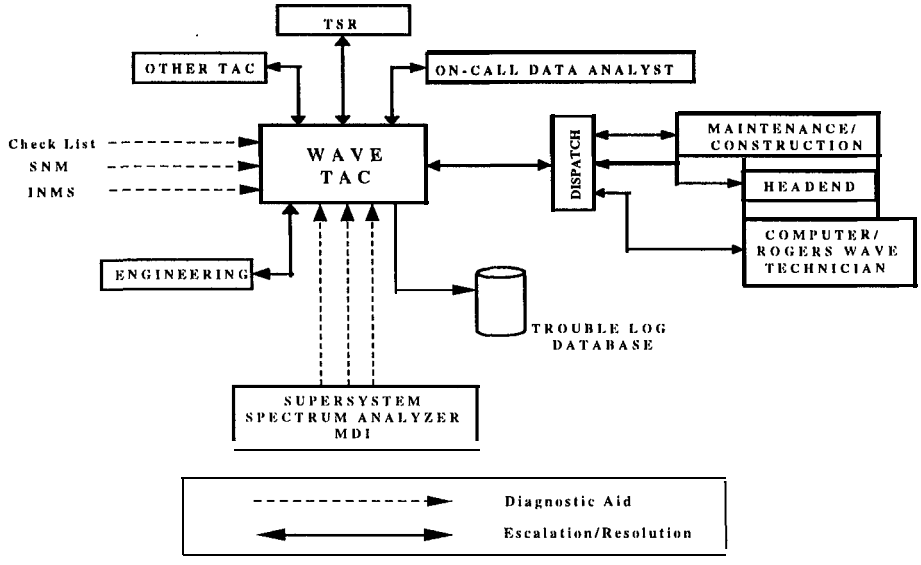

Figure 2. Organization Task Flow

Service Provisionine Procedures

Service provisioning involves a number of steps from the initial customer service request to the cable modem installation and start of the service. Figure 3 depicts the entire process and the tasks performed by each of the support groups involved.

Requests for new service are initially handled by the TSR group whose first function is to confirm the customer lives in a Rogers™ WAVE™ service area, and to verify minimum hardware and software requirements are met. Once the above information has been verified, the next step is to provide the customer with a service ID and any necessary passwords depending on the selected service options. TSRs then generate the necessary service and work orders, and request to the TAC to add the new customer to the service database. Adding the customer to this database results in the assignment of a start-up operating frequency for the cable modem, IP addresses for the customer PC, and any other information required to enable access to the Rogers™ WAVE™ service.

The final step, cable modem installation and service activation, is coordinated with the TAC. The TAC performs an initial test using the start-up frequency initially assigned to the cable modem to verify proper connectivity to the cable headend. Upon successful completion of this test, the modem is assigned its new operating frequency, and the installer can then proceed with the hardware and software configuration process to complete the installation.

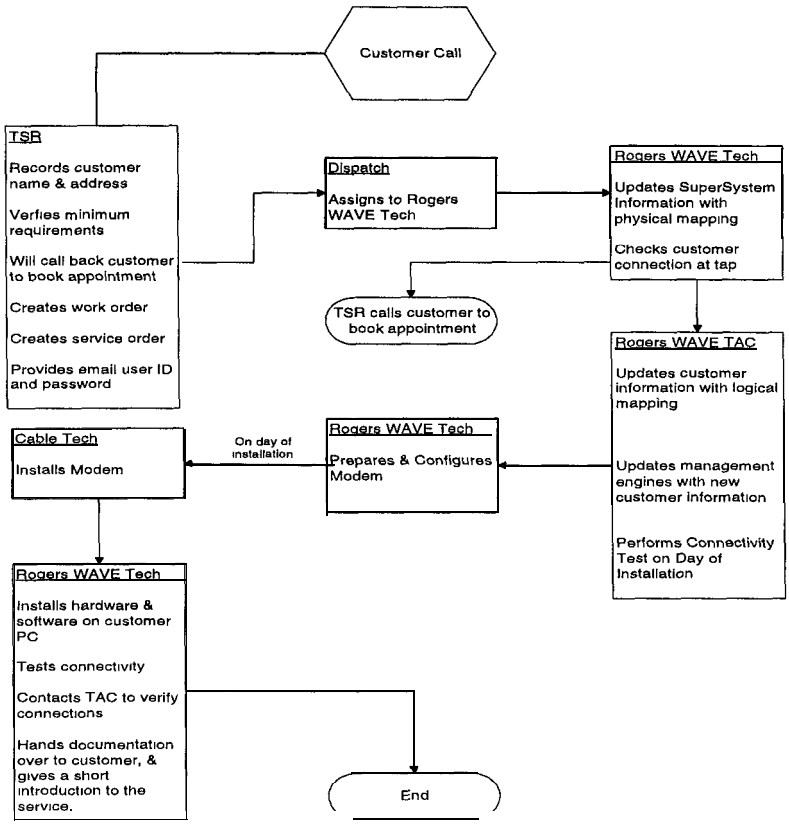

Figure 3. Service Provisioning Process

Problem Resolution Procedures

First Level Troubleshooting and Support

Individual Rogers™ WAVE™ customer reported problems are initially handled by the Technical Service Representatives (TSRs) who are the first level of telephone support. The TSR's role is to determine whether the reported problem is cable related, PC related, or "other", and to resolve or escalate to the Technical Action Center (TAC) which constitutes the second level support.

TSRs access Rogers™ WAVE™ customer information which has been entered into the CATV billing system, and have access to PCs supporting the same data services offered to customers. They can find out about any signal outages through special notification screens built into the existing trouble call tracking system for CATV operations. TSRs also have the ability to conduct echo testing to any hosts on the cable data network to verify network response times and connection quality. In addition, a background-running utility in the TSR PC allows the TAC and TSRs to exchange notes and updates regarding any activities affecting Rogers™ WAVE™ services.

Once the TSR has diagnosed the situation, he/she enters the appropriate fault and clearing codes available in the trouble call tracking system and which were created specifically to deal with faults affecting the new data services. A description of the problem is entered as well as troubleshooting steps taken on special fields in the trouble ticketing application.

Second Level Troubleshooting and Support

The second level Rogers™ WAVE™ customer support function starts when a TSR refers the reported problems to the TAC after determining that he/she is unable to resolve them. The TAC then takes ownership of all reported problems and is ultimately responsible for their resolution. It also has access to the billing and CATV trouble call tracking systems for customer and problem information, and to Rogers™ WAVE™ services as seen by the customer.

In its monitoring capacity, the TAC looks at both the cable and data components of Rogers™ WAVE™ and alerts TSRs and cable dispatch of signal outages and other problems through the CATV trouble call tracking system. Furthermore, the TAC also has the ability to book new trouble calls which can in turn generate pending work and maintenance orders at cable dispatch. Cable dispatch can then prioritize and assign those orders to the on-call CATV technicians. The TAC thus becomes responsible for all trouble tracking and for ensuring proper problem resolution. After successful resolution, the TAC can clear a pending order by entering the appropriate resolution code in the trouble call tracking system. Figure 4 illustrates the current problem resolution flowchart.

If a referred trouble call is resolved without further referrals to other Rogers™ WAVE™ technical support groups, the TAC enters the appropriate clearing code that best describes the action taken and closes the pending call. Should the TAC require further clarification or assistance from a customer during troubleshooting, then the TSR is asked to contact him/her directly. The TAC does not have direct contact with the customers.

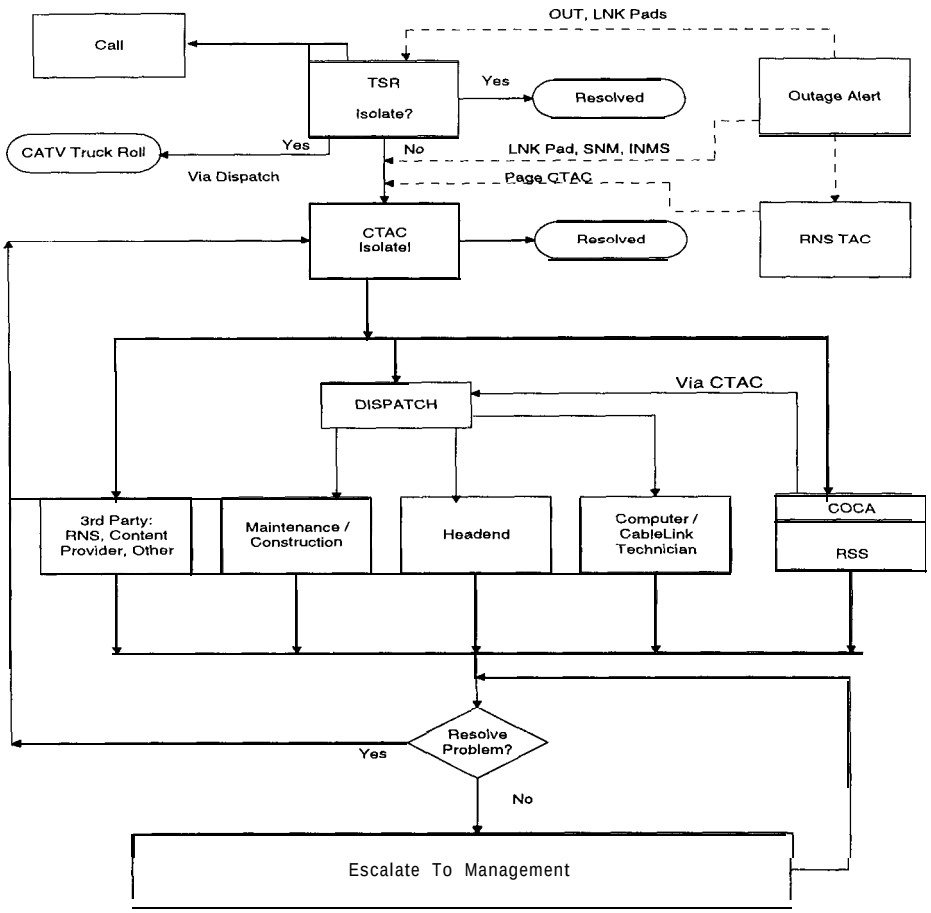

Figure 4. Problem Resolution Flowchart

Change Control Procedures

Change control procedures are currently under implementation whose main goal is to ensure all network changes, whether affecting the physical cable plant or the overlaid data distribution and switching network, are communicated to the TAC and eventually authorized by it. The TAC will evolve from strictly a monitoring and troubleshooting entity to a clearance center responsible for the management of the entire end-to-end network.

Change control is being introduced in two phases. Phase 1 is implemented with the help of the various cable groups responsible for provisioning of Rogers™ WAVE™ services. Phase 1 requires that each of these groups notifies the TAC 24 hours in advance of any network changes which have the potential to affect service. All involved groups are required to provide the TAC with the following information:

- Name of the originator
- Location(s) affected
- Date and time of the change(s)
- Expected duration of the planned activity
- Type of work and justification for it
- If potential for an outage exists, provision for a backup plan and

potential number of customers that could be affected

Phase 2 will require that any changes on the network be authorized by the TAC, and that request for changes be made to the TAC at least 72 hours in advance. The TAC will keep track of all changes, and will authorize or deny change requests. Eventually, a maintenance window will be enforced for all networks and all changes will take place within that window.

Upon notification and approval of any changes, the TAC will also be responsible for informing all customers of the planned activities and of the potential for any problems affecting their service.

CONCLUSIONS AND NEXT STEPS

Rogers has implemented new procedures to support the introduction of high-speed data services, specifically, the Rogers™ WAVE™ service offering.

In order to offer high levels of service quality and reliability, the need to have end-to-end visibility over all the network components has been clearly identified. This visibility is required over both the physical cable plant and data network operation to ensure that potential problems are addressed before they lead to service degradation, and to allow prompt resolution of any service outages. To help achieve these goals, Rogers has set up a Technical Action Center (TAC) with the mandate to monitor operation of two-way plant in general, and Rogers™ WAVE™ services in particular. The TAC constitutes the second level of Rogers™ WAVE™ product support after the traditional Technical Service Representatives (TSRs). TSRs continue to be the first contact with cable data customers and perform preliminary problem troubleshooting. Should TSRs fail to achieve proper resolution at this initial stage, the TAC takes ownership of the problem and becomes responsible for its proper resolution. The TAC has access to a wide variety of tools to rapidly diagnose the problem, and to escalate it further if necessary to other technical support groups. The support groups encompass traditional cable technical groups, i.e.: construction and customer service, or any other groups specifically created to support other aspects of the new service, i.e.: data network administration and maintenance groups.

Although initial service goals have been defined, these requirements were generated within the context of Rogers™ WAVE™. The need has already been identified to expand these requirements to cover all two-way cable services, and to slowly migrate current TAC operation into a global Network Operations Center (NOC).

To achieve the latter objective, current network monitoring procedures and tools will need further refinement. The migration towards a fully empowered TAC to enforce change control procedures is one of the first steps already taken in that direction.

ACKNOWLEDGMENTS

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