



THE HP CALAN  
RELIABILITY SERIES

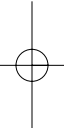
# Are You Ready for Cable's Future?



PART 1:  
PREVENTIVE  
MAINTENANCE



A SPECIAL SUPPLEMENT TO  
COMMUNICATIONS  
TECHNOLOGY



# Revenue, Telecommunications Law and Your Net

Early this year, President Clinton signed into law the Telecommunications Act of 1996 legislation—the subject of hot debate for over a year and a half in Washington, DC's corridors of power. This act will change the competitive climate in the cable industry forever.

With this reform, the door has been opened for cable operators to explore new revenue streams, including telephony and data delivery. Of course, the same door has been opened to telephone companies to take part in video and data delivery. So, while cable companies will be able to compete with two-

way service providers in areas such as personal communications services (PCS), data delivery and telephony, they also will have to defend against attacks on their traditional market niche by outside competition.

To compete effectively in this changing marketplace, cable operators must shore up the one perceived weakness in their technology: Network reliability. How do you ensure robust, reliable two-way network operation? One way is with a careful program of preventive maintenance (PM).

It all boils down to a matter of quality management. In some com-



peting services, such as DBS, image quality is key. For cable operators, however, the issue goes beyond image quality to network reliability and system availability (uptime).

## What Is Preventive Maintenance?

**PM** is an ongoing program of quality management, testing system performance, and tracking that performance over time. A PM program, coupled with tracking, ensures continued optimal quality of service and reliability of system architecture. That, in turn,

saves money for system operators.

According to Syd Fluck, broadband business development manager for HP CaLan, "money invested in PM is not lost. Your company's investment in PM is recovered, and savings

are realized, through fewer trouble calls, less frequent system outages, better customer service and better overall system performance."

### SYSTEM SWEEP: THE KEY TO GOOD PM

The heart of any sound PM program is sweeping the system to detect problems or potential problems in the network. Think of sweep as looking at your system through a microscope. That kind of close scrutiny is important.

In fact, you can sweep your system and look at half dB changes in the system response. Maintaining a system to closer tolerances is part of optimizing its operation. A sweep of your system will also enable you to examine points where you may not yet have channels. Checking and normalizing the response of your system can be done more precisely by sweeping. You can notice, identify and correct

system weaknesses before they are detected by your customers.

Sweeping the system can detect problems not only in the forward portion of the cable network, but on the return as well, said HP CaLan's Fluck. "Downstream, problems with cable shielding and connectors are typical culprits in poor system performance, because they affect higher, rather than lower, frequencies. Cracked shields and bad or oxidized connections in the shield as well as the center conductor are common problems. On the return path to the headend, a little oxidation on the center conductors, in the connectors, or anywhere two dissimilar metals come in contact, can create a diode effect in the system, which in turn will generate common-path distortion, beats and harmonics which fall in the return path."

From the forward point of view, sweep will detect such discontinuities, typically as an impedance mismatch. The problem really manifests itself in the return, where



HP CaLan's  
Syd Fluck

### A SPECIAL SUPPLEMENT TO: COMMUNICATIONS TECHNOLOGY

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# rk's Performance

Unfortunately, consumers believe other providers offer better reliability than cable. In particular, uptime and reliability are perceived as telephone company advantages. A recent consumer poll indicated that only one-third of those polled would buy telephone service from their cable company; two-thirds, however, would buy cable video services from the phone company.

That kind of result is partially due to the public's perception of telephone network reliability: If it's not down when you need to use it, it's not down. What's more, the public generally seems to accept that if a telephone connection gives you a

busy signal, it means someone is tying up the line, not that the network is down.

In fact, telephone network reliability *is* quite good—fewer than 5.3 minutes of downtime per year, or 99.999% availability. With test and measurement products from HP CaLan and a sound PM program, reliability figures like these can also be within reach of cable operators.

This supplement explains how a PM program can help you remain competitive in today's changing telecommunications environment. It's an investment you can't afford to put off. ■



HP CaLan 8711B bench sweep

common-path distortion combines with ingress. Ingress or noise with or without common-path distortion on the return can hinder your system's two-way performance, and keep you from competing effectively with other service providers.

## HP CALAN OFFERS SOLUTIONS

Drops from the feeder system into the home and commercial power problems continue to be among the highest sources of failure in cable networks. For that application, HP CaLan offers the 8711B bench sweep. This product can analyze a component—whether a piece of coax cable or an amplifier—and measure its

transfer characteristic (loss or gain) or structural return loss.

That type of analysis has been done for years on the bench; now, however, there's greater need for it in the field. Sweeping a drop and analyzing its characteristics are essential for cable operators venturing into digital services such as data delivery or advanced telephony, because micro reflections and phase and delay distortions become more significant in those applications.

HP CaLan also has sophisticated return path analytic processes and equipment to determine availability of return path. An HP CaLan consultant can be hired to help you look for ingress in your network, and can qualify the network for handling different forms of digital modulation. For example, one reliable product for monitoring ingress is the SAT 330 cable television monitoring system, co-developed by HP CaLan and SAT, a channel partner of HP's. The product is used by AT&T in its qualifying procedure for cable operators who want to carry their long distance services. ■

## The Bottom Line on Preventive Maintenance

**W**hy should you adopt a program of PM? A carefully planned program can ensure peak system performance, which leads to improved network reliability, less downtime and increased customer satisfaction. PM can improve the performance of the entire system, including the upstream path, and save money at the same time.

Take the example of a 50,000 subscriber system with average revenue of \$30 per subscriber per month. That's \$18 million per year in total revenues. What are the savings, if any, this system operator could hope to realize? The answer may surprise you.

■ **Reduced maintenance costs.** Maintenance costs typically equal 10% of revenue. In our example of an \$18 million network, that's \$1.8 million per year. By some studies, PM can save 15% of overall maintenance costs. The net savings in this case is \$270,000 per year.

■ **Increased customer satisfaction.** The benefits here are easy to identify: Lower customer turnover. More services ordered. Greater market share. If the system's improved quality generates even \$1 more per subscriber per month in revenue, the result is \$50,000 per month, or \$600,000 per year.

■ **Your total savings.** Now let's add up the total annual return on the investment of the PM program: \$270,000 on reduced maintenance costs; \$600,000 on increased customer satisfaction. That's a net return of \$870,000 (amortized deployment expense, give or take some incremental support expense)! Although your individual system's savings may vary, it's clear that a thorough and careful PM program really can help your bottom line. ■

# PM Saves Cash

## HOW A 28-YEAR-OLD SYSTEM STAYS COMPETITIVE

**W**oody Cash, system technician and crew chief for TCI-San Jose, has a saying that confirms his belief in the benefits of PM: "A service call is a poor and costly substitute for good engineering practices." That motto recently found its way onto a plaque Cash was awarded when he was named TCI's Technician of the Year for Northern California and Nevada. The recognition came to Cash at least in part because of the PM program he helped establish for the 28-year-old plant.

TCI-San Jose is a plant that serves the California towns of San Jose and Campbell, as well as parts of Santa Clara County. Slightly over 2,400 strand miles of plant comprise the network. The San Jose system is dual cable, running 37 channels on each side. It has some 180,000 subscribers.

"The San Jose network is actually a system on which TCI has overlaid fiber to reduce cascading," Cash explained. "The basic design, though, still requires a lot of maintenance. We've had to be persistent about PM to keep it working."

Competition is stiff in the region, Cash commented, with the availability of 21 over-the-air channels customers can pick up with an outdoor antenna. "We're also being overbuilt by the telcos," he added. "There's plenty of competition, but we're still hanging in there."

### GETTING WITH THE PROGRAM

According to Cash, TCI-San Jose instituted its PM program six years ago. The system by that time was beginning to show signs of its advancing age.

To ensure the continued reliability of the network, Cash and his team sweep all optical nodes every three months, sweep all trunk

amplifiers every year, and sweep the feeder amplifiers every two years. Cash characterizes the maintenance program as not just a sweeping, but a proofing of the system.

"We set up a sweep reference at the headend," Cash said, "then we sweep the optical link, checking for frequency response, carrier-to-noise, composite triple beat and composite second order distortions at each node." The process is repeated throughout the trunk and feeder

system. Information from the test is recorded and kept on a database as a history of the active network, from which reports can be developed.

### KNOW WHAT TO EXPECT

During field tests, technicians place a sticker inside every amplifier, so the next time a technician returns to that point, he'll know what to expect. "We always try to make things a little better than they were before," Cash noted. He and his crew use HP CaLan sweep gear for all their field measurements.

In particular, TCI-San Jose uses the HP CaLan 8591C for FCC proof of performance testing, and the 1776 sweep and spectrum analyzer. "HP CaLan test gear can do both sweep and full spectrum analysis, including CTB and second-order measurements," he said.

Most of the testing at TCI-San Jose has been downstream, although Cash said he is getting

more involved in testing the return path. In particular, Cash tests the return on systems serving Sunnyvale and Cupertino/Los Altos. The Sunnyvale network is hybrid



*TCI-San Jose's Woody Cash, with the HP CaLan 1776*

fiber/coax (HFC); Cupertino/Los Altos is a fiber hub. Cash noted that the network serving the Cupertino and Los Altos areas was built as a fully two-way system and is being used for impulse pay-per-view. Return alignment is routinely tested in that portion of the network, specifically level balance and ingress elimination.

It takes constant vigilance to ensure the reliability of the return system. Cash said the majority of ingress in the return is noise from the tuner and from home electronic devices getting into the cable system.

Is the program making an impact? While Cash acknowledged that "the hardest part of engineering is measuring results in dollars," he added that the PM work has "paid for itself many times over." The results that can be measured are impressive, however. As Cash put it, "It's not too often that you see a nearly 30-year-old system running 74 channels." ■

# Five Steps

## TO IMPROVED RELIABILITY

**PM** has a wide range of benefits for cable operators. Using PM, you can:

- Decrease service calls and reduce overhead,
- Decrease system failures by identifying potential problems early,
- Improve picture quality, and
- Prepare your system for competition in two-way telecommunications.

"Communications Technology" asked HP CaLan's Syd Fluck to provide a step-by-step overview to making PM work for you. Broadly speaking, the five points he outlined, together with the accompanying sample timeline for scheduling and tracking (Figure 1), should get you started planning your own program.

**Manage your assets.** Know what equipment you have deployed, and where it is located.

**Maintain a history.** Log serial numbers, pad and equalizer values for amplifier stations. At hubs, end-of-lines, and all other appropriate locations, use HP CaLan test and measurement gear to record levels, distortion parameters, ambient temperature and the date and time when maintenance was last performed.

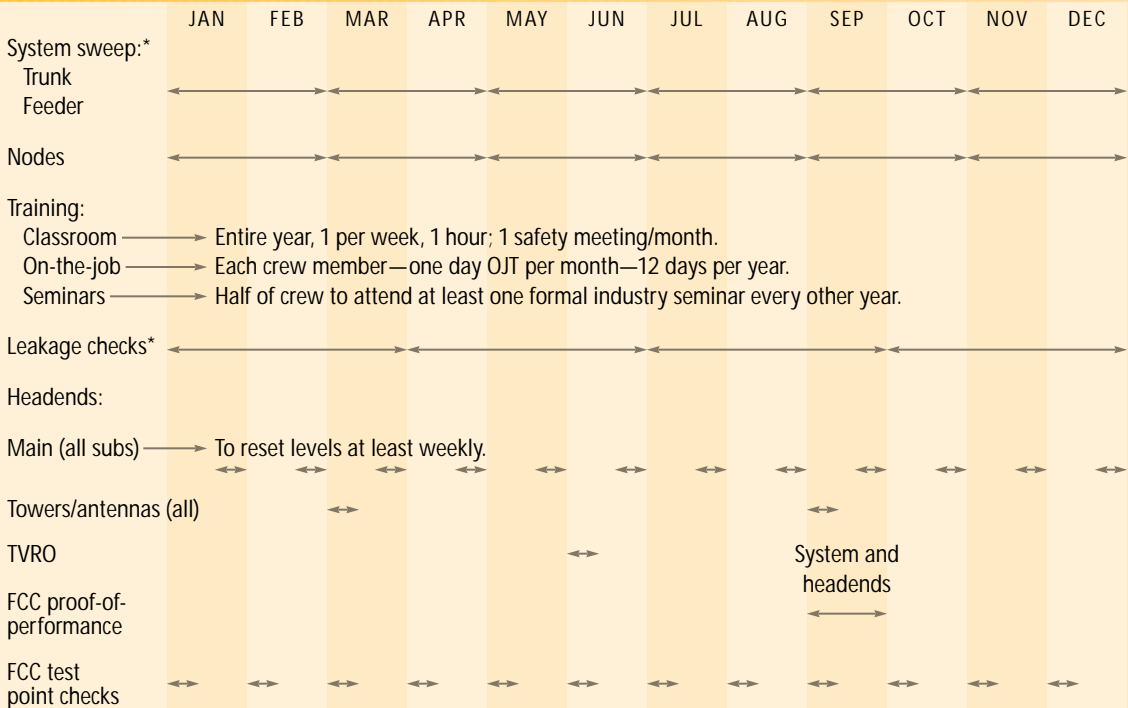
**Plan routine inspections.** Make plans of daily, weekly, monthly, semi-annual and annual inspections and procedures to be performed. Establish checklists or integrate your plans into a network monitoring software program.

**Compare your results.** Check the data from your test equipment against your history of previous activity.

**Be proactive.** As you review or process the data, look for trends and schedule corrective action. To establish the importance of your PM program, recognize employees who find and fix problems.

One last note: Don't forget the obvious. Check routinely on standby power supply, fuel for motor generators, pole hardware, grounding connections, heat and air conditioning for the headend, lights, safety equipment, manuals and test procedures, loose antenna elements, tower guy lines, paint, and so on. Remember, the key to PM is solving minor problems before they become major ones. Fix the small stuff. ■

**Figure 1**  
**SAMPLE TIMELINE FOR SCHEDULING AND TRACKING PROGRAM**



\*Entire distribution system

Timeline concept courtesy of Ron Hranac

# The Trust Factor:

## CAN YOU RELY ON YOUR TEST GEAR?

As you start on your PM program, keep in mind that testing a system for reliability means trusting your instrumentation.

Some technicians feel they have to put upper and lower margins on their measurements, to compensate for potential instrument error. If you have to do that, you're adding the same level of uncertainty to your system. Tighter specifications make for a more reliable system. Consider amplifier performance. If you can maintain amplifiers with closer tolerance in the upper and lower boundaries for their performance, your whole system benefits.

HP CaLan holds itself to a high standard of instrumentation quality, traceable to specifications established by the National Institute of Standards and Technology. Not all manufacturers can say the same. With HP CaLan test equipment and proper testing procedures, problems and remedies can be identified right away, and with confidence.

These products from HP CaLan can help you reap the rewards of PM:



### HP CALAN 8591C CABLE TV ANALYZER

The industry's only one-box tester for non-interfering, in-service RF and video proof of performance testing. The HP CaLan 8591C, with option 107, can perform manual interactive measurements and continuous system monitoring.

### HP CALAN 85921A FCC REPORT-GENERATOR SOFTWARE

Easily transfers FCC proof of performance data from your HP CaLan 8591C to your PC.



### HP CALAN 85942A VIDEO SIGNAL MONITOR (VSM)

For low-cost, automatic video performance monitoring and FCC testing, the VSM has all the performance you need, including a built-in, frequency agile demodulator.

### HP CALAN 2010 SLM PLUS

With the HP CaLan 2010 SLM Plus you get a field rugged, easy-to-use signal measurement device. More than just a signal level meter, the 2010 is also a data management system that lets you store and analyze test results.

### HP CALAN 3010 SWEEP/SLM PLUS

The HP CaLan 3010 has all the features of the 2010, plus the industry's fastest, non-interfering digital services compatible sweep.



### HP CALAN 8711B BENCH SWEEP

Ideal for accurate and economical swept frequency measurements of cable TV amplifiers, taps and cables. It also measures structural return loss (SRL) and locates cable faults.

### HP CALAN 1776 SWEEP/SPECTRUM ANALYZER

A rugged, portable sweep system for noninterfering, in-service, high-resolution sweep and distortion measurements.

### HP CALAN 1777/1777P INTEGRATED SWEEP TRANSMITTERS

Used with the HP CaLan 1776 or 3010, the 1777 transmitters provide noninterfering digital services-compatible sweep signals.



### HP CALAN 85990A MULTI- CARRIER SIGNAL GENERATOR

Our multicarrier source gives you up to 180 clean, noise-free, stable carriers for cable TV headend simulation and distortion testing. ■



# Do It How

## AN OVERVIEW TO HELP OPTIMIZE YOUR NETWORK

**B**y now, you should be well on your way to becoming converted to the benefits of a sound PM program. How do you turn the concept of PM into action? The following gives you some important considerations to note when creating a robust network environment.

### TAKE PROACTIVE PREVENTIVE MEASURES

*Find the weak points in your network.* That means sweep alignment. Some operators think that sweep alignment is not important in HFC systems, because there are fewer amplifiers in a typical HFC cascade. On the contrary, the amplifiers in an HFC network have to deliver a higher level of performance at the output, which is in turn affected by the network's optical link. Periodically sweeping the response of amp cascades in an HFC network is vital to the network's performance.

*Test to stricter limits than specified by the FCC, and maintain equipment at closer tolerances.* Aim for second and third order distortion characteristics of 51 dB, and carrier to noise of 43 dB. Try to improve upon those figures, if possible. Remember, for optimal performance of any network, it's better to be several dB inside spec than to be sitting right on the edge.

### SELECT COMPONENTS CAREFULLY

*Verify your headend's performance.* Use the HP CaLan 8591C cable TV analyzer to make sure that all your levels are correct. Carrier to noise ratios and depth of modulation are important to check, as are the video characteristics of differential gain, differential phase and CLDI.

In addition, be concerned about your in-channel response, frequency of aural and video carriers, and deviation of FM carriers. The HP CaLan 8591C is designed to do manual interactive measurements, as well as continuous monitoring, in which you can accumulate data over a time period and look at the overall performance and any variations of the headend.

*Pre-balance or sweep system components to ensure reliable operation.* Use the HP CaLan 8711B bench sweep to align the processors, and balance the amplifiers for performance. For new system construction, you may consider substituting the headend with an HP CaLan 85990A multicarrier signal generator, to look at lasers and distribution nodes, and to make sure your system is performing according to your design specifications.

Other HP CaLan equipment will help you make the sweep process easier. The 1776 sweep/spectrum analyzer, and the 3010 sweep/SLM Plus are two good choices. The matching 1777 transmitter from HP CaLan can be used at the headend as a reference forward transmitter. For field work, the 1777P (a portable version of the 1777) is the right way to go.

For FCC color tests, use the HP CaLan 85942A video signal monitor, or add Option 107 to your 8591C. Either product can perform these and other critical measurements on a continuous basis.

### THE TRICKY PART: SWEEPING THE RETURN

Typically, when technicians sweep, and analyze a network for ingress, they have a device at the headend looking at return path

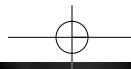
ingress, or looking at the return sweep coming back from the operator in the field. When this sweep gets back to the headend, the technician needs to see what it looks like. That's the problem in sweeping the return: There has been no easy, portable way for the technician to gain access to this information in the field.

Some technicians run their HP CaLan 8591C's composite video output through a modulator, then run the feed directly into a channel of the cable system's forward path. The field technician carries a portable TV to see what the response is at the headend on the 8591C's display, and makes adjustments at the location he's working on, based on what he sees.

The catch is, it can be costly and cumbersome to use this method: It requires an available channel, and the technician has to carry a TV set in the field to perform the test. Further, communicating over the same network you're trying to balance or fix is not the best possible solution; network conditions may prevent you from getting a signal back through that return. Also, if more than one technician tries to do the same test on other legs of the return, that can only make matters worse.

If only there were a way to properly measure ingress on the return path without having to rely on a cumbersome jury-rigged approach like this... ■

*Editor's note: In Part 2 of the HP CaLan Reliability Series, coming in the June issue of Communications Technology, we take a closer look at ingress and sweep, and discuss the problem of maintaining the return path.*



# Coming in June!

## THE HP CALAN RELIABILITY SERIES

A SUPPLEMENT TO  
COMMUNICATIONS TECHNOLOGY

### PART 2: SWEEP AND INGRESS

**FEATURING:**

How sweeping your network for ingress  
can keep your system running smoothly.  
Tracing the causes of RF leakage.



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June 10-13  
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