

The Need For Proactive RF Monitoring Across The All-Digital Cable Plant:

A Application Note for Broadband Cable Operators | September, 2011

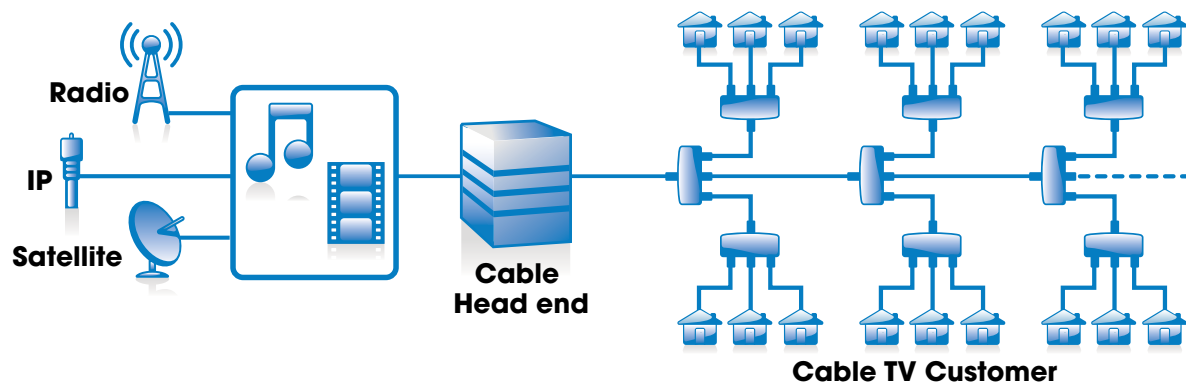


Transition to the All-Digital Cable Plant

It makes a lot of business sense for Cable Operators to migrate to an all-digital cable plant. The move to all-digital means a huge gain in the amount bandwidth available, both in the downstream and upstream directions. This additional bandwidth enables advanced digital subscriber services and creates incremental service revenues.

In the upstream, the transition to DOCSIS 3.0 enables new services offerings based on high speed internet, voice and video telephony. Upstream expansion to 85MHz is also on the horizon.

In the downstream direction, the transition to higher QAM opens more bandwidth for cable's bigger video and data payloads. Many Cable Operators have already upgraded from 64 QAM to 256 QAM, a step that boosts channel bandwidth from 27 Mbps to 38 Mbps increasing the number of video streams that can be carried in a single channel from 8 to 12. The new downstream bandwidth has paved the way for additional HDTV programming, and an increase in available video-on-demand (VOD) services.



The migration to "all-digital" is an important part of the strategy of advancing and increasing service offerings in a highly competitive environment. MSOs are facing ever increasing competition from IPTV service offerings from telecom and satellite operators as well as web-based video content providers. Cable's best opportunity to compete is to fully exploit the two-way and interactive capabilities of the cable system – a capability that the all-digital cable plant can provide.

The analog-to-digital transition continues to move forward as cable operators weigh the need to make the change versus the need to minimize the subscriber impact. An estimated 10-20% of the cable plant in North America is now considered to be all-digital. They must find a cost-effective way to support the huge base of "cable-ready" TVs and VCRs through the all-digital transition. The investment community also has a say. Cable operators must leverage as much as possible the huge capital investments they've made over the past decade in rebuilding plants and installing digital set top boxes (STB). As a result, the digital transition is being phased.

Role of RF Monitoring in Raising Subscriber QoE

While the industry systematically moves to the digital transport realm, the impact of RF impairments and the need to continually detect them isn't going away. In fact, RF monitoring is getting more important. Advanced digital services – high speed internet, VoIP, HDTV, VOD – are all sensitive to RF impairments and Cable Operators need to consistently monitor key RF parameters to confidently roll-out and maintain high Quality of Experience (QoE) for subscribers.

With DOCSIS 3.0, multiple data and video streams spread over as many as 8 downstream QAMs. One intermittent QAM can wreak havoc at multiple subscriber locations with no obvious single point of failure that a technician would be able to identify. This is a nightmare situation that will especially aggravate those subscribers who weren't sure about switching to that new STB in the first place. Now they are having problems, the technicians have been to the house twice now. They have changed the STB each time and they are still having the same problems. Without some type of forward path monitoring from the headend or distribution hub, this is a subscriber waiting to be lost. This is a problem the field technician just can't diagnose and hence cannot fix. Gone are the days when a technician easily correlates a problem with a TV service like HBO with a specific RF channel.

Upstream impairments remain a huge issue. The list of possible digital cable impairments is larger in breadth, although not necessarily magnitude, than most digital communication systems. This also means more services are affected by plant impairments. All of the following exist on an HFC channel and can contribute to signal degradation that feeds the need continually monitor. The wide variety of possible issues occurs primarily due to the nature of the system infrastructure – it is both an optical link and an RF link, – it is a very wideband multiplex of multiple signal types, including both analog and digital. A comprehensive list of impairments is shown below:

- Thermal Noise
- Reflection paths
- Frequency response flatness
- Interference - RF nonlinearity
- Group delay variation
- Phase Noise
- Laser Clipping
- Spurious AM

Classifying RF Monitoring for the All-Digital Cable Plant

Centralized RF Monitoring and Testing can be broadly reduced into two categories of analysis:

1. Forward Path Analysis

Forward Path (or Downstream) analysis includes analog and digital QAM performance monitoring, performed on feeds located at and in the downstream direction from the headend or distribution hubs.

Did you know the FCC has required digital signals on most cable networks to meet certain technical performance parameters, and that this requirement has been on the books for several years? §76.640 of the FCC rules states that digital signals in 750 MHz and greater plants MUST meet the technical parameters in SCTE-40. The FCC rules don't say when, how, or how often to verify that digital signals are in compliance, nor do the rules say how to document that compliance. But those signals must comply—that part is clear.

The good news is that QAM signal technical parameters in SCTE-40 can be measured with multi-function analysis solutions from Sunrise Telecom, combining QAM analysis, spectrum analysis, and signal level metering (SLM): either as a field-portable test set like the Sunrise AT2500 and CM3800, or as a Proactive RF Monitoring System (Proactive RFMS), such as the Sunrise realWORX. This paper introduces the Proactive RFMS, which can be deployed to perform this FCC-required proof-of-performance testing.

SCTE-40 measurements of analog and digital QAM parameters at the headend and distribution hubs include signal levels, in-channel frequency response, digital channel power, channel spacing, micro reflections, MER (down to -43dB as required by SCTE-40), AM hum modulation, group delay variation, pre- and post-BER, EVM, and ENM.

2. Return Path (Upstream) Analysis

Return Path (or Upstream) analysis includes RF ingress (carrier-to-interference ratio) and signal performance monitoring, performed on feeds located at and in the upstream direction to the headend or distribution hubs.

Early fault detection in a superior return path monitoring system saves maintenance time and costs. There are huge quality gains to continuously monitor the upstream noise and carrier levels returning from multiple nodes. Because of its analog legacy (e.g. notching frequencies in taps and passives all along the cable plant), the spectral location of the return path is like a dark alley, with foot-deep potholes. And you're driving a VW Beetle. A noisy, bumpy path requires a sturdier (read: slower) modulation. In the upstream direction, with hyper-vigilant plant maintenance, the very best you can do is 64 QAM – as opposed to 256 QAM on all digital downstream channels.

Measurements include comprehensive return path monitoring (from 1 MHz to 200MHz), RF signal, ingress (including monitoring above 65MHz to better detect laser clipping), and Common Path Distortion (CPD) events.

How Analysis is Used

With respect to both categories of analysis, validation can be performed reactively in support of spot testing, e.g. in remote support of a technician in the field (at the subscriber premises). Or the analysis can be done proactively. In the later case, RF performance is continually monitored across feeds, measured results compared against preset limits and alarm notifications triggered when signal impairments are detected (result exceed preset limits).

Finally, the ability to perform relevant RF analysis for both analog signals and digital signals will be a requirement for some time, as was discussed previously, most cable plants will remain a mix of analog and digital for the longer term.

How Centralized RF Monitoring Complements Field Testing

Automated, systematic RF monitoring and testing at the headend and distribution hubs is a complement to testing in the field. Field testing is required to fully verify performance at new service activation. It is often required to troubleshoot problems in a way that centralized systems cannot fully see, e.g. the ability to sectionalize the network and test isolated portions is often a critical step in the field to isolate a specific problem cause.

At the same, centralized monitoring is a key element for proactive quality control and to detect problems before subscriber QoE is affected. Centralized RF testing is often used in conjunction with and to aid field technician testing in the field. Central systems remotely accessed from the field can simplify tests that previously required two technicians at each end of a link – one to send a test signal and the other to receive and record the results – to now only require a single tech. The tech in the field can operate the field test set to run tests, remotely control the test head at the headend or distribution, and view the remote test results.

A 24/7 RF monitoring system can also maintain an archive of historical tests that can be used to help troubleshoot intermittent impairments. This is particularly useful when the technician in the field can access and view these results with a test set or laptop.

Introducing the Proactive RF Monitoring System

A Proactive RF Monitoring System (Proactive RFMS) can be a complete and cost-effective solution for assuring subscriber QoE proactively. It enables a complete scalable process for Cable Operators to integrate upstream ingress, downstream analog and digital QAM verification and remote analysis. A Proactive RFMS is a necessary system to increase service reliability and subscriber QoE of advanced digital services, such as RF CATV, Broadband Communication Services, high speed internet, VoIP, HDTV, VOD and other advanced services. The market-leading Proactive RFMS is realWORX™ from Sunrise Telecom.

Sunrise Telecom realWORX RFMS provides a highly efficient, continuous, and automated method of monitoring and analyzing RF performance. The competition among video service providers continues to heat up, which means video service quality is becoming an essential differentiator. The FCC requires Digital Proofs of Performance (PoP). A Proactive RFMS can do this PoP, along with other functionality and flexibility in a single platform.

The test heads of a Proactive RFMS are placed at headend and distributing hubs site as well as Video Hub Office (VHO) and Video Serving Office (VS) monitoring for telcos. Its preventative, automated, and remotely accessible system functionality can save significant CAPEX (system hardware) and OPEX (training, support) – driving a quick payback and a compelling Return on Investment (RoI).

A Proactive RFMS can improve cable plant performance and availability by alerting operations to impairment before they affect subscriber QoE. For example, lifeline voice, high-speed data, other interactive services are degraded when commonly occurring RF ingress-related impairments are not detected and isolated. By constantly monitoring both upstream and downstream channel performance across the cable plant, Cable Operators can proactively identify and eliminate these often subtle impairments prior to service degradation.

For highly accurate and consistent measurements, a Proactive RFMS should use a high-end lab-grade spectrum analyzer as the basis of its test heads, making it possible to detect and capture extremely low level RF impairments like transients, Common Path Distortion (CPD) and noise floor degradation, which are invisible to competing systems.

A Proactive RFMS should constantly monitor digital and analog measured parameters, then storing these results for historical analysis. Customized graphs should display the measurement deviations over time. In-depth views allow individual channel results to be displayed graphically over time. Moreover, a unique dashboard provides overall health status information for each node, while the node status menu makes it easy for technicians to drill down and isolate individual alarm conditions.

A Proactive RFMS should incorporate a multi-user web-based GUI, so that Cable Operators can control the monitoring applications from any location using a standard web browser. The monitoring system should also incorporate industry-standard MySQL and XML file formats, so that operational support systems (OSS) and third party applications can be easily integrated.



Proactive RF Monitoring System Description

A Proactive RFMS consists of the following components:

- A. **Multi-User Web GUI** – browser accessible software for user control of test and monitoring configurations, results viewing and processing, and overall system administration.
- B. **Web-Based System Server** – pre-configured high availability appliance, includes database redundancy with dual hard drive RAID configuration, as well as power redundancy.
- C. **RF Test Heads** – rack mounted spectrum analyzers located at the headend and/or distribution hubs, e.g. Sunrise AT2500 Series of RF Test Heads.
- D. **RF Switches** – high performance and cost effective RF multiplexing between AT2500 Test Heads and up to 256 input feeds, e.g. Sunrise AT1600 Series of RF Switches.



Sunrise Telecom's realWORX is the market-leading Proactive RFMS, based on the AT2500HM series of headend/hub spectrum analyzers. The realWORX server controls multiple test head analyzers, monitoring the performance of several headends and hubs. The analyzers monitor multiple return or forward RF test points by means of RF switches. Using AT1600 series switches, up to 256 feeds can be monitored by each analyzer test head.

The realWORX system has a modular, software architecture, with separate software modules for return path ingress and forward path performance analysis. Operators can choose to purchase only the modules needed for their particular testing requirements.

Application Examples

There are many useful applications for a Proactive RFMS. Here is a summary description of two of the most popular applications, as depicted by Sunrise Telecom's realWORX.

Application Scenario #1: Proactive 24/7 Monitoring of the (Downstream) Feeds.

The proactive, automated monitoring is done at the headend and distribution hubs to detect service-affecting RF degradations before subscriber QoE is affected. The monitoring is fully automated – a single system can switch between up to 256 feeds, perform sequence of tests, gather and archive a set of measurements, and repeat the process again. Performance threshold triggers are logged; statistics are logged for historical analysis (very useful in troubleshooting because RF impairments are often intermittent in nature).

Analyzer and switches are installed in the head end to provide automated forward path monitoring of broad and narrow cast carriers...

Analyzer and switches are installed in remote Hubs to provide automated forward and /or return path monitoring...

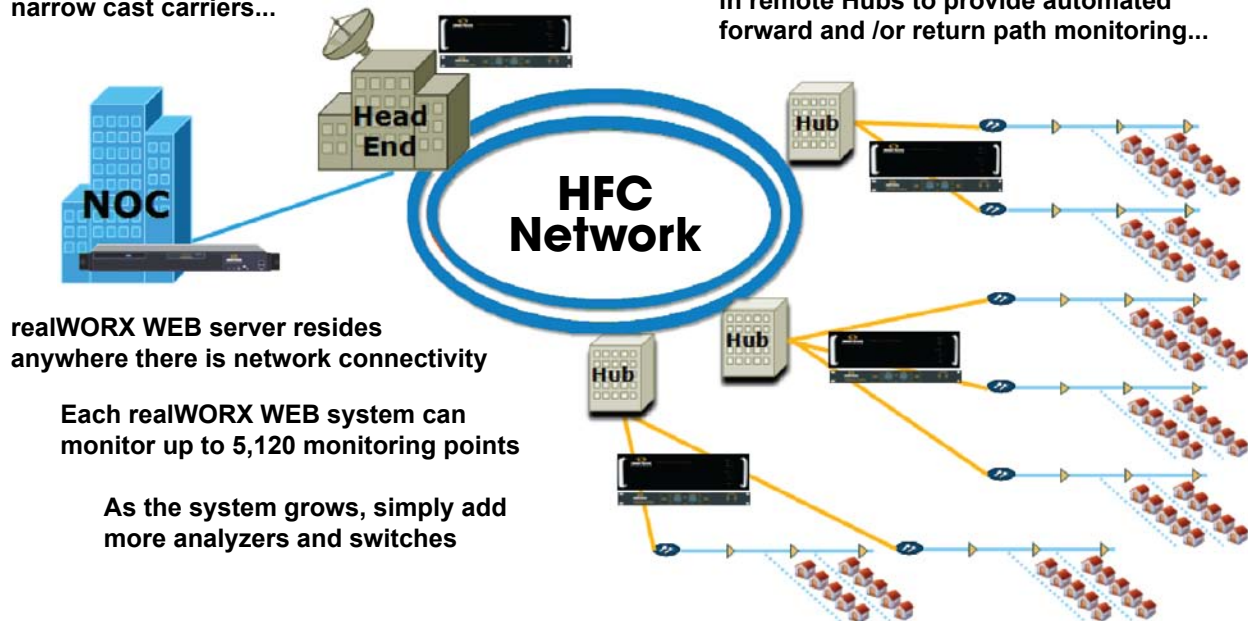


Figure 4: Proactive 24/7 RF Performance Monitoring Example

Application Scenario #2: Remote Testing via Field Access.

Field techs also have the ability to receive real-time return path spectrum traces/screen views from multiple test head analyzers at the headend or distribution hubs.

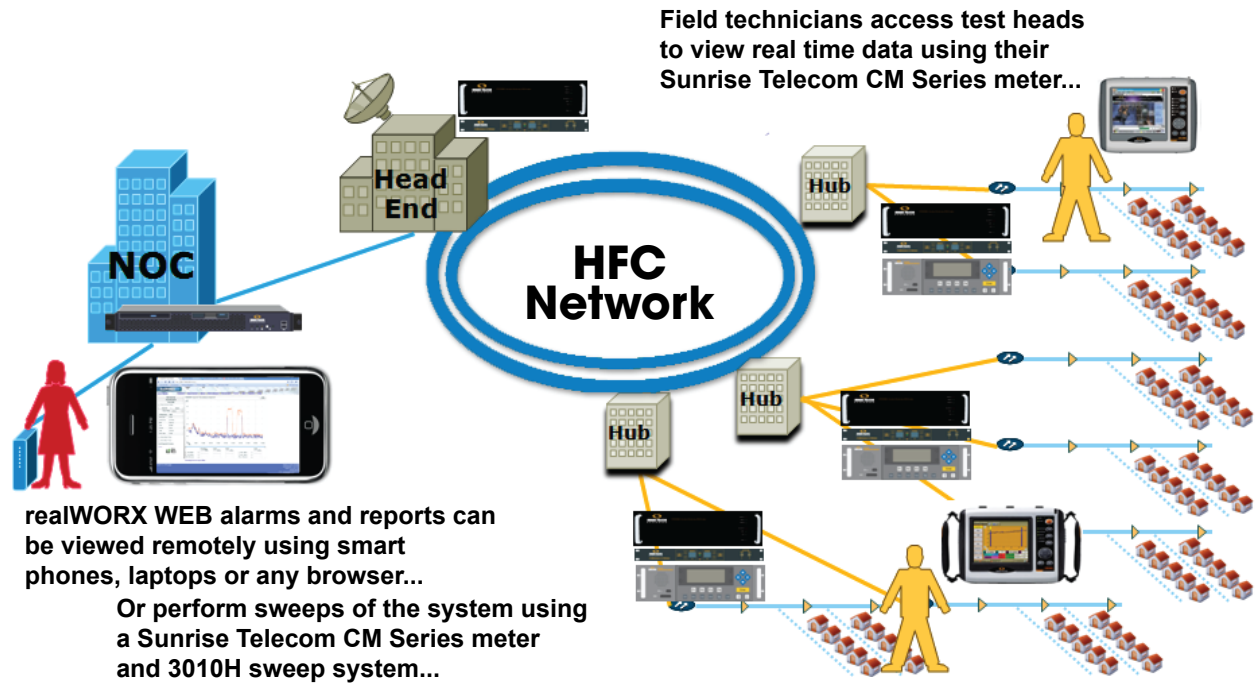


Figure 5: Remote Field Access Example

Why Should You Care about Proactive RF Monitoring

Whether you're a Cable Operator executive, manager, engineer/architect, or technician, proactive, automated RF monitoring at the headend and distribution hubs addresses your priority challenges.

Operations and Engineering Manager

Operations and Engineering managers have a lot of challenges to consider: efficiency improvement, cable plant reliability, system integration, quality processes, bandwidth, and vendor support.

A Proactive RFMS allows you to assign work orders based on real-time node status and track progress and changes as work is being done. This means more efficient node certification for advanced digital services. A Proactive RFMS integrates the monitoring of both forward and return paths provides 24/7 data collection for each node, forwarding alarms using a variety of mechanisms. You can correlate real-time and historical RF performance data with other systems, e.g. compare to the IP and network layers. A Proactive RFMS archives performance history to track RF performance on nodes. The system reduces network traffic with results compression to just alarms until detail is requested. And by deploying a system from global leader like Sunrise Telecom, you get comprehensive professional services for installs/upgrades, training, system optimization, and on-site calibration.

Network Operations Center (NOC) Administrator

NOC personnel are challenged with having to monitor the entire network, sort through the useful alarms, implement network operations including the monitoring of forward path and return path performance, all while making sure systems scale and are easy to use.

A Proactive RFMS certifies your forward paths and return paths for advanced digital service deployments. It optimizes monitoring plans based on node past performance. A Proactive RFMS can use smart alarm filtering to sort out low priority alarms and includes a feature to view detailed data before and after an event. You can set alarms for minimum and maximum levels, by frequency. Historical performance for any node is available for up to a full month of data. On the system admin side, you can assign client rights for ease of use and configuration control. If you choose a Proactive RFMS that has scalable hardware and software, you can add or subtract system capacity as needed.

Network Operations Analyst

Network Operations Analysts are challenged with alarm management, node health and trouble tickets, and efficient node certification.

A Proactive RFMS provides multiple means to identify the importance of an alarm, including the ability to instantly view detailed data before and after an event. You can export detailed data, or a simple snapshot of a view. Monitor multiple nodes simultaneously and consistently the same way on all nodes. Then record results to support certification. Also, you should be able to view any node, or collection of nodes, with real-time remote views.

Field Tech/Installer Supervisors

Field tech supervisors are challenged with quality control at service install, reduction of repeat service calls, and the isolation of RF ingress source.

The Sunrise Telecom's realWORX is a Proactive RFMS that integrates with a field view option on Sunrise Telecom's CM series field meters and AT2500 series spectrum analyzers. You can toggle between local and remote spectrum views, then move between nodes and select appropriate node remote view at the meter.

Next Steps to Better Subscriber QoE

The Proactive RFMS has become an essential component to maintaining the all-digital cable plant transition. To more about how a system can be economically deployed in your plant, contact the market-leader in Proactive RFMS, Sunrise Telecom.

Sunrise Telecom can give you access to a hosted realWORX demo system to facilitate your realWORX evaluation. The Sunrise Telecom professional services team can also engage with you to discuss how the realWORX system can be easily deployed in your cable plant infrastructure. Talk to your Sunrise Telecom sales manager or channel partner representative today.



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