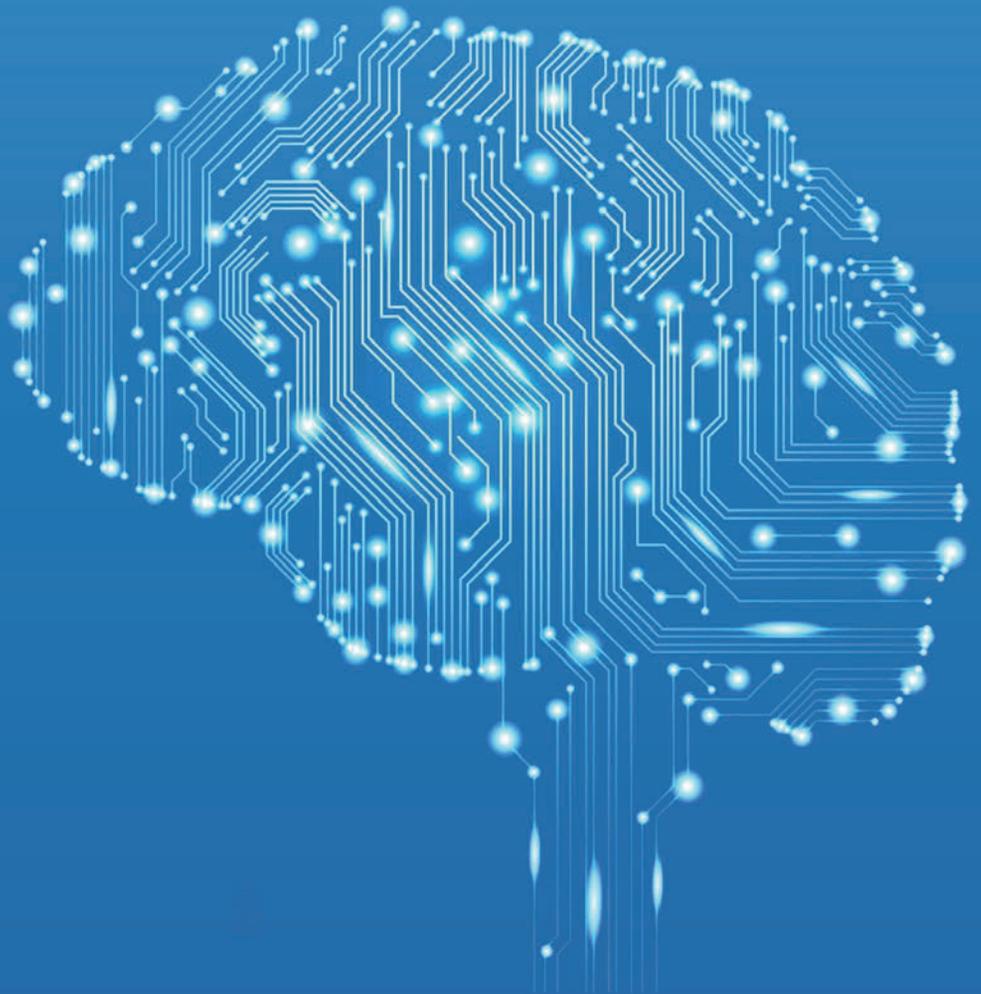




***WE ENABLE  
YOUR HFC NETWORK  
TO THINK***

Full-Band Capture Empowered  
Smart HFC Solutions

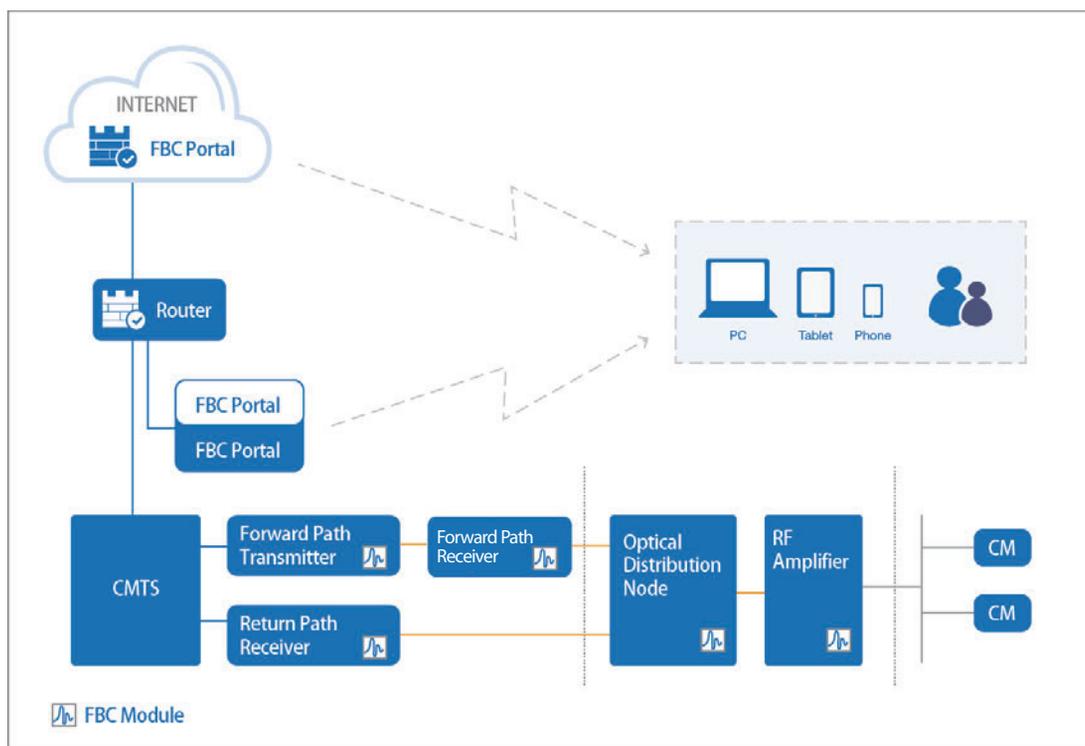


## Improving QoS and QoE for Today's HFC Network

As competition increases, cable operators face the following challenges:

1. How to improve the efficiency of network construction and maintenance whilst ensuring service quality
2. How to determine network operation status accurately, economically, and effectively
3. How to change the maintenance method from reactive to proactive to detect potential network failure, as well as quickly detect and locate network weaknesses to reduce failure recovery time

Benefiting from the popularization of DOCSIS® 3.0 technology, PBN has developed a series of Full-Band Capture (FBC) applications to identify HFC network problems, aimed at helping MSOs improve the Quality of Services (QoS) and Quality of Experiences (QoE).



PBN Smart HFC System Overview

## HFC Network Equipped with X-Ray Vision

By integrating PBN's proprietary FBC modules into our forward and return path headend products, specifically the AIMA3000 headend platform, we can collect, process, and transfer the data to the central FBC software management system. It provides the network visibility that Operators could traditionally only acquire through extra monitoring hardware.

For outside plant applications, PBN has an optical node series which are equipped with FBC modules. Operators can also choose to keep their existing nodes and line extenders by adding PBN customized FBC-enabled transponders.

The software remains at the core of what makes smart HFC possible. PBN's software platform is designed with big data analytics, scalability and storage in mind. By leveraging the Apache Spark Streaming framework, PBN's FBC software suite can handle millions of data entries per day with modest hardware configurations. Alternatively, Operators can choose to integrate PBN's FBC software capability into their existing network platform through public DOCSIS SNMP MIBs.

# Enabling Smart Networks

## Network Performance Data at Your Fingertips - Anytime, Anywhere



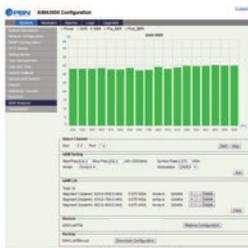
FRAS-M-Spectrum



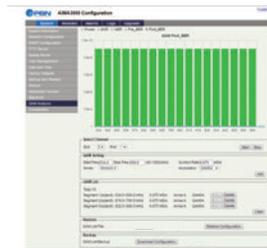
RRAS-Spectrum



QAM Constellation



QAM Analyzer-MER



QAM Analyzer-BER



Upstream Spectrum Analysis



Downstream Spectrum Analysis

Network component failure and resulting system downtime presents a serious risk to high-bandwidth service providers. Ongoing network monitoring and maintenance is a mission critical task which can be an expensive, labor intensive, and a time consuming exercise for ensured quality continuity. Operators need a better solution to be on top of their network performance when they need it.

With the data collected via PBN FBC modules across the network, Operators can access these elements via a standard web browser or through dedicated mobile applications tailored for Apple iOS or Android devices. Through the intuitive GUIs, field technicians and the central office can have access to the data anytime and anywhere along the network.

## Product Portfolio Overview

### Headend

#### AIMA3000



FRAS-S-M  
Forward-Path Receiver



RRAS-Q-M  
Return-Path Receiver

- 1.2 GHz / D 3.1 compliant
- Low noise profile
- Minimal distortion characteristics
- High RF output
- Automatic Gain Control (AGC) for a stable RF output
- Electronic slope control
- Monitor the downstream spectrum and QAM demodulation data, including RF level of each channel, SNR, MER, BER, and constellation
- 204 MHz / D 3.1 compliant
- Up to 64 RXs in 4 RU AIMA3000 Chassis
- Wide band receiver (1260~1620nm) to suit CWDM and DWDM applications
- Low noise profile
- Minimal distortion characteristics
- High RF output
- Automatic Gain Control (AGC) for a stable RF output
- Electronic slope control
- Monitor the upstream spectrum to locate the upstream noise and the related upstream signal levels

### Outside Plant

#### ODN2000/ODN2100/LE2000

Modular Optical Node and Line Extender



- 1.2 GHz / D 3.1 compliant
- High output power supports node+O architecture
- DOCSIS 3.0 transponder to monitor downstream and upstream transmission signals (SNR, MER, BER, constellation, upstream noise)
- Electronically controlled attenuation and equalization (ODN2100)
- Modular design. Can deploy as Line Extender then upgrade to Optical Node

#### APCM

Outdoor Hardened DOCSIS Transponder



- Compatible with DOCSIS and EuroDOCSIS 1.0, 1.1, 2.0 and 3.0
- Downstream and upstream spectrum analyzer
- Downstream QAM decoder enables Constellation display, SNR, MER, pre-BER and post-BER calculation
- Monitoring of key SC-QAM performance metrics with configurable alarm thresholds
- IP68 housing and industrial grade components for harsh environment

### Management

#### netWatch

FBC and PNM Software Platform



- Collection and analysis of CM data, optical nodes, return receiver and CMTS to identify plant degradation
- Troubleshoot impairments such as micro-reflections, group delay, CPD, laser clipping and so on 7\*24
- Geographical mapping and color-coded health indicators to pin-point trouble areas
- Support field techs with mobile APP for one-man upstream troubleshooting
- Intelligent alarm notification and preventative maintenance work list setting adapt to user preference
- No need any additional equipment, cabling or connectors
- Increase plant reliability through more nodes data available in the upstream and downstream path
- Improve network maintenance efficiency by proactive maintenance and gridding management
- Reduce customer calls and truck-rolls by identifying problems before they impact customer experience
- Improve subscriber satisfaction and service quality



## Transform Passive Operation to Proactive Maintenance

Network management has traditionally operated on a reactive basis, responding to system failures and maintenance issues as they arise. In the current climate of ubiquitous broadband, with customers requiring reliable persistent access to high-bandwidth services, reactive response strategies are no longer viable.

Network operators have a pressing need for constant system monitoring and predictive analysis which identifies potential failure points and impending risks, before they impact customers, causing degradation and service interruption.

To achieve the Proactive Network Maintenance goal, operators are required to build hardware and software capability along with continuous operation optimization.



## Integrated Smart HFC Network - Delivered

Expensive and cumbersome spectrum analysis tools have long been in use in the cable industry for troubleshooting, design and calibration purposes.

Traditionally this meant buying and maintaining large quantities of power meters, spectrum analyzers, and other specialized tools. This increased expense and training time acted to limit the number of people who could assess the system, and placed added resource stresses on the MSO.

By utilizing the Full-Band Capture and QAM signal demodulation function of DOCSIS® 3.0 cable modems, PBN's FBC platform converts the entire active network transmission component into an intelligent network probe cluster, capable of facilitating analytics based automation for ubiquitous, proactive network monitoring and maintenance.

This frees up workforce resources to focus on other areas of network construction, with the end goal to ultimately minimize unscheduled downtime as much as is possible, in the most cost-effective manner, yielding increased customer satisfaction.

Today it is possible to use cost-efficient, integrated FBC modules, leveraging existing DOCSIS® 3.0 capability to enable passive system elements with reactive network management and maintenance features, resulting reliability improvement as a seamless, intelligent and automated afterthought.

## About PBN

PBN is an experienced global supplier of optical broadband products and technology solutions for HFC, RFoG, FTTx and EMS/OSS applications. We enable profitable and scalable transitions to IP Networks, nowadays required by a consumer-empowered world. PBN is well known globally for its innovation and expertise, offering advanced fiber optic products and solutions for applications demanding high bandwidth for transporting video, VoIP and high-speed data. Today our products are installed to deliver comprehensive broadband access solutions to over 35 million subscribers, served by hundreds of headend facilities worldwide.

## The PBN Advantage

- Integrated smart HFC portfolio for smooth deployment of headend and outside plant products
- Continued investment and commitment to HFC product lines
- Operational experience delivered (planning, deployment, support)
- Pre-integrated hardware and software packages are designed for sustainable operation
- High-quality products with competitive pricing to fit every business case
- Ease of management due to sophisticated NMS3-software solutions which ensures stability
- Global 24/7 support organization operated by PBN

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