HMS and SMC over OOB

A Virtualized Approach to Legacy Monitoring Integration in DAA Systems

The growing importance of service quality and network availability is fundamentally changing the requirements for modern cable access networks. In DAA architectures in particular, existing monitoring protocols must continue to function reliably, even as network structures undergo significant changes. The virtualization of traditional FSK-based monitoring systems opens up new possibilities for efficiently integrating existing infrastructure, while reducing costs, energy consumption and complexity. By Ádám Békefi, Senior Developer

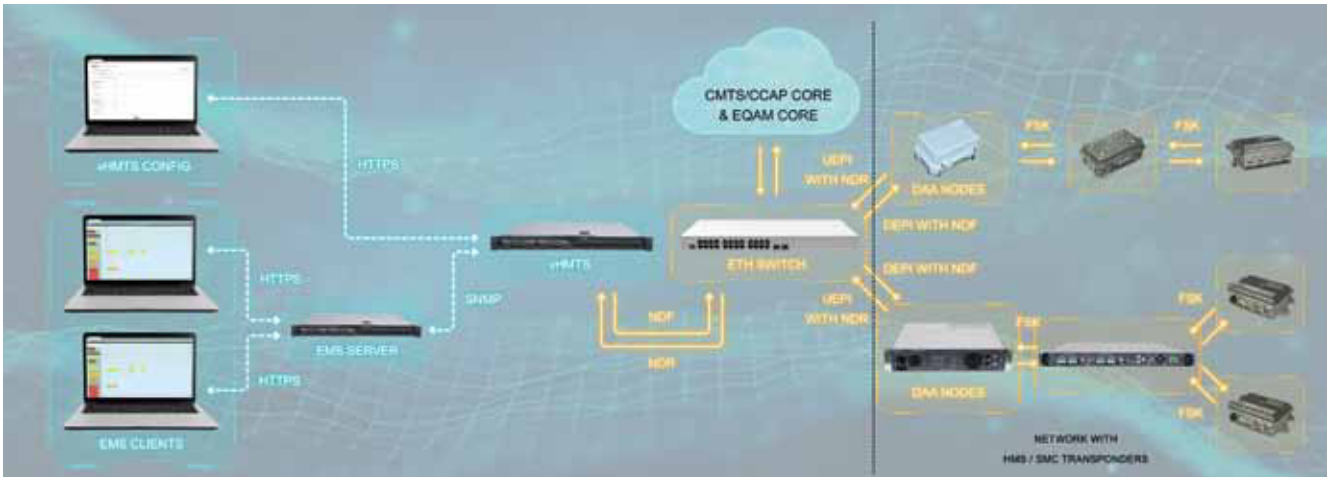
Cable services market is undergoing continuous change from technological, regulatory, and stakeholder perspectives alike, resulting in intensifying competition among providers. For a long time increasing data speed constituted the primary competitive advantage; now, however, subscribers make their choices based on other considerations. Regarding the usage patterns, it has become evident that many users are unable to utilize the bandwidth made available by modern solutions. For them, availability is of greater importance. Maintaining this at a high level requires continuous measurement: the status of the active elements along the transmission path must be monitored.

Therefore, even the FTTB/RFoG distribution systems with only a few cascaded elements complementing the currently emerging DAA-based access networks often include this option. When other architectures are applied, some active elements with the need of monitoring are also expected, since installation of a DAA device directly in the house network is rarely viable economically. In cases where the original coaxial network is kept behind the DAA node, the monitoring subsystem may already be available in existing amplifiers. Two narrowband solutions are widely used in Europe for this purpose: the standardized HMS/SNMP protocol and the SMC/TNCS protocol developed by Cisco.

FSK-based monitoring systems in a DAA environment

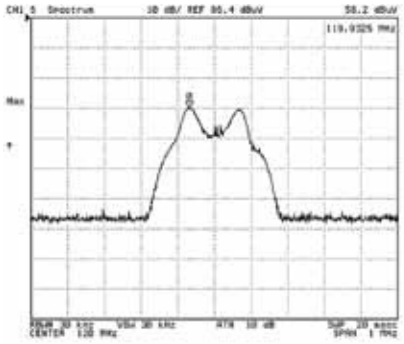
At first glance, it may seem advisable to replace them with an inherently DAA-compatible DOCSIS-based solution. However, where some infrastructure is already installed, its replacement may generate costs that do not yield an adequate return. Beyond this, the retention of FSK-based solutions is also supported by their lower power consumption compared to DOCSIS, which results in reduced heat dissipation – this can be a decisive factor at certain sites. To leverage these advantages, it is necessary to ensure narrowband access to the devices behind the DAA node. This can be achieved by utilizing the standardized OOB channel defined by the CableLabs CM-SP-R-OOB specification.

Using the OOB channel for this purpose is not a new idea; hardware-based solutions for delivering FSK carriers to segments behind the Remote PHY Device (RPD)have existed for a long time. However, the analog-digital-analog conversion implemented by such solutions not only introduces extra latency into the communication but also increases power consumption and the number of potential failure points. A more efficient approach is direct digital signal generation, i.e. virtualization of the HMTS (Hybrid Fiber Coax Management Terminal Servers). In



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Schematic operation of the vHMTS and its integration into the narrowband monitoring system



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Generated FSK signal at the output of the RPD

practice, this involves migrating most of the gateway functions from embedded processor-based hardware to a server environment and implementing a routine that computes the instantaneous amplitude of the carrier instead of relying on discrete modulator circuits. The carrier samples are encapsulated into L2TP packets, and the actual RF signal is then generated within the RPD using them. Due to its software-based nature, the solution offers lower CAPEX and OPEX compared to alternatives, reduces the number of potential failure points, and provides greater flexibility – since commissioning additional virtual transmitters and receivers is fast and does not require fieldwork. Recognizing these advantages, Comtech developed a fully virtualized monitoring gateway solution, the vHMTS.

Virtualisation of the HMTS: architecture and technical parameters

During the development, a key question was the selection of an appropriate bandwidth value from those offered by the DAA core. Two considerations had to be considered: the relationship between baseband parameters and sampling frequency, as well as the need to minimize bandwidth wastage. Since the data rate of HMS communication is 38.400 baud, the nominal bit duration is approximately 26.04 µs. To ensure error-free operation, a tolerance of no more than ±2 percent is permitted, meaning that the bit duration must fall between 25.52 µs and 26.56 µs. As the bit duration must be an integer multiple of the sampling interval, a channel bandwidth must be selected that provides a sampling frequency with suitable temporal granularity. This condition is first satisfied at a channel bandwidth of 320 kHz, resulting in a bit duration of 26.56 µs; therefore, this is the smallest applicable channel bandwidth. From the other perspective, the bandwidth of the modulated signal is determined by the 67.5 kHz deviation and the bit rate, yielding a value of 173 kHz. This is smaller than the required channel bandwidth, using a wider channel would result in spectrum inefficiency. Consequently, the selected channel bandwidth is 320 kHz.

Signal quality of this configuration is suitable for HMS, SMC, as well as Comtech's proprietary protocol. All three have been implemented, switching between them is possible at any time. Other parameters, like DS and US carrier frequencies, are freely configurable and depend solely on the capabilities of the RPD/RMD. The mandatory characteristics of the OOB channel thereby ensure future-proof operation: DS carrier frequency can be set as high as 1 GHz, guaranteeing compatibility with any diplex filter.

Performance, scalability and integration with DAA cores

An entry-level server is sufficient to run the vHMTS. The recommended specifications include a 4-core, 3.5 GHz, 64-bit architecture processor, 32 GB RAM, a 10 Gbit/s Ethernet network interface, and at least 25 GB of storage capacity. Testing was performed on a machine with these characteristics. The results showed that, using unicast addressing toward the RPDs, one RF group, i.e. one RPD, can be reliably served per CPU core. This can be optimized by introducing multicast addressing for DS communication. In the test setup four RPDs were operated; in the DS direction they were served by a single stream (NDF), while US communication remained unicast-based, using 4 independent streams (NDR). Compared to hardware gateways, this configuration corresponds to an HMTS with one transmitter and four receiver modules. With this setup, the system

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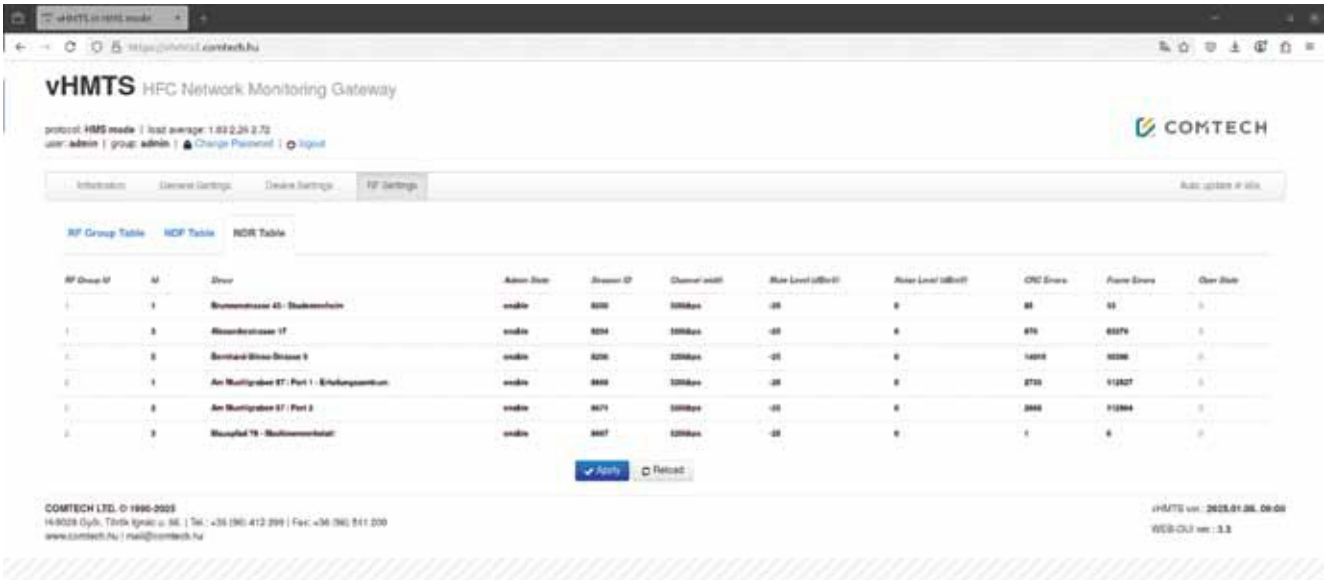
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Web-based interface for system configuration

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Comtech is a flexible technology partner for cable operators modernizing their HFC and DAA networks. In recent years, the company has launched several new developments and strengthened its market presence through successful partnerships with Harmonic, Aurora Networks, Sumavision, and Vecima, which honored Comtech with its 2025 Rookie of the Year award. Comtech's DAA portfolio includes R-PHY and R-MACPHY node solutions that combine the proven processing platforms of leading vendors with Comtech's own system integration and hardware expertise. In parallel, the company continues to invest in proprietary solutions such as its V-HMTS monitoring software, as well as in upgrade modules that help extend and modernize existing networks. Thanks to its size and engineering flexibility, Comtech can also respond quickly to special customer requirements and develop tailored solutions even for smaller-volume projects.

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load averages over 1, 5, and 15 minutes did not exceed 3.00, while per-core CPU utilization remained below 25 percent. The number of transponders is not a limiting factor: a single RF group is capable of managing up to 1000 NEs, which constitutes the basic unit of scalability. To add further RF groups, the number of CPU cores must be increased accordingly, depending on the addressing mode used.

Easy commissioning and user-friendly configuration

During compatibility testing, DAA devices of our trusted partners Harmonic and Vecima enabled reliable communication. In order to ensure compatibility with any other DAA node, the vHMTS relies exclusively on the standardized functions of the DAA core. This also simplifies the commissioning procedure: only the OOB channels need to be configured using the core, after this the vHMTS is ready for operation. To further accelerate deployment, no installation is required; Comtech delivers the solution as a preconfigured virtual machine.

To enable an easy configuration of SNMP parameters, the vHMTS provides web-GUI. In line with the requirements of modern networks, the vHMTS supports SNMPv3 communication toward the NMS software and offers IPv6 addressing for both its own interfaces and the RPDs. Centralized user management via LDAP, as well as the definition of 3 distinct user authorization levels is also supported.

The licensing model based on a one-time purchase fee further enhances flexibility. Licensing is managed through a centralized server; the purchased capacity applies to the entire system and can be shared among different instances. ■