VIAVI Solutions

White Paper

# CCAP and Remote PHY in the Headend

## Solutions for today's dynamic cable networks

Consumers are changing the way they use video and data in the home. Multicast, or broadcast programming, is no longer meeting consumers' appetite for content while demand for unicast services, such as video on demand (VoD), has exploded. Part of the change is the result of consumers having more devices on which to consume data and video.

Televisions are still the most dominant screen for family viewing, but individuals are increasingly using laptops, mobile phones, tablets, and other Internet protocol (IP)-connected devices as well. With more screens in each home, cable providers must find ways to keep up with bandwidth demand. In addition, the IP network is rapidly becoming more dynamic in nature due to this increased unicast traffic.

According to a recent white paper by Cisco, global consumer Internet video traffic will be 69% of all consumer Internet traffic in 2017, up from 57% in 2012. In addition, VoD traffic will nearly triple by 2017: the equivalent of 6 billion DVDs per month.

For cable providers, this new dynamic is causing traffic congestion in the headend of the network—the area that links the plant with the consumer. Most cable networks still treat data and video as two separate entities, yet as network traffic continues to grow in unpredictable ways, cable providers must look for new solutions to handle traffic.

This paper explains the converged cable access platform (CCAP) approach as one such solution. It presents the benefits of CCAP along with two possible implementation scenarios. The paper also discusses testing, as the current testing environment will dramatically change. Finally, we will look at remote PHY as a way to further decrease congestion in the headend.

Topics include:

- What is CCAP?
- Implementation
- Testing for CCAP
- Remote PHY
- Conclusions

## What is CCAP?

In a typical headend configuration, an edge quadrature amplitude modulation (edge QAM) unit handles broadcast and narrowcast traffic. A separate cable modem termination system (CMTS) handles data and unicast traffic. However, with today's dynamic network environment, the two separate systems must fight each other for bandwidth as demand grows. It is a challenge to manage all network traffic effectively with two isolated systems in place. This causes congestion and bottlenecks that create quality of service (QoS) issues for residential and commercial customers alike.

CCAP eliminates this problem by combining edge QAM and CMTS into one platform. It intelligently looks at the amount and type of traffic flowing over the network and makes adjustments in real-time to ensure that traffic flows smoothly. In essence, CCAP puts all downstream carriers, including DOCSIS and video QAMs, in a single radio frequency (RF) port with the flexibility of changing between carriers via software. This creates a transport-agnostic network architecture that deals effectively with today's traffic needs and will be compatible with future networks as they evolve.

CCAP helps consumers gain the bandwidth they need, when they need it, while also creating cost savings for providers. For example, CCAP exploits more bandwidth because it uses digital instead of legacy analog channels. This adds five to six digital channels for every one analog channel it replaces and uses more of the available spectrum within the cable.

CCAP also saves providers money since one unit can now do what two units, the edge QAM and CMTS, used to do. This frees up as much as 50% of the rack space in the headend, saving 50% or more in power consumption.

CCAP edge devices also save space by having a higher port density. Each port can deliver a full lineup of QAM carriers, with a single CCAP port serving a smaller number of nodes: 'narrower' casting. However, the sheer number of ports and individual QAMs that will have to be tested/measured as part of install commissioning and on-going maintenance will bring its own challenges.

## Implementation

Cable providers look at two different models for implementing CCAP across their networks—integrated CCAP and distributed CCAP. Which method they choose depends on how much traffic is currently running through each headend and how much of that traffic is broadcast and narrowcast versus unicast and data.

The Integrated CCAP method removes both the edge QAM and CMTS units at the same time. It replaces them with one CCAP chassis that handles packet processing and data management and has line cards to handle both downstream and upstream traffic. This type of CCAP also has modules to handle traditional HFC network traffic and commercial EPON deployments.

This all-in-one approach is cost effective in the long run and makes the headend as efficient as possible. However, it has significant upfront costs that may deter some providers.

The distributed CCAP model keeps the CMTS in place, but replaces the edge QAM with a newer, high-density edge QAM unit. This gives the headend more bandwidth and the ability to handle more narrowcast traffic, but does not address the dynamic nature of unicast traffic.

This approach offers providers more flexibility on implementation and can save money upfront, but costs more in the long run. A CCAP core chassis, that also manages the high-density edge QAM unit, will eventually need to replace the CMTS.

Which method a provider chooses ultimately comes down to the situation they face at each individual headend. For urban areas with lots of traffic of all types, the integrated approach is best. For more remote areas that do not have as much unicast and data traffic, the distributed approach makes more sense.

## Testing for CCAP

CCAP solves many of the bandwidth and congestion problems cable providers face in the headend, but testing and solving service disruptions become much more challenging. In a pre-CCAP environment, providers manually created a channel lineup plan to determine which network programs to run over the physical channels in the network. For example, if a consumer experienced pixilation while watching HBO, a video technician called the office to find out on which physical channel HBO was broadcast. From there, he or she tested that channel to find the issue.

A CCAP environment creates the channel lineup automatically, changing dynamically to best utilize overall bandwidth. This becomes an issue for testing. The channel lineup may be completely different from the time a customer experiences a problem to the time the technician conducts the test. The channel may even change while a test is being conducted; this makes it even more difficult for a technician to know which physical channel has a problem.

Another issue is that most cable providers have separate technicians for video, data, and the physical layer—the cable itself. In a CCAP environment, all three are intertwined. Technicians must become experts at all three and have completely integrated testers to handle this new environment.

Next-generation test instruments (such as the VIAVI Solutions VSE-1100) are now available that combine tests for data, video, and the physical layer into one fluid operation. They also auto detect the current channel lineup so a technician can quickly test the correct channel as soon as they are notified of a problem. This is possible because these new test instruments are portable and robust enough to go out to the plant, see where the traffic currently is, and see what specific carrier or QAM is handling that traffic. This eliminates a lot of diagnostic layers and work for the technician, saving valuable time as they try to solve a problem.

However, as more bandwidth is used, current methods for testing noise and ingress detection become impossible to complete. This is because testing typically takes advantage of unused bandwidth—testing from outside the channel to detect if noise is leaking out of or into a specific channel. In a CCAP environment, all channels may be in use. New, in-band testing methods such as “ingress under the carrier” use an active channel and demodulate its traffic. These methods obtain data based on the modulation and by matching and determining what data doesn’t belong. This does not interfere with the delivery of the traffic itself.

A similar problem is interference from nearby wireless (over-the-air) networks such as LTE/4G services that operate in the 750 MHz range. As the FCC and other regulators continue to sell spectrum, wireless carriers and cable providers must use more frequencies which overlap with the LTE/4G range. Currently, cable providers move traffic from one channel that is experiencing interference to a channel farther away to solve the problem. However, as the network uses more channels, this solution no longer works—and the problem is only getting worse as LTE/4G rollouts increase.

New, in-band testing methods such as “ingress under the carrier” use an active channel and demodulate its traffic. Providers can quickly locate which channel is having a problem, see if noise is leaking into or out of the channel, and correct the problem without ever needing to move traffic.

In the age of CCAP, testing not only needs to be faster. It also needs to help pinpoint where a problem is geographically located down to certain segments within the network. For example, the increase in the number of QAMs being broad/narrowcast means that traditional, slower test tools will take too long to complete a comprehensive quality check at the headend/hub for every QAM. Test tools must speed up significantly in order to decrease total test time for commissioning, maintenance, and troubleshooting. In addition, the latest HFC monitoring solutions let the headend monitor each node in the field and determine if a node is unhealthy. New analyzers can then segment the line between the headend and home to determine which segment is having the problem.

One of the most frustrating interference issues is impulse noise. This transient noise only disrupts a channel for a fraction of a second but causes significant QoS issues for the consumer. Impulse noise itself is hard to detect, but when complicated by the CCAP dynamically changing the channel lineup, finding the root cause of a problem becomes even more complex. The service experiencing the problem will be changing and potentially different from one CCAP port to another.

To counteract this issue, new testing units need to not only auto-detect the current channel lineup. They also need to make the impulse noise visible and show it graphically so technicians can decide on the best course of action to resolve the problem.

## Remote PHY

With all the positive changes CCAP is bringing to the headend, one problem still remains as consumers continue to use more bandwidth—up and downstream capacity. Remote PHY brings downstream QAM generation, upstream demodulation, and more processing closer to the home to increase capacity. Put another way, remote PHY moves part of the headend/hub out into the field (at the node), closer to people's homes.

Nodes used to handle traffic to and from as many as 3000 homes, but with the increasing bandwidth and service demands from consumers, that number is now closer to 250 homes per node.

Remote PHY will come in the form of new node hardware, replacing existing nodes in the field. It does the same job as existing nodes, but adds dynamic traffic allocation to the downstream and upstream channels. Backhaul from node to the headend also changes from RF optics to gigabit Ethernet optics in order to deliver higher capacity while using standard IP/Ethernet technology.

How soon can remote PHY be deployed? The main factor gating deployment seems to be finalizing a technology roadmap that creates optimal, future-proofed, scalable solutions. A logical place for providers to start is in new, greenfield neighborhoods that don't currently have nodes in place.

## Conclusion

The question is not if CCAP will be implemented, but when. Demand for bandwidth is growing at such a rapid pace, cable providers have no choice but to deploy some version of the solution. CCAP looks like a wise investment as it has the ability to be compatible with future networks as they evolve.

CCAP also offers different methods of implementation to meet the needs of each cable provider. It lets a provider select a CCAP model that meets their needs on a headend-by-headend basis. This provides the flexibility to implement CCAP in the most cost-effective way to bring down cost-per-bit and increase bandwidth.

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