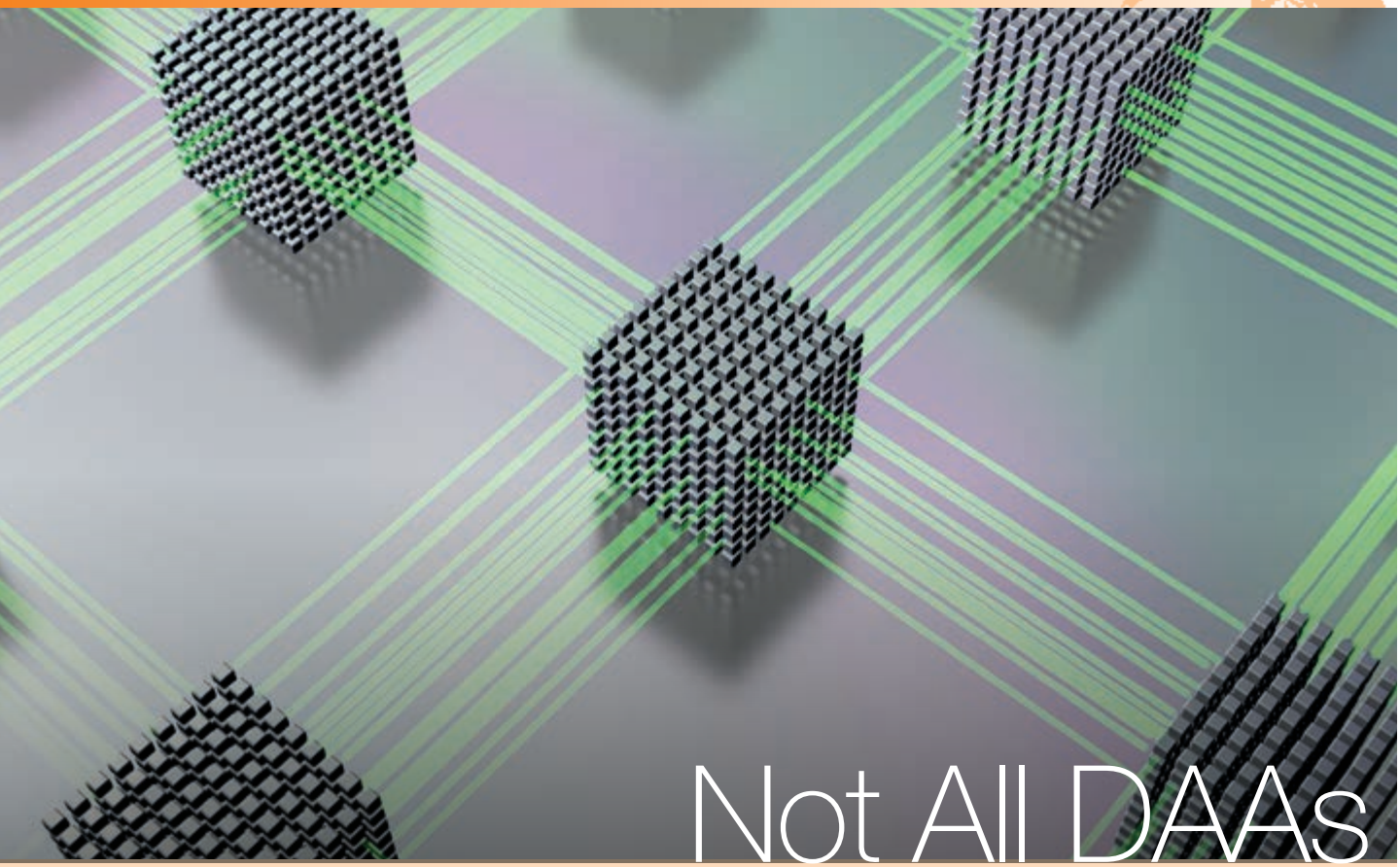


Not All DAAs are Created Equal

By Karthik Krishna, Product Marketing Manager, Nokia Networks

As the shift increases towards Distributed Access Architectures, a true virtualised DAA solution can offer superior bandwidth capacity and signal quality without the cost, power, space and distance limitations of traditional cable network upgrades. It lays the foundation for migration to a cloud-based/cloud-native implementation and easy evolution to next-generation technologies, such as Full Duplex DOCSIS or FTTH.

Karthik Krishna
Product Marketing Manager

Karthik Krishna has 20 years of technology marketing, business and product management, and engineering experience including over 10 years in the cable and video segment. He currently drives product marketing for the cable business unit at Nokia.

Karthik joined Nokia through its acquisition of Gainspeed, the cable technology innovator that built 'the industry's first Distributed Access Architecture (DAA) and virtualisation solution', where he played key roles in business development and defining product requirements. Previously, Karthik held system integration and product management positions at ARRIS and Big Band Networks.

Karthik earned a Master's Degree in Business Administration from University of Berkeley, California and a Bachelor's Degree in Electronics and Communication Engineering from University of Madras.

The cable industry is facing one of its largest inflection points in its almost 70-year history. The confluence of three massive trends – the explosion of new users and devices, the proliferation of high-speed data services and the move from QAM-based video to IP-based video – has fundamentally changed the face of cable. Today, it is generally believed that more than 70% of traffic is real-time video and entertainment, and this percentage is growing every year. As a result, multiple-system operators (MSOs) are seeing a hockey stick demand growth for data capacity.

MSOs have responded to this sudden surge in network capacity demand by expanding their HFC networks in three ways:

1. **Increasing service group capacity:** MSOs have expanded and reallocated spectrum to increase the number of channels and capacity of service groups.

2. **Implementing node splits:** By adding nodes to the access network, MSOs reduce the number of customers in a service group, effectively giving each customer more capacity.
3. **Moving to DOCSIS 3.1:** The latest version of the standard, that enables high-bandwidth data transfer on cable networks, provides more capacity by better utilising the existing spectrum.

However, all is not well. Increasing network capacity in these ways poses a number of challenges. They all necessitate additional equipment in the hub and headend. In addition to the capital expense, the additional equipment also increases operating expenses associated with greater space and power requirements. Many hubs and headends have maxed out their available space and power. Furthermore, enabling the full benefits of DOCSIS 3.1 often requires significant network improvements to boost signal quality.

In light of these challenges, most MSOs are now debating two paths forward:

- **Fibre to the Home (FTTH):** FTTH provides unlimited capacity and is future proof. However, pulling fibre can be very expensive and is accompanied by considerable time, logistical and regulation challenges.
- **Distributed Access Architecture (DAA):** DAA delivers Gigabit network performance, increased network flexibility, reduced capital and operating expenses, and a number of additional benefits, but leverages the existing HFC infrastructure.

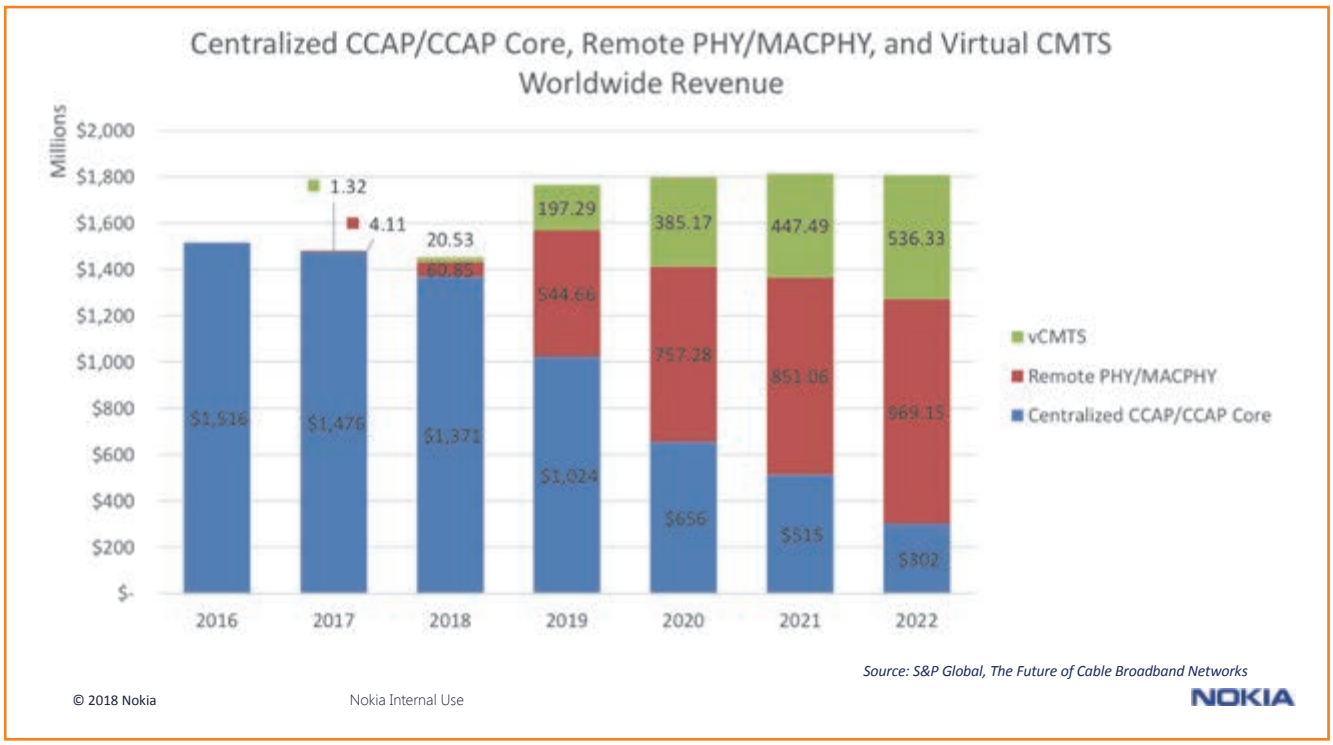
While FTTH is full of promise, it can be too expensive in the short term, especially for brownfield deployments. DAA allows MSOs to have their cake and eat it, too.

What is DAA?

In basic terms, DAA distributes certain functions of the Converged Cable Access Platform (CCAP) to other parts of the network. For example, the DOCSIS PHY may be pushed out to the node, enabling network expansion without additional cable-specific headend equipment while digitising the outside plant to eliminate distance limitations.

DAA addresses the key challenges associated with traditional HFC network growth and enables significant additional benefits, including network simplification and virtualisation.

Nearly all major cable MSOs recognize the benefits and value of DAA. As shown in the chart, over the next four years, industry analysts project that spending on centralised CCAP and CCAP core equipment will drop from approximately US$1.4 billion in 2018 to just US$300 million in 2022 while spending on DAA-related equipment will go from only about US$80 million in 2018 to US$1.5 billion in 2022.



Varying degrees of DAA today

There are many vendors talking about DAA, and they are using various terms. These include:

- **vCMTS –** A Virtual CMTS performs all CMTS functions, except the DOCSIS PHY layer, on a commercial off-the-shelf server (COTS) or appliance. A vCMTS allows the MSO to eliminate "Big Iron"* CCAP devices, which drive most of the space and power challenges in the headend.
- **R-PHY –** A Remote PHY Device (RPD) pushes the DOCSIS and QAM PHY layer to the node. Doing this digitises the hub-to-node connection, improving signal quality to the neighbourhood. An RPD is typically linked with a "Big Iron"* CCAP/CCAP core or a vCMTS running on a server in the headend. R-PHY introduces a small power cost in the outside plant.
- **R-MACPHY –** A Remote MACPHY Device (RMD) is simply an RPD with the vCMTS running on the node instead of in the headend on a server. An RMD requires only about 5% more outside plant power than an RPD.

Most MSOs want to deploy DAA and virtualise the CCAP to gain maximum space, power and cost reductions while introducing minimal impact on the node. As a result, there have been a variety of announcements of DAA-labelled deployments, each only delivering part of the promise of DAA. Here are some examples:

Example 1 – Big Iron* plus R-PHY

In this deployment, an R-PHY node is hanging off a CCAP device or CCAP-core. Although, the DOCSIS PHY functions are moved to the node, the MSO still maintains a "Big Iron"* CCAP in the hub.

While this does improve signal quality, it does not have a big impact on space and power in the headend.

Example 2 – Virtual CCAP plus standard Fibre Node

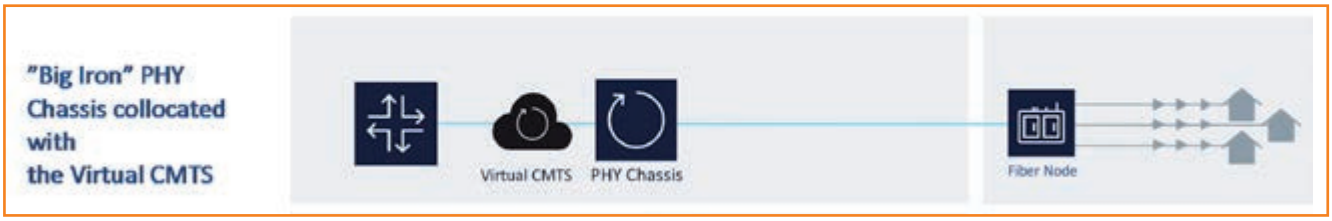
In this network design, the CCAP functions are split between a vCMTS and PHY. However, the PHY is part of the "Big Iron"* Chassis co-located with the vCMTS.

This solution offers the MSO experience with a vCMTS, and it is a stepping stone towards DAA, but it does not deliver any short-term benefits.

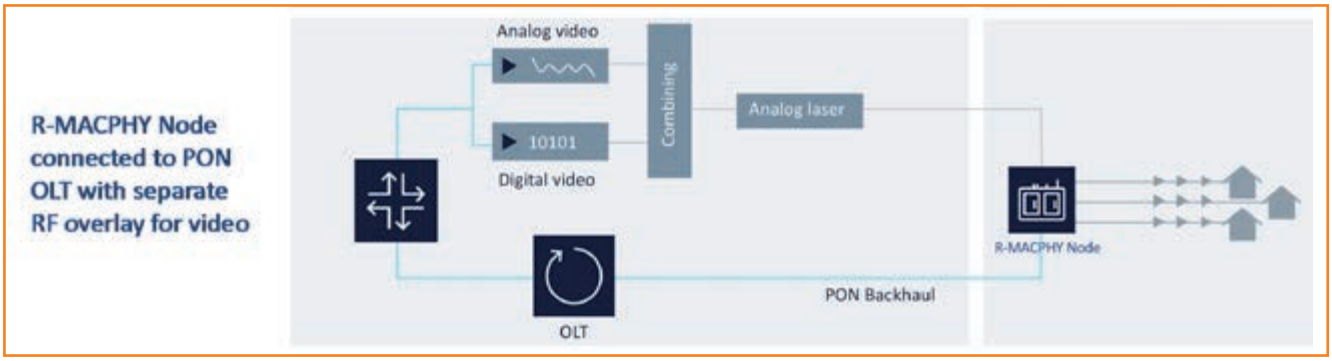
Example 3 – DAA with RF overlay for Video

This deployment has an R-MACPHY node, R-PHY node with vCMTS running in the node, with a PON backhaul for data traffic, but has an RF overlay for video.

Example 1 – Big Iron plus R-PHY



Example 2 – Virtual CCAP plus standard Fibre Node



Example 3 – DAA with RF overlay for Video

* Refers to large, energy-intensive integrated CCAPs, CMTSs and similar cable-specific headend equipment.

> **Off-the-shelf servers running the virtualised CMTS require far less space and power than cable-specific hardware.**

With two separate networks, this solution actually increases the OPEX, and possibly the CAPEX. It is a stepping stone to DAA but, financially, it is a step backwards.

Although these deployments all have some characteristics of a DAA, none of them deliver the full benefits of DAA. There are three simple questions to ask when deploying a DAA solution to ensure that it maximises the short and long-term benefits to your network:

1. Does it include DAA nodes, housing at least the DOCSIS PHY, in the outside plant?
2. Does it eliminate the "Big Iron"* CCAP/CCAP core by virtualising the CMTS?
3. Does all traffic between the hub and node, including video, travel via IP/Ethernet (i.e. no RF overlay network)?

If the answer to all three of these questions is 'yes', the solution is leveraging both distribution and virtualisation to maximise the benefits. This solution is often referred to as a Virtual Distributed Access Architecture (vDAA).

Essentials of a vDAA

Let's take a deeper dive into each of the three vDAA criteria.

1) Does it include DAA nodes, housing the DOCSIS PHY, in the OSP?

A DAA solution must have an R-PHY node in the OSP. Once the components of the CCAP are distributed, and the PHY and possibly the vCMTS (MAC layer) are placed in the node, MSOs enjoy these benefits:

1. **No more analogue optics:** Placing the PHY in the node digitises the headend/hub-to-node link, eliminating the costly analogue optics. This makes it a "fibre deep" solution, a clear stepping stone to an FTTH solution.
2. **Reduced hub footprint:** Moving the PHY layer to the node does away with RF combiners, bulky analogue equipment, in the hub. Not only does this free up real estate, it significantly lowers power consumption.
3. **Better signal quality:** Since the QAM (RF) signals are now generated in the node, much closer to the customer, the signal quality is significantly better. This leads to higher customer satisfaction and fewer truck rolls.

2) Does it eliminate "Big Iron" CCAP/CCAP core by virtualising the CMTS?*

In a vDAA environment, in addition to the PHY, the rest of the CCAP functions are virtualised and distributed. The controller is centralised in the headend or data centre and other CCAP core functions become the vCMTS. The vCMTS can run on the node, creating an R-MACPHY node, or anywhere else in the network – outside plant, hub, headend, data centre or cloud – based on the use case.

Benefits of eliminating the "Big Iron"* CCAP/CCAP core and virtualising the CMTS include:

1. **Centralised control of various CMTS functions:** Centralising the controller simplifies overall network operations and management.
2. **Even greater reduction of the hub:** Off-the-shelf servers running the virtualised CMTS require far less space and power than cable-specific hardware.
3. **Increased network agility and service velocity:** Virtualisation enables MSOs to make changes to the network and introduce new revenue-generating services faster and more easily.
4. **Greater network architectural flexibility:** Virtualisation of the CMTS allows the MSO to suit the network architecture to the use case, including the ability to configure nodes in software as R-PHY or R-MACPHY (R-PHY + vCMTS) and switch them on the fly.

3) Does all traffic between the hub and node, including video, travel via IP/Ethernet (i.e., no RF overlay network)?

A design that requires an overlay network defeats many of the key benefits of moving to DAA. A vDAA solution demands that all traffic travel across the Ethernet link between the headend/hub and the node. That is, there is no longer any RF traffic between the headend/hub and the node.

Benefits of this design include:

1. **It dispenses with analogue optics and enables longer reach:** Transmitting the video over the digitised Ethernet link on a single fibre clearly has almost no distance limitation, allowing for hub consolidation and maintaining the "keep it simple and flexible" mantra of DAA.

2. **It lowers cost:** Dispensing with a second separate network for video eliminates significant capital and operational costs.

Future cloud-native benefits

With vDAA as the baseline, MSOs have the foundation to take full advantage of the virtualisation benefits as they move forward. The software-based distributed nature of the vDAA components makes them a perfect candidate to be placed in containers and launched as cloud native solutions. In the cloud native environment, the SDN controller orchestrates and automates the configuration of vDAA components and seamlessly integrates with existing OSS, back office and management systems.

A cloud-based vDAA solution provides benefits, including:

1. **The cloud native vDAA solution fosters further virtualisation:** A cloud native vDAA solution provides a common platform to run these virtualised CMTS functions alongside other virtualised services in any data centre – centralised or hub-based.
2. **The cloud native vDAA solution accelerates and simplifies service deployment:** Zero-touch provisioning simplifies network configuration to quickly deploy new services and provide a faster return on investment (ROI).

Maximising the value of vDAA

A true virtualised DAA solution assures MSOs that they can get the most out of what they deploy today. A vDAA enables superior bandwidth capacity and signal quality without the cost, power, space and distance limitations of traditional cable network upgrades. A vDAA also lays the foundation for migration to a cloud-based/cloud-native implementation and easy evolution to next-generation technologies such as Full Duplex DOCSIS or FTTH.

As operators deploy a DAA implementation, it is essential that they remember not all DAAs are created equal. To maximise their benefits and have a clear path to the future, they should choose a complete vDAA solution.