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Practical applications and considerations when using existing in home coaxial cabling for a home network

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Introduction

Forthcoming European MSO services and next generation system architectures will rely heavily on the existence of a robust and high bandwidth home network. To date, many of these services have traditionally stopped at the eMTA, cable modem or set-top box (STB). The reality is that cable TV service is no longer just about delivering pictures – it's about delivering a whole home experience that meets the customers' expectations. A home is not an isolated network. It's now an in-home extension of the cable, satellite or telco "plant".

The forward thinking operator needs to be aware of and willing to adopt new technologies to deliver services such as multi-room DVR and VOD to every room the customer desires. Further out, as MSOs consider next generation system architectures such as all IP video delivery models, the in home network plant will be a key enabler; delivering television services from a cable gateway to thin client IP set-top boxes.

This article focuses on practical applications and considerations for using existing in home coaxial cabling as the home network. A brief overview of the MoCA® (Multimedia over Coax Alliance) technology along with a discussion of requirements when installing MoCA based products and network filters is provided. Additionally, this article provides an illustration of the types of home networks European MSOs can offer along with considerations for overcoming potential issues of multiple STBs accessing VOD services by applying MoCA technology.

Coaxial Cabling as the In Home Network Plant

The need for a home network to support real-time streaming of multimedia content imposes stringent requirements on the underlying network technology. Most home networks, created primarily for sharing Internet access among computers, view data within the home, whether web pages from the Internet or the occasional FTP file transfer, as merely packets to be delivered on a best effort basis. Little consideration is paid to the overall quality-of-service. As long as data packets are eventually received at the intended destination, the target application and user experience has been generally acceptable.

On the other hand, streaming video applications require real-time delivery. Now, the home network must be capable of supporting very low latencies with extremely low packet error rates at very high throughput. To be acceptable to MSOs for both performance and profitability, delivery of HD should be guaranteed in all subscribers' homes and at any outlet in the home. In the United States and increasingly in Europe, existing coax outlets are the defacto delivery outlet of choice. Why? In many home situations, coax has already been installed and is easy to extend within a home environment either by professional or home owner.

While coax cabling within the home provides plenty of bandwidth for a home network, any home entertainment and home networking technology using coax must be accepted by operators; it must also extend, coexist and support existing MSO services. To resolve the challenges of MSO services support, low latency, low packet error and high throughput, MoCA, since 2004, has been dedicated to developing a home networking technology specifically designed to address the distribution of multimedia content around the home using existing coax cabling.

MoCA – An In Home Entertainment Networking Technology

To achieve these requirements of support, low latency and low packet error rates the MoCA specification defines a layer-2 network PHY and MAC protocol that can establish a full-mesh communications network using existing coax cables found in typical residential dwellings. Subscribers are attracted to features like fast broadband connections, an extensive selection of HD channels, a library of up to date video-on-demand movies, and set-top boxes with DVR capability. An additional trend is that more HD televisions will be making their way into bedrooms, offices and children's rooms as newer models are purchased and older sets make their way into secondary viewing locations. This means that operators will not only need deliver these features to the home but also deeper into the home. Thus, the coax within the subscriber's home is becoming a critical element of being able to deliver these services with operator class robustness.

Reliable and ubiquitous coverage is partly achieved by having a large dynamic range. The goal being that if a TV can receive a signal at a particular outlet then MoCA must also be able to connect at that outlet. By having a deep knowledge of the path loss characteristics in the home coax environment, MoCA specifies a dynamic range capable of traversing multiple splitters and jumping between splitter outputs. Hence, any coax outlet in the home is able to communicate with any other coax outlet, providing the means for full connectivity between MoCA enabled products distributed throughout the home.

The MoCA PHY uses adaptive orthogonal frequency division multiplexing (OFDM) modulation with reed-solomon forward error correction to achieve 175 Mbps of application layer throughput and high reliability with over 95% outlet coverage. 175 Mbps of application throughput is more than enough to support multiple simultaneous high-definition video-on-demand programs and other services like multi-room DVR STB streaming and Internet data access for STBs, DVRs, and personal computers. To ensure that communication between each MoCA node in the full-mesh network is always optimized for best possible throughput, the PHY periodically adapts each subcarrier to the highest modulation profile possible to match the conditions of the coax channel on an outlet-to-outlet basis.

Low packet error rates (PER) and low latency are achieved through a fully-coordinated, collision-free MAC. When sending video packets over a home network, the technology must provide low packet error rates at the PHY layer since retransmission of packets above the MAC layer is not supported. Since the MAC is fully coordinated with no retransmissions necessary to achieve low PER, latency remains low and is more deterministic than technologies that use collision-sense multiple access protocols. These key attributes help ensure that video glitches due to dropped packets or starved data buffers are kept acceptably low to provide a high quality consumer experience.

MoCA provides spectrum flexibility and service provider support with channels available from 875 MHz to 1500 MHz. New specifications under current development at MoCA will significantly raise this spectrum and channel support. This allows MoCA to coexist with traditional broadcast TV services and EuroDOCSIS data services. Frequency agility built into the standard also provides a flexible way to allocate spectrum on the subscriber's coax wiring so that it is future proof against any potential bandwidth expansion required for the home network. Figure 2 details how a MoCA product, such as router, bridge or adapter, operating above typical MSO services in the D-band can coexist with EuroDOCSIS data service and broadcast TV service.

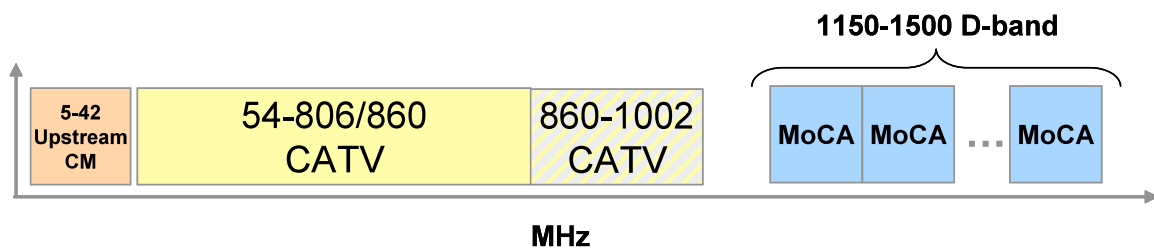


Figure 2 - MSO Frequency Coexistence With MoCA

Installing MoCA in the home

Competition among service operator's for new subscribers as well as preserving existing customers' remains as fierce as ever. Figure 3 illustrates all the numerous opportunities there are for connecting MSO products and services using a MoCA home network.

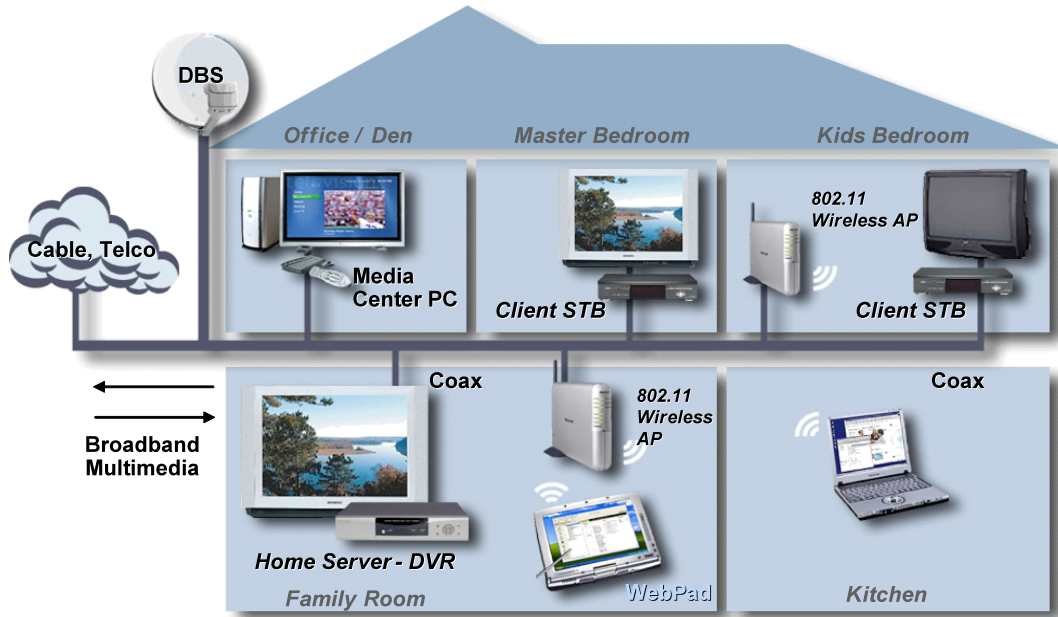


Figure 3 - The MoCA Networked Home

Multi-room DVR Capability

Using MoCA an installer can provide technology for a robust and high throughput network whilst minimizing capital and operating expenses by transforming the subscribers existing coax wiring into a peer-to-peer network. With plenty of the throughput capacity to reliably stream high-definition content between rooms, operators can offer services including multi-room DVR. A DVR STB with a MoCA network connection allows any show recorded on the DVR to be viewed from any other television in the home simultaneous and without interrupting any live content viewing. The subscriber no longer has to watch their recorded program on the same TV that is attached to the DVR STB. For example, the children can watch their recorded shows in the bedroom while dad can continue to watch his sports program on that same DVR STB, thereby eliminating family arguments about who gets to watch what on the best TV in the home. Figure 4 shows the concept of how a remote DVR can stream two recorded programs to STBs in other rooms.

MoCA technology employs the same RF connector already used on existing cable equipment; it simply uses a different frequency band. Thus, setting up a MoCA enabled STB is the same to subscribers as setting up one without MoCA. The only thing a subscriber may want to do is set a MoCA password but even in this case the operator can provision equipment beforehand so subscribers don't even have to worry about this. MoCA also provides for autonomous channel scanning so devices will automatically find each other and form a network. Or if the operator prefers, a default channel frequency can be provisioned on equipment so that all devices power up using the same frequency.

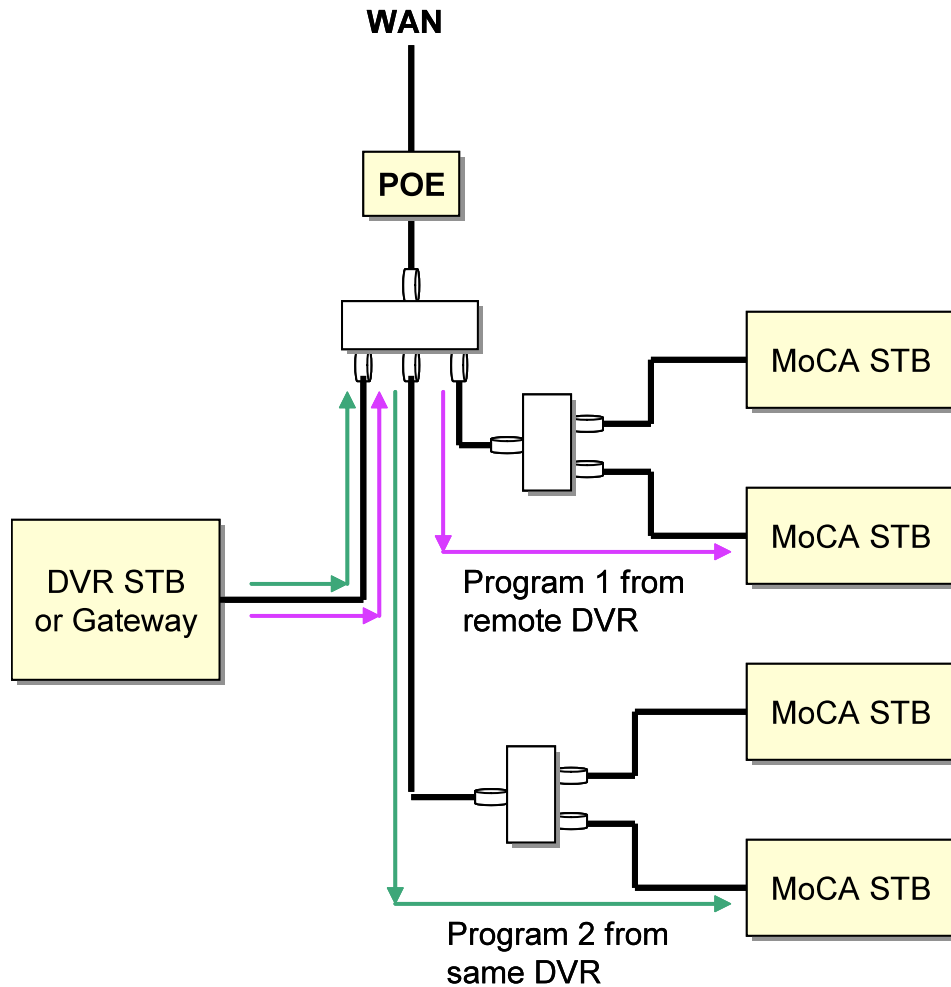


Figure 4 - Multi-room DVR Over MoCA

An added benefit to installing a MoCA home network is that it offers a way to scale these advanced services to additional rooms while minimizing ingress noise back into the plant. A single set-top box or cable modem can terminate the WAN access into the home and then MoCA can be used to distribute services around the home. By isolating set-top boxes on a MoCA network and filtering below the MoCA frequency of operation any noise introduced on the DOCSIS return channels can be eliminated, allowing operators to support homes with multiple STBs. The terminating device could be a cable modem, STB or a gateway which bridges operator services like VOD to the various STBs in the home.

Using the MoCA home network also facilitates the migration toward next generation network architectures like IP video. Once the cable network has transitioned to an all IP delivery model, STBs can become very simple and inexpensive, eliminating the need for tuners and conditional access modules in every device. All that is needed is a MoCA network interface, DRM decryption and an A/V decoder. In this scenario a gateway device terminates the WAN link and can store the video at the gateway for DVR functionality or forward the IP multicast over MoCA to the STB that requested the channel. The multi-room DVR functionality is the same as illustrated previously, but now the client STBs can be lower cost since they receive all their content over the home network.

Ease of Installation

While North American operators typically have equipment installed by service technicians, MoCA presents nothing new to a consumer who is familiar with setting up a typical STB and can be easily self-installed by European subscribers.

For any MSO installation it is recommended to install a MoCA point-of-entry filter. This is simply a low-pass filter that blocks MoCA frequencies from getting into the WAN. Readily available today as an in-line bullet type of filter, a subscriber simply needs to install this at the home's point-of-entry or anywhere prior to the home's first cable splitter. This also has the added benefit of introducing a reflected version of the MoCA signal which can help increase outlet coverage throughout the home.

Summary

The good news is that cable operators can now offer advanced services to their subscribers, scale their services within the home and facilitate migration toward next generation architectures by using MoCA for their home networks. Already field proven in North America, MoCA opens up pathways to previously isolated pockets of multimedia content providing the ability to stream multiple high-definition video and audio content to any room with a coax outlet

Though seemingly complex in theory of operation, MoCA is a technology simple enough for self-installation by cable subscribers. A MoCA home entertainment network is the natural choice for subscribers and MSOs who need saleable new features now and in the future.

About the Author:

Jon Iwanaga, Product Marketing Manager, Entropic Communications

Jon Iwanaga has over 15 years of experience in the development of semiconductors for graphics, video and communications systems. Early on at Brooktree Corp., Jon worked on graphics chips that first brought color to personal computers and workstations. At Conexant Systems, he worked on cable modem ICs along with video and tuner chips that enabled the capture of video signals on personal computers. Currently, as product marketing manager at Entropic Communications, he manages the company's c.LINK products for home networking. Jon Iwanaga holds a B.S. Degree in Electrical Engineering from UC San Diego and Masters Degree in Business Administration from UC Irvine.

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