

RF RETURN SUPPORT IN ENABLENCE FTTH PRODUCTS

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INTRODUCTION

Enablence has more experience with video than does any other fiber-to-the-home (FTTH) equipment vendor. We are familiar with both broadcast and IP video transmission, and can recommend the best mix of services for any application. Broadcast video remains important to many operators, both those having existing HFC plant and those not having such plant. We have always made sure that our systems are very compatible with HFC plant, including being the first FTTH supplier to offer RF return for set tops, in 2002. This document shows how RF return is used in our system to support all standard RF return systems, SCTE 55-1 (Motorola), SCTE 55-2 (Cisco) and DOCSIS (for DOCSIS set top gateway, DSG).¹

RF return is important when using broadcast video distribution, because it enables the plethora of competitive services available on cable TV set top boxes (STBs) today. These services include pay-per-view, video-on-demand, electronic program guides, interactive game playing, electronic commerce, and other applications. Virtually all RF set top boxes (STBs) today have a two-way communications path with the headend for STB control. The downstream signal is modulated on a carrier in the normal broadcast passband (54 – 1,002 MHz) and travels with all other RF signals on the 1550 nm optical carrier. In HFC plant, the return path to the headend is implemented using a lower-frequency (5-42 MHz) upstream RF path. FTTH systems don't have an inherent upstream path for the RF signal. This note shows how such signals are accommodated in Enablence FTTH systems.

FTTH SYSTEM DESCRIPTION

Those who already understand how FTTH systems work may skip to the next section. This section is a brief introduction to the technology.

Figure 1 illustrates a basic FTTH system. It applies to any PON (*passive optical network*) standard. Enablence supports all relevant ITU and IEEE standards (GPON and EPON, plus Active Ethernet point-to-point). You can deploy in a mix-and-match arrangement in which you may intermix the standards if desired, or you may go with all one standard. We also offer the ability to mix-and-match low cost and high performance optics to optimize deployment and cost efficiency of the network.

The *headend* (*central office* for those with a telephone background) is shown on the left of Figure 1. Video is transmitted via a 1550 nm optical transmitter just as you might use for HFC transmission. The composite RF signals are modulated onto the optical carrier using an RF optical transmitter familiar to cable operators. Optical amplifiers (not shown) will also be used. This optical equipment is sometimes called a V-OLT (video OLT) by telephone-oriented users. Data is processed in a device called an OLT, *Optical Line Terminal*. It is functionally equivalent to the CMTS in an HFC plant, in that it takes all data (including voice) from the headend switch, and formats it to go on the fiber. The subscriber-facing ports on the CMTS are connected to PONs, or *passive optical networks*, each of which serves up to 64 subscribers, with 32 subscribers being the most common implementation. Broadcast video is multiplexed with the data in a *wave division multiplexer*, WDM, which combines the downstream broadcast video at 1550 nm, with the downstream data at 1490 nm and upstream data at 1310 nm. Note that in FTTH, data is transmitted as on/off keying of the

¹ Patents issued and pending

optical carrier, independent of the video. Different wavelengths are used for video and data. You transmit data without using any video bandwidth – you get the entire 54-1,002 MHz video band for video.

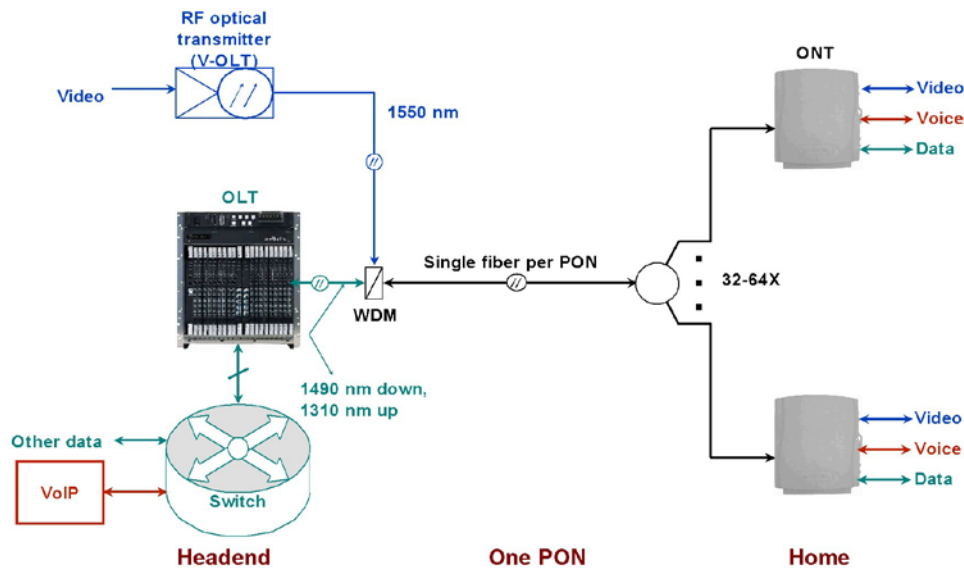


Figure 1. Basic FTTH System

At the home, a box called an ONT, *Optical Network Terminal*, is used to convert the 550 nm optical signal to RF broadcast, exactly as that delivered by an HFC network. In addition, the ONT derives analog voice (POTS) and data (10/100/1000Base-T) using information from the 1490 nm downstream optical data carrier. Upstream data is carried on a 1310 nm optical carrier. Normally the ONT is mounted on the side of the house and is powered from the house using a battery-backed power supply (battery backup might be omitted if voice service is not furnished). This way, your equipment is on the outside of the home, easy to access at all times. Enablence also provides lower-cost indoor full featured ONTs, and data-only ONTs for customers who don't need video or integral voice services. We also supply ONTs designed for multi-dwelling units.

ADVANTAGES OF FTTH

Compared with HFC, Enableness' FTTH systems offer a number of advantages, both in service offerings and in operational savings. Among the advantages:

- The all-passive network saves power, improves reliability, and removes the need for field taps into the power grid.
- The all-dielectric network eliminates sheath current, corrosion, and strain-related issues.
- No plant ingress.
- No home ingress.
- Enableness's technique for offering RF return precludes noise funneling.
- No composite leakage index (CLI) measurement and reporting requirements because the maximum signal level in the plant is well below the level that invokes the CLI Rules.²
- No amplifiers to balance!
- More video bandwidth: the entire band to 1 GHz is available for video – no spectrum needed for data or voice.
- Very high carrier-to-noise ratio and low distortion, independent of distance.
- More data bandwidth – 30 Mb/s or more *average* data bandwidth to home, vs. a few kb/s average in DOCSIS systems. Data peaks of 100 Mb/s are easy!
- Symmetrical bandwidth allows tiers for peer-to-peer traffic, fast game playing, and home-based web servers.
- Integral service disconnect, all services independently of each other.
- Built-in MTA function – connect home telephones directly. Compatible with SCTE-defined protocols.
- Integral network monitoring of all active elements.
- Advanced element management with northbound interfaces into OSS and billing.
- Very versatile bandwidth management, down to a customer and a service.
- Ability to add IPTV at any time it makes sense.

HOW RF RETURN IS IMPLEMENTED

Enableness has long offered integral RF return to support standard cable TV set top converters. It has been part of our product offering since 2002. This section shows how it is done.

Figure 2 is a high-level illustration of RF return in an Enableness FTTH plant. On the left is the headend, where for illustrative purposes we have broken out the device(s) needing RF return separately. These devices are any of the set top control systems for either SCTE 55-1 or SCTE 55-2 set top systems, or DOCSIS (to support DSG – DOCSIS Set Top Gateway). We shall refer to these generically as the SCTE 55 control system. Physically, the diagram looks the same for any of the systems, though there are differences in transport implementation, as shown below.

² Please consult your communications attorney for verification

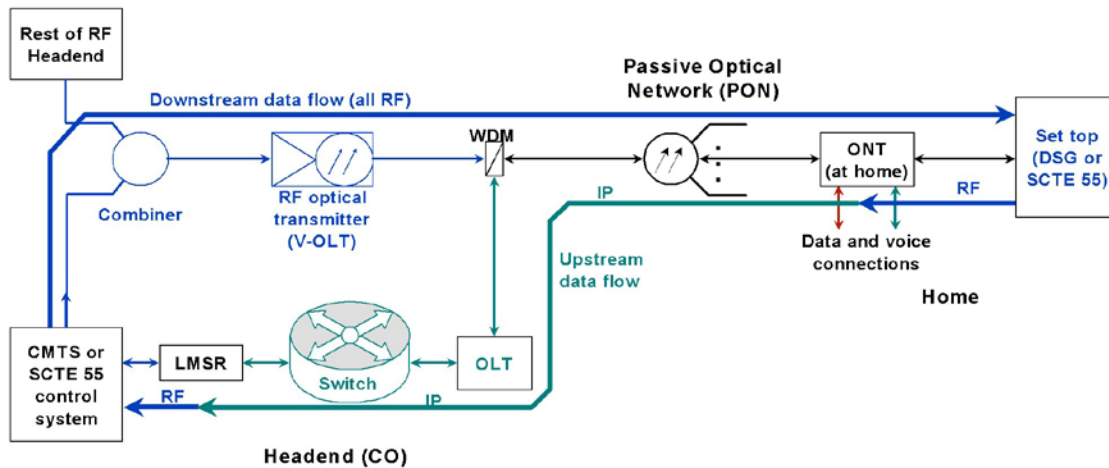


Figure 2. RF Return in an FTTH Plant

Downstream data from the SCTE 55 control system is combined with all other downstream outputs from the headend in the usual manner. These combined signals are supplied to a 1550 nm broadcast optical transmitter as usual. Sometimes this transmitter is called a V-OLT (*video optical line termination*). The output of the 1550 nm transmitter is wave division multiplexed (WDM'ed) with data from the OLT, and the complete signal is routed to ONTs at homes.

At the ONT, the downstream RF-modulated control signals come out of the ONT on the F connector, along with all other RF signals. This output looks just like the output of an HFC plant, except with better specifications. Upstream RF return signals from the set top go to the F connector on the ONT just as they would go to a tap in an HFC system. In the ONT the RF return signal is digitized, some fast data reduction is performed, and the result is put in a packet having the IP address of a special box in the headend (the LMSR), which serves all RF return devices. The upstream RF return is carried with all other data packets in the upstream direction of the FTTH network (on the 1310 nm optical carrier).

The upstream data interface at the headend is the OLT which, in turn, is connected to the headend data switch. Like the CMTS in a DOCSIS system, the OLT handles the specific FTTH protocol conversion, as well as the optical/electrical conversion. The Enablence OLT also features internal switching, saving ports on the headend data switch. One of many devices connected to the headend data switch is a 1 RU device manufactured by Enablence, called the LMSR, or *Last Mile Subscriber Return*. RF return data packets are addressed to the LMSR, which converts the packets back to their original RF form. The RF return signal is then supplied to the SCTE 55 control system for normal processing. The gain of the return network is carefully controlled to allow the normal level control loop in the SCTE 55 system to work. Gain distribution is such that the level required from devices in the home is near the high end of their capabilities. This is done intentionally in order to minimize the effect of any noise that is generated in the home. Because we digitize right at the home, and the gain is preserved from there to the output of the LMSR, we can control the demanded output level carefully. Thus, we can ensure operation near the top end of the output range, minimizing the effect of noise generated in the home.

Furthermore, because we digitize the RF at the home and send the resulting packet to the headend, we ensure that there is no noise funneling at all. Even if a home has such high

level of noise as to trigger the RF return system (highly unlikely), the resulting packet will be isolated in time from all other RF return packets, eliminating any possibility of noise funneling.

THE ONT

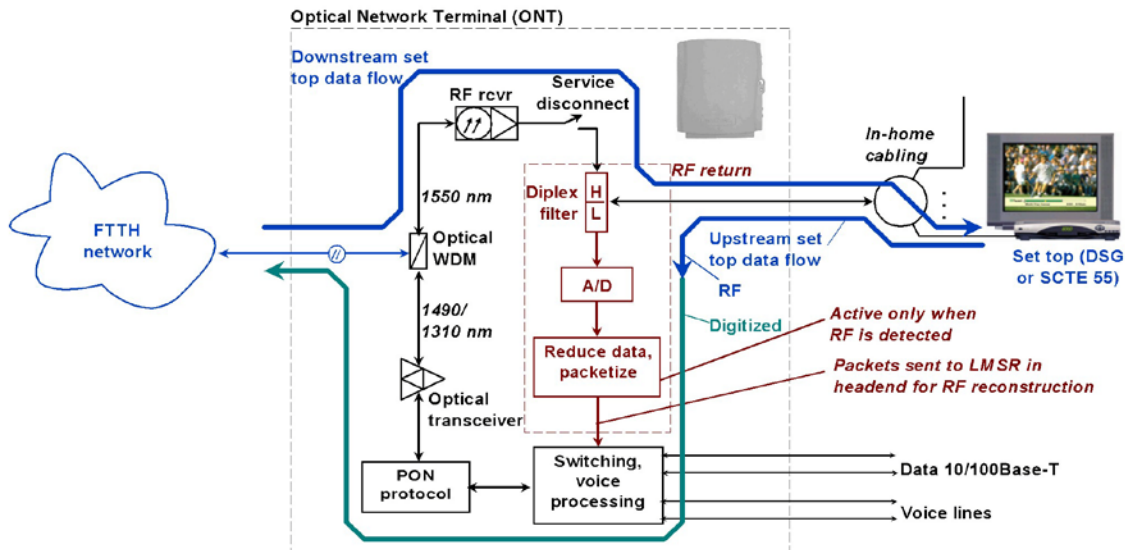


Figure 3. RF Control Signal Flow in ONT

Figure 3 illustrates RF control signal flow, both downstream and upstream, through the ONT. The downstream control signal is part of the downstream broadcast information coming in on the 1550 nm wavelength. The broadcast signals are converted back to RF in the RF receiver at the top of the figure, and are supplied from there to the set top, through a diplex filter, an RF filter that separates two frequency bands.

Upstream RF signals appear on the low frequency output of the diplex filter, where they are digitized in an analog-to-digital converter. The size of the data is reduced using certain data reduction algorithms, and the data is put in a packet for transmission to the headend LMSR. That data packet is internally switched into the upstream data and returned, ultimately, to the LMSR in the headend, where it is converted back to its original RF form and supplied to the SCTE 55 receiver of Figure 2. The packet containing the RF return data is relatively small, and such packets occur only infrequently – when no RF return data is being transmitted from the set top, no bandwidth is used. Thus, the bandwidth burden on the upstream data flow is insignificant.

A HEADEND FOR HFC AND FTTH

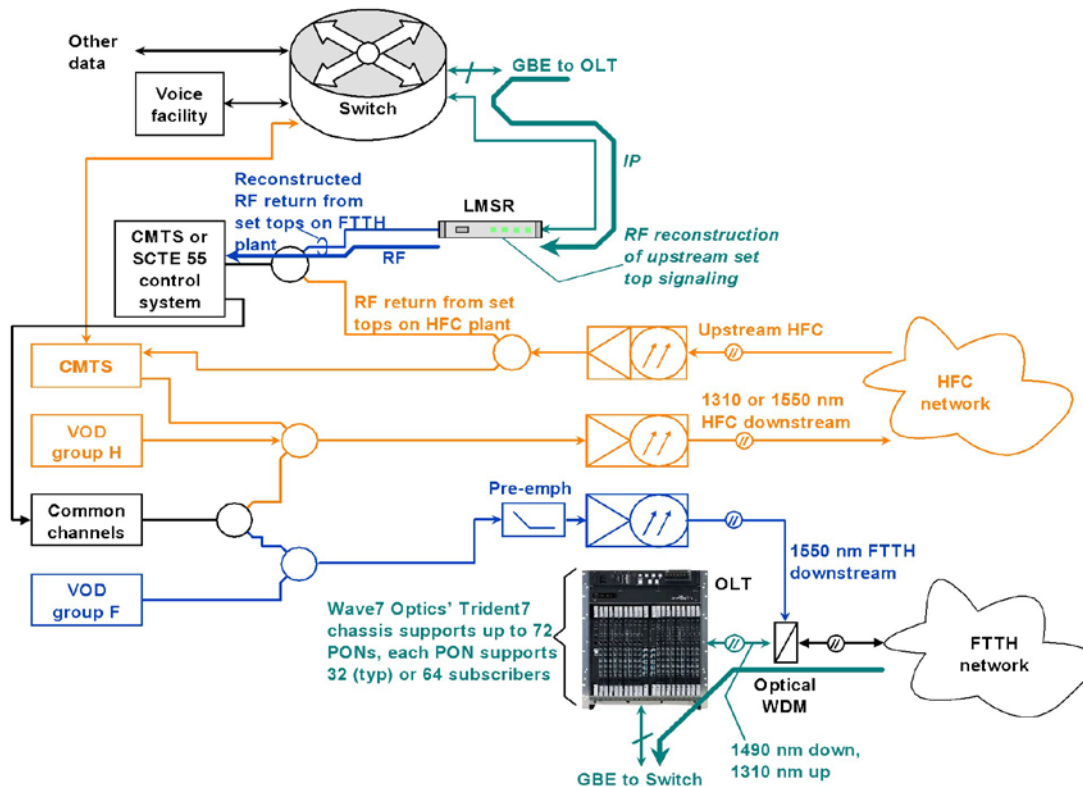


Figure 4. Headend Used for HFC and FTTH

Figure 4 illustrates a headend configured for both HFC and FTTH. It is feeding an HFC plant (toward the center right) and FTTH at the bottom right. For illustrative purposes, we have shown different VOD zones for HFC and FTTH, but of course this will vary depending on local needs. At the top is the headend data switching facility connected to the voice facility and other data services. It is connected to the CMTS for the purpose of data transmission on the cable plant, including voice. Following standard practice, the downstream signals to the HFC plant and the upstream signals from that plant are transported to and from the node on separate fibers.

RF FEED IN THE FTTH PLANT

The same common-channel video headend serves the HFC plant as serves the HFC plant.

For illustrative purposes, we show a separate VOD line-up serving the FTTH plant.

Depending on the system in use, for the FTTH plant it may be recommended to add a filter at the transmitter input, that will boost the lower frequency channel amplitude by 2-4 dB at channel 2, decreasing the boost at higher frequencies, to the point of little boost above about 200 MHz. The reason for this boost is that fiber optic cable exhibits a nonlinearity called *Stimulated Raman Scattering* (SRS) that causes the downstream data, carried at 1490 nm (in accord with all modern standards with data rates below 10 Gb/s), to crosstalk into the video channel, reducing carrier-to-noise ratio (C/N). The effect is frequency-dependent, affecting lower frequencies the most. By boosting the low-frequency channels, the C/N can be maintained equal to or better than that delivered by short HFC amplifier cascades.

The other necessary precaution to take against SRS-induced issues is to mitigate the effects of idle codes when no data is being transmitted. Patented idle code mitigation is built into all Enablence OLTs, and only needs to be turned on through the element management system or the command line interface.

DATA FEED IN THE FTTH PLANT

The CMTS does not act as the data interface for the FTTH network, because data is carried as on-off modulation of the optical data transceiver at different wavelengths than that used for video. Thus, data doesn't take spectrum away from video. The interface taking the place of the CMTS is the OLT. It includes front-end data concentration (switching) to reduce the number of ports required on the headend switch. It interfaces to the headend switch, usually using either optical or electrical Gb/s or 10 Gb/s Ethernet connections.

RF RETURN IN THE FTTH PLANT

In HFC plant, RF return is accomplished by providing an upstream path between 5 and about 42 MHz, using diplex filters at the input and output of each amplifier and at the coax side of a node. We normally use a second fiber to return RF signals to the headend from an upstream RF optical transmitter in the node. FTTH doesn't have an RF return path for signals needing it. (Some add a modulated laser at each home to accommodate RF return, but this is a less satisfactory solution from cost and maintenance standpoints.)

The RF return signals arrive at the OLT as data. From the OLT, all data, including RF return, voice, and Internet access, are routed through the switch, which decides where to send each packet. RF return packets are sent to the LMSR, where they are restored to their original RF format. The RF may then be combined with RF returns from the HFC plant and supplied to the SCTE 55 control system. The LMSR includes multiple converters to support larger systems.

The RF return system as shown can handle any of the standards in widespread use today, including SCTE 55-1, SCTE 55-2, and DSG (DOCSIS Set Top Gateway). Somewhat different provisions must be made for each, due to the properties of the different standards. Enablence can support any of these RF return needs, and has even handled some less-common RF return needs.

ADVANTAGES OF THE ENABLENCE RF RETURN SOLUTION

Because of the way Enablence' RF return works in FTTH plant, there is no noise funneling. Referring again to Figure 3, the only time there is a transmission from the RF return section is when an upstream transmission is detected. The threshold for detection is set as high as possible, consistent with the need to make sure all set tops can reach that threshold within their specified maximum output level, taking into account in-home splitting and cable loss. Because of the way the system operates, the packet can only be transmitted when nothing else in that PON is being transmitted, and though the RF reconstruction hardware in the headend (Figure 3) services many PONs, only one signal can be passed to it at a time. Thus, the system inherently offers protection against noise funneling. In the unlikely event that you have a home generating enough noise to make the RF return circuitry think a signal is present, then that noise cannot affect reception from any other home. Furthermore, the offending home is easy to locate: you simply sniff upstream packets and note the source address the noise packets are coming from. Also note that for SCTE 55-1 systems when using contention signaling, the system can actually improve efficiency by queuing multiple transmissions.

Compared with analog systems offered by some other vendors, the Enablence approach offers a number of advantages, including:

- No additional network infrastructure (except for a single 1 RU LMSR).
- The set top control system may be located anywhere in the plant without concern for getting return signals to it. No special infrastructure is needed to support RF return.
- No additional signal loss from WDM'ed components.
- No additional fiber.
- Completely integrated system. No additional boxes or cabling at the home.
- All elements are managed.
- Much lower cost adder.
- No noise funneling.
- Immunity to noise originating in a house.
- Plug-n-play performance.
- Greater level consistency, supporting greater immunity against noise.
- Thousands of homes combined in one RF return path.
- Standard PON wavelengths only.

ACCOMMODATING EACH SYSTEM

We need to accommodate three different systems with this configuration. Because of differences in the nature of the systems, there are differences in operation above the physical layer. In Enablence's system, the differences are accommodated by firmware downloads to the ONT and the LMSR.

SCTE 55-1. This is the RF control system used by Motorola and it's licensees. It uses a query-response protocol and also a contention protocol for use when a set top needs to get the headend's attention quickly. Because timing is not critical in this system, we don't have to do anything further to accommodate it. The output of the LMSR provides the input for the

RPD-2000 set top control receiver. We have a number of customers successfully running SCTE 55-1 control systems over FTTH.

SCTE 55-2. This RF control system is used by Cisco and its licensees. It has its history in DAVIC, and as such is a slotted system in which the upstream timeslots are timed to the downstream transmission. Because any packet-based system will of necessity jitter the time the packets arrive at the LMSR output (reconverted to RF), the DAVIC system as-is cannot work over FTTH or any other packet-based system. Cisco has developed a communications software package called *DAVIC Express*. It is intended to work with FTTH systems. A slight further modification at the DNCS permits operation with the Enablence RF return system. The LMSR supplies the input to the DNCS.

DOCSIS also has roots in the DAVIC system, and has the same timing needs as does SCTE 55-2. For DSG or any other DOCSIS-based embedded application, we cannot make software changes to the modems. Rather, we use a CMTS, software-modified to render it insensitive to timing variations. The LMSR supplies input directly to the modified CMTS. The DOCSIS RF return is designed only to support DSG and other relatively low-data-rate control services. It is not intended to support all DOCSIS services, since a much faster data pipe is available in FTTH.

MULTIPLE RETURN SYSTEMS

In order to support multiple return needs, the Enablence ONTs' RF return features two RF paths to two receivers. This allows you to utilize two RF return systems. For example, you can support SCTE 55-2 and DSG in situations where you have mixed set top boxes. Consult the factory with your exact needs.

THE SUPERIORITY OF THE ENABLENCE APPROACH

Because the Enablence system is integrated with the digital upstream channel, there is no extra laser, no extra packaging. System design is easier, first because you don't have to deal with another wavelength and its loss budget. The set top management system may be located wherever you wish, without regard for whether or not you can get the upstream RF/optical signal to that location – anywhere you can get IP connectivity you can locate the control system. The RF return packets in the Enablence system come back to the headend along with all other IP packets, so connecting into the set top control system is easy, no matter where it is located.

With analog return systems, you are limited in the number of return transmitters you can combine to one upstream receiver in the headend. This limitation arises from the combining loss you will suffer. With luck, you may be able to combine the outputs of a (very low) hundreds of ONTs before you have to provide another headend optical receiver – and you will need another WDM for each PON. These requirements can create additional cost and fiber management headaches in the headend. With the Wave7 system, you don't have any extra WDMs, and you can effectively combine the outputs of thousands of ONTs, to at least the same density as a cable operator would use – you are limited by the capacity of the set top upstream system, not by optical loss budgets. This saves a lot of cost and complexity in the headend.

You are completely future-proofed with the Enablence system. All functionality is contained in firmware (in a field programmable gate array – FPGA – to be precise). In the unlikely event a

new system appears on the market, Enablence will simply develop the supporting software and download it to your ONTs. Sending the entire 5-42 MHz RF return spectrum back to the headend is wasteful and expensive. Cable TV systems use most of that spectrum for DOCSIS data transmission. DOCSIS is very limited, compared with FTTH in the amount of data that can be returned, even using the most optimistic DOCSIS 3.0 profiles. So it is pointless to spend effort and money to return this spectrum when it does no good.

The box below summarizes some of the reasons that the Enablence integrated digital optical approach is superior to the analog separate wavelength approach used by other vendors. First and foremost, it is lower in cost. Other techniques require the use of a separate upstream laser located at every ONT. The laser cannot operate near the zero-dispersion wavelength of the fiber (about 1310 nm) because that wavelength is already in use for the digital upstream. So another wavelength must be found, usually between about 1590 and 1610 nm (1610 nm is becoming the standard, based on the RFoG FTTH standard used some in cable TV). Because this wavelength is so far from the zero dispersion wavelength of the fiber, a DFB laser is almost certainly required, even for short paths. The DFB laser itself is relatively expensive. Furthermore, in many cases, the upstream transmitter is an add-on physical package, not necessarily even manufactured by the FTTH vendor. This adds cost to the device, and also adds labor cost to installing the system at the home.

Why it is better

- Lower cost
- Easier system design
- No increased loss budget
- Combine thousands of homes in one return path for headend efficiency
- You are free to place the set top management system anywhere in your network you like, without having to worry about getting RF return signals to it.
- So long as you have IP connectivity, you are good to go
- Completely future-proof
- Download software for new systems if they are ever developed
- No wasted upstream spectrum
- Why pay dearly for what you'll never use?
- Supporting the entire upstream band costs dollars, cabling complexity,
 - o power, system design and maintenance complexity
- Digital precision, home to headend – no level maintenance worries

Finally, the Enablence technology is all-digital, and this offers several advantages over the analog return technology being used by others. The RF signal level of upstream set top transmitters in the home is moderately critical: demand too much level and the set top will not be able to deliver, and/or you may overload the upstream transmitter. Demand too low a signal level and you may suffer degraded performance due to noise and/or spurious signals generated in the home. All upstream RF transmitters in set tops are controlled through a long-loop AGC, whereby the signal level is measured in the headend, and a correction is sent to the transmitter at the home, telling it to increase or decrease its level until the level measured in the headend is correct. The signal level measured in the headend is not only a function of the signal level entering the ONT at the home, but is also a function of the optical level arriving at the headend optical receiver. This in turn is a function not only of the output from the ONT optical transmitter, but also of the loss in the network at the upstream wavelength. Because of the way optics work, the R F level change is twice the optical level change. This means that you will need to control the optical loss budget at the upstream wavelength fairly carefully in order to keep the RF transmitters at the home within their operating range. You can do it, but doing so does represents more work. On the other hand,

the Enablence approach, being all-digital, affords you very high precision in setting up your return system. You can keep the signal levels at the home high (to help overcome any in-home generated noise), while not fearing that the long-loop AGC will either drive the set tops out of their range of output levels, or into transmitter overload.

CONCLUSION

In summary, Enablence's' approach to RF return is based on our many years experience with cable TV systems and their needs. Our digital RF return technology has been in use since 2002, with more units in the field than all other vendors combined. Any new standards that may be developed in the future are likely to be IP-based, so we provide native support for them. If any future RF-based standards are developed we will support them with downloadable software.

Enablence supports all of the RF return standards, and does it in a most friendly, economical manner. We digitize the RF return at the home, and put the digitized data in a return packet to the headend. The bandwidth required is negligible, because we only require bandwidth (typically one packet) when a set top is actually sending an upstream transmission.

Glossary

1310 nm	1310 nanometers. The wavelength on which upstream data is carried in most PONs.
1490 nm	1490 nanometers. The wavelength on which downstream data is carried in most PONs.
1550 nm	1550 nanometers. The approximate wavelength on which downstream broadcast video is carried in PONs.
Broadcast	The process of transmitting television (or other material) to subscribers by modulating one or more programs on an RF carrier and sending them to all or to a group of subscribers. The term is also used in data communications to refer to a communication that is intended to be received simultaneously by all end points.
C/N	Carrier-to-noise ratio. A measure of the ratio of RF carrier for a signal, to the noise present in the channel. For analog video, C/N is the way to quantify the amount of “snow” in the picture.
Carrier	See <i>RF Carrier</i> .
Cat5	Category 5. The most common form of cable used today for carrying data over short distances (usually up to 330 feet or so), and also used for telephone wiring. It consists of four twisted pairs of conductors.
CMTS	Cable Modem Termination System. The headend termination for cable modems.
CO	Central Office. In telephone terminology, the central point that manages telephone calls and data transmissions to and from subscribers. It may in some cases be used to refer to the same facility for data. Compare with <i>Headend</i> .
Coax	Coaxial cable. This is a special form of cable used to carry RF and frequently video signals. It consists of a <i>center conductor</i> , surrounded by an insulating layer called a <i>dielectric</i> , which is in turn surrounded by a conductive layer called a <i>shield</i> . There is usually an outer insulating jacket around the shield.

DAVIC	Digital Audio Visual Council. A European Telecommunications Union standard that forms the basis of much of the data transmission techniques used in cable television.
DOCSIS	Data Over Cable Service Interface Specification. The cable modem standards. As of this writing, the defined standards are DOCSIS 1.0, 1.1, 2.0 and 3.0.
DSG	DOCSIS Set Top Gateway. A protocol to allow tunneling of SCTE 55-1 or SCTE 55-2 data over a DOCSIS channel, permitting a CMTS to be used for communications with set tops.
EPG	Electronic Program Guide. A program guide generated in a set top box (usually), commonly consisting of a grid program display. The subscriber sorts through the grid until he finds something he wants to watch or record. He presses a “select” button and is taken to the program (or the PVR is set up to record it).
EPON	Ethernet Passive Optical Network. Also know as GE-PON (Gigabit Ethernet Passive Optical Network), or 802.3ah, after the IEEE committee that developed the standard. A standard for transmitting video, voice, and data using an all-optical network and using standard Ethernet protocols.
FTTH	Fiber-to-the-Home. A vastly superior way of transmitting video, voice, and data using fiber optics all the way to the home.
GE-PON	Gigabit Ethernet Passive Optical Network. See EPON.
GPON	Gigabit Passive Optical Network. A standard for transmitting video, voice, and data using an all-optical network and using standards developed by the ITU. The GPON standard includes provisions for transmission of ATM, TDM, and Ethernet, though in the most common forms, ATM is not actually supported.
Headend	In cable TV terminology, the point where all signals, video, data, and voice, are organized and formatted for distribution to subscribers. Comparable to the Central Office (CO) in telephone terminology. When the CO terminology is used, <i>headend</i> may be used to refer to the facility for organizing and controlling video.

HFC	Hybrid fiber-coax. The most common physical architecture used by cable television systems. Fiber optic cable transports RF signals in both directions most of the way to a neighborhood, to a device called a node. The node converts RF signals in both directions to/from optical form, and the signals are transported the remainder of the distance on coax, using amplifiers as necessary to increase signal strength.
IPTV	Internet Protocol Television. The transmission of television programming as data in a data transmission network that utilizes the Internet Protocol.
LMSR	Last Mile Subscriber Return. A Enablence device used to convert the upstream signaling from set tops back to RF form in order to supply them to the headend RF return system.
Mb/s	Mega bits per second. This is a data rate of one million bits per second, a measure of the speed of any digital communications network.
Node	In cable TV, the physical device that translates signals between optical and RF form. The term also collectively refers to the subscribers served by a node.
Noise Funneling	A characteristic of HFC plant in the return, or upstream, direction. Noise originating at each home is added to noise added at all other homes, resulting in a degraded C/N at the headend. This can limit the performance of the upstream plant. Noise funneling doesn't happen with Enablence' RF return system.
OLT	Optical Line Termination. The central point of termination of an FTTH passive optical network. The term can refer to the chassis housing the PON interfaces, and it can refer to a single PON interface.
ONT	Optical Network Termination. In an FTTH PON, the terminating device at the home. Sometimes called an ONU, for Optical Termination Unit. The subtle difference is that ONT usually implies more intelligence than does ONU, but the division is not well defined. The terms are sometimes used interchangeably.
ONU	Optical Network Unit. See ONT.

PON	Passive Optical Network. A video, voice, and data distribution architecture in which multiple subscribers are served from one central transmitter and receiver, using optical splitting and combining of signals. Can also refer to the set of subscribers served by one central transmitter and receiver.
PPV	Pay-per-View. A programming service in which programs are scrambled and broadcast to all subscribers at the same time. Subscribers may purchase programs a la carte for a one-time fee. If they purchase the program, they are provided the key to descramble it. PPV is almost always offered as <i>impulse</i> PPV (IPPV, though that term is just about obsolete), implying that the subscriber may purchase it on impulse, by so commanding his set top box. The set top box remembers the purchase, and when requested, so informs a billing system at the headend. Compare with video-on-demand (VOD). Typically the programs are transmitted with start times every 10 to 30 minutes, so that the subscriber has a choice of when to start watching the program, but once he starts watching, he must watch it to its conclusion (he may be able to “pause” by a time increment that moves him to the next showing window). This used to be known as <i>near video-on-demand</i> (N-VOD), but this term is obsolete now.
RF Carrier	A signal that can be tuned by a radio or (in this case) TV, which carries one or more programs.
RF Return	The need and the technologies used to move data from (usually) set top boxes to the headend. This data includes but is not limited to, information regarding VOD or PPV programs watched, and requests for program guide data.
SCTE 55-1	An RF return standard based on query-response and non-slotted contention protocols.
SCTE 55-2	An RF return standard based on assigned upstream timeslots.

STB	Set Top Box. Any of a large class of devices for converting video from cable broadcast, satellite broadcast, IPTV, or whatever, to a form that can be used by a TV. Also called Set Top Converters, Set Top Terminals (STT), and several other terms.
Trident7	Enablence' OLT, featuring very high PON port density and layer 2/3 data concentration to save ports on the headend data switch.
V-OLT	Video Optical Line Termination. A name sometimes used for the fiber optic transmitter(s) and optical amplifiers located in the headend and used to transit the broadcast tier information over the FTTH network.

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