Segmentation of a CATV-HFC system.

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Why segment the network.

- Increase the forward bandwidth.
- Reduce home passed ratio.
- Assure video on demand delivery.
- Faster and secure INTERNET delivery.
- Reduce NOISE and Distortions on the forward path.
- Reduce Noise and Distortion on the return path.
- Prepare your HFC network for “IP” transport.
Let’s have a look at some of today’s available technologies to:

- Increase bandwidth.
- Deliver better signal quality.
- Reduce home’s passed ratio.
- Improve transmission specifications.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

- By replacing RF amplifiers with better diplex-filters.
- 5-30 MHz, filters no longer practical for today’s need.
- 5-40/- 5 - 65 MHz filters mostly commonly used today.
- 5-65 MHz, diplex-filter used in Europe and available in North America, with forward band starting at 88 MHz. These filters will get you to lose 30 MHz on the forward path, but increase your return path by 25 MHz.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

- By replacing existing RF amplifiers.
- **Push pull amplifiers:**
  
  \[ \text{Have a 44.5 dBmV maximum output level.} \]
- **Power doubling amplifiers:**
  
  \[ \text{Have a 46.5 dBmV maximum output level.} \]
- **GaAs (Gallium Arsenide) amplifiers**
  
  \[ \text{Have a 53.5 dBmV maximum output level.} \]

Above specifications are with 80 analog channels and 350 MHz of digital signal, where 256 QAM signal are 6 dB lower.

- Higher output level guarantee better quality signal before distortions appears.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By upgrading the forward 1310 nm optical transmitters.

Available frequencies today: 750, 870 and 1003 MHz.

Available power:
- 4 dB reach (10 km) between TX and RX.
- 5 dB reach (12.5 km) between TX and RX
- 6 dB reach (15 km) between TX and RX
- 8 dB reach (20 km) between TX and RX
- 10 dB reach (25 km) between TX and RX
- 12 dB reach (30 km) between TX and RX
- 14 dB reach (35 km) between TX and RX.

Above measured with 0.4 dB loss per km @ 1310 nm.


You should always try to hit the NODE with 0.0 to 2.0 dBm level, for better Carrier to Noise and Distortion specification.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By upgrading the forward optical transmitters from 1310 to 1550 nm.

**Available frequencies today:**
750, 870 and 1003 MHz.

*Transmitter output can be: 7.0 and 8 dBm
Should always look for equipment with 16 SBS control. (Stimulated Brillouin Scattering).

*Must be coupled with an EDFA.*
(Remembering the maximum power introduced in the fiber is : 16 dBm)
Where 0.0 dBm should be the input target for good distortion and C/N level at the NODE.

* With the proper use of an EDFA, the maximum length at 1550 nm should be around 130 km between the TX and RX

*Above measured with 0.25 dB loss per km.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By replacing the existing 1310 nm optical return transmitter.

**Available frequencies today:**
5 to 200 MHz. (The RF portion is limited by the diplex filters)

**Available technologies today:**
- Fabry Perot (FB)
- Distributed Feedback (DFB)

**Power available:**
- 0.4 mW (-0.4 dBm) (FB) distance 25 km.
- 1.0 mW (0.0 dBm) (DFB) distance 35 km.
- 2.0 mW (3.0 dBm) (DFB) distance 42.5 km.

Above measured @ 0.4 dB loss per km with -14.0 dBm input at RX.

*Return optical receiver are capable of an input between +0.0 to -14.0 dBm.*
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By installing TDM return 1550 nm Optical return transmitter.

**Time Domain Multiplexing.**

**Available frequencies today:**
5 to 200 MHz. (The RF portion is limited by the diplex filters)

*TDM Available technologies today:*

Three (3) RF return channels, Multiplexed @ 3.1 Gbps.
Four (4) RF return channels, Multiplexed @ 4.2 Gbps.
Output level between 0.0 to 8.0 dBm
ITU wavelength available with the use of DWDM.

*TDM optical receivers are capable of:*
Between 0.0 to –18 dBm input, giving a 26.0 dB link at a single 1550 nm ITU grid, without the use of an ESFA.

*Possibility of using EDFA*
Must MUX and DEMUX.
Must be careful to keep the level at +/- 2.0 dB between ITU wavelength.
Remembering, the EDFA output will change with the adding or removal of ITU wavelength.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

IMPORTANT NOTE ON 1550 NM EDFA AND MULTI WAVELENGTHS.

*A 16.0 dBm EDFA with one wavelength will have its output reduced to:
13.0 dBm with two (2) ITU wavelengths.
10.0 dBm with four (4) ITU wavelengths.
7.0 dBm with eight (8) ITU wavelengths.
4.0 dBm with sixteen (16) ITU wavelengths.

*EDFA are available with: 13, 16, 18, 19, 21 and 22 dBm output.

*With the use of multi ITU wavelengths, it might be time to have a look at using EDFA’s with an AGC control, this should help give a constant output level.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By using better QAM technologies.

*On the forward path:
Move from 64 to 256 QAM transmission schemes.
Have a look at 1,024 QAM, soon to be available.

*On the return path:
With DOCSIS 1.0 use the maximum bandwidth of 3.2 MHz and go from QPSK to 16 QAM.
With DOCSIS 2.0 use the full 6.4 MHz bandwidth.
With DOCSIS 2.0 use 128 QAM at a 30 Mbps throughput.

*Remember high QAM levels will require a cleaner signal.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

Today’s CATV-HFC system.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By adding additional NODES in the original pocket, this will reduce INGRESS-NOISE in the return path and improve communication and quality signal.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By replacing NODE with four RF output
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By replacing NODE four RX and TX optical and four RF output
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By installing a NODE with a digital return TX operating at 4.1 Gbps to combine four (4) RF input.

A digital TX operating at 3.1 Gbps is also available (3) inputs.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

By installing 1550 nm equipment, EDFA’s and optical couplers.

This should gave you an idea of all the RF output of all the NODE.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

Reducing NOISE and INGRESS on the return path by using TDM technology. One (1) fiber with five (5) NODES Forward and Return.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

A bi-directional 1550 nm system, using EDFA and optical couplers in both direction.

In this example, we have upgraded a 72 km HFC system, using 1550 nm equipments in both fibres which include 5 bi-directional NODES.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

One more consideration to guarantee a clean return system, is by the installation of an INGRESS control system.

Since INGRESS are sometimes very hard to find, an INGRESS CONTROL system is the best option to help you locate the problem area and assure a clean return system.

INGRESS control system can reduce or remove unwanted return signals, leaving the rest of the system fully operational.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

One more way to insure a good quality signal on the return path, is to equip your CATV-HFC system with a “Return status monitoring system’.

The system should be able to provide a local or “IP” communications system and should be able to call technicians and managers when INGRESS appears.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

**Competition to CATV-HFC system.**

- **EXPRESS VU and STAR CHOICE.**
  Digital television signal from satellite direct to the home.
  So far these systems are unidirectional, with no Internet service.

- **TETEPHONE COMPANY.**
  DSALM technology thru twisted pair, capable of Internet service at 6 Mbps in both directions.
  Starting to install fiber to the home (FTTH).
  In small area as a test.

- **LOOK TV.**
  Digital Television in one direction.
  Trying to deliver bi-directional Internet service.
Let’s have a look at some of today’s available technologies for increasing bandwidth:

**Conclusion.**

- With a well reengineering system.
- A good maintenance and monitoring practices.
- A good INGRESS free return system.
- You should be able to guarantee a full operating system at all times.
Segmentation of a CATV-HFC system.

Thank you for your attention.

If you require more information on this subject.

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