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Technetix Group

Installing the Connected Home

…and the Future of HFC Broadband Networks

SCTE Taster Training Days

Christopher Bailey FSCTE

Agenda

- Introduction
- Potential Pitfalls Installing the Subscriber Network Connection
- Learning About Noise Ingress
- Explaining the Subscriber RF Passive Technologies
- We Need Good RF Screening
- Why Class A++ Screening
- Taking Care With High Density Cable Management
- Essential Quality Control
- Capacity demand in the Access network
- Access network upgrade considerations
- Typical star HFC network – upgrade path
- Typical tree & branch HFC network – upgrade path
- The next generation Access platform
- Network upgrade conclusions

Network Investment

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Virgin Media has invested millions of pounds…

…building triple/quad play networks.

- **Digital head-ends**
- **CMTS**
- **VOD servers**
- **Redundant optical back bones and nodes**

To obtain…

- **Reliable and high quality networks**
- **Optimum bandwidth use**
- **High QoS**
- **Low maintenance cost/truck rolls**
- **High Customer satisfaction**

Compromising the Subscriber Connection?

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At the subscriber premises, compromises are sometimes made…

- **Splitters and Taps**
- **Connectors**
- **SCART Leads**
- **Wall Outlets and Isolators**
- **Fly Leads**

These passive components form the "GATEWAY" to the broadband network

Gateway Vulnerability

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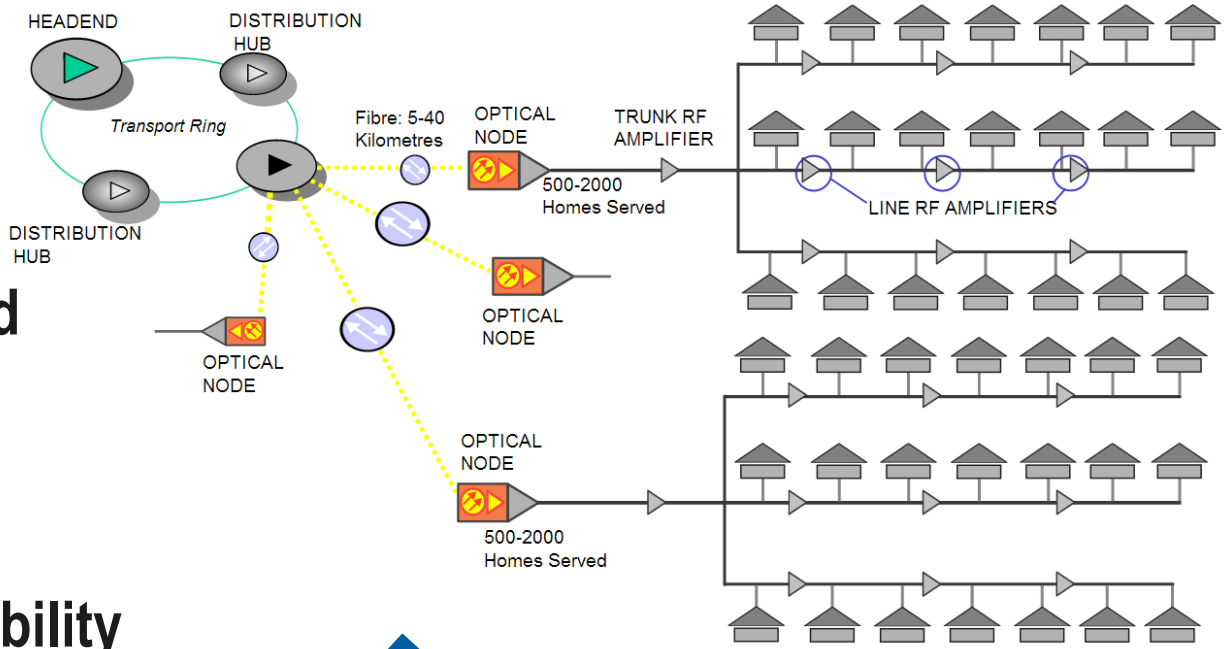
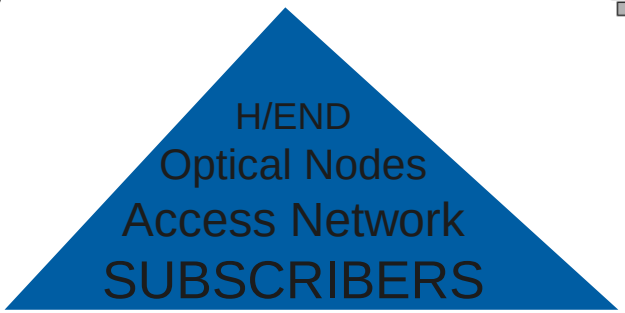
The Subscriber Connection is the "GATEWAY" to the Broadband Network

- Not Redundant
- Large Quantities
- Geographical Spread
- Harsh Environment
- Failure Can Be Fatal
- Higher Failure Possibility
- Expensive Truck Rolls
- Higher Demands





HFC Network is Like a Pyramid

Investment vs. Maintenance (80-20 Rule)

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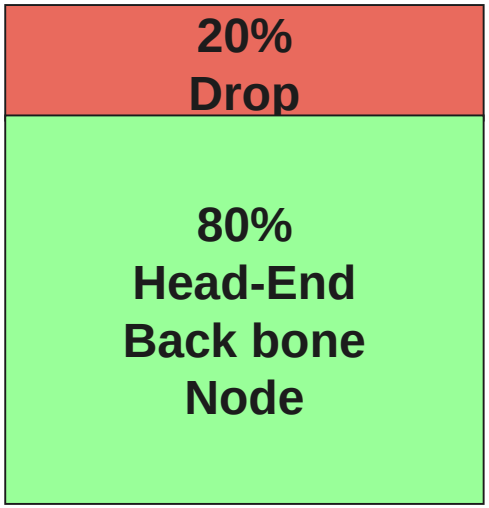
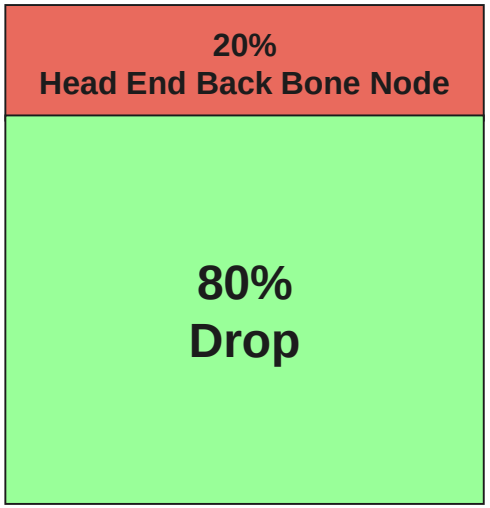
Investments

“CAPEX”



Maintenance Costs

“OPEX”



The Pareto principle (also known as the 80–20 rule) states that, for many events, roughly 80% of the effects come from 20% of the causes.

Potential Problem Areas

Problems that may Adversely Effect Performance of the Broadband Network

- Bad Contacts
- Bad Connections
- Damaged Cables
- Intermodulation
- Ingress
- Common Path Distortion CPD
- Screening

Bad Contacts in the “Drop”

“F” Connectors are a Crucial Element in the Subscriber Connection (Drop)

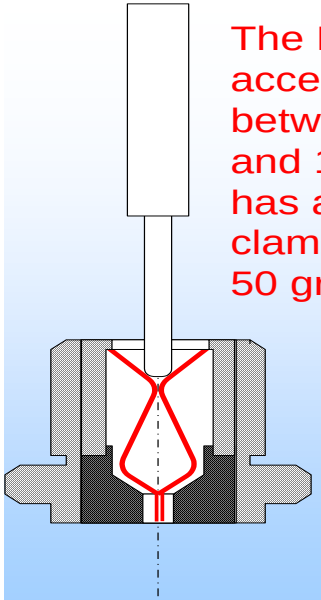
- **Inner Spring Contact of a “F” Female Connector**
  - **Accommodates 0,51 mm to 1,2 mm Inner Conductor**

- **Low Inner spring Resilience causes:**
  - **Intermitting Disturbances**
  - **CPD**

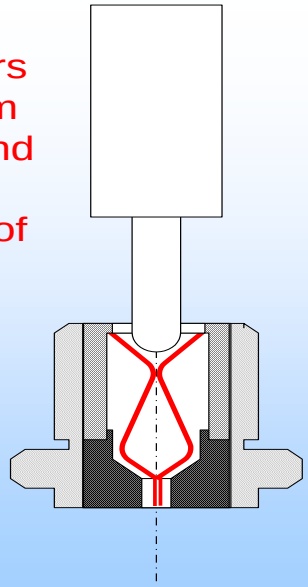
- **Inner Spring Material**
  - **Beryllium Copper / Silver Plating**
  - **Phosphor Bronze**

Inner Spring Testing at Technetix

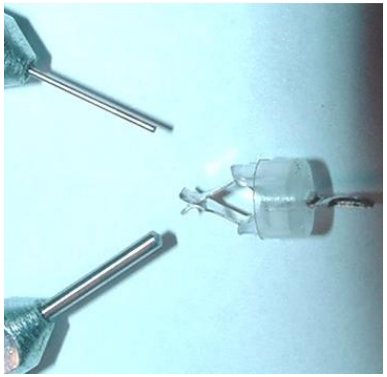
The BL+ series accept diameters between 0,5 mm and 1,63 mm and has a minimum clamping force of 50 gramms



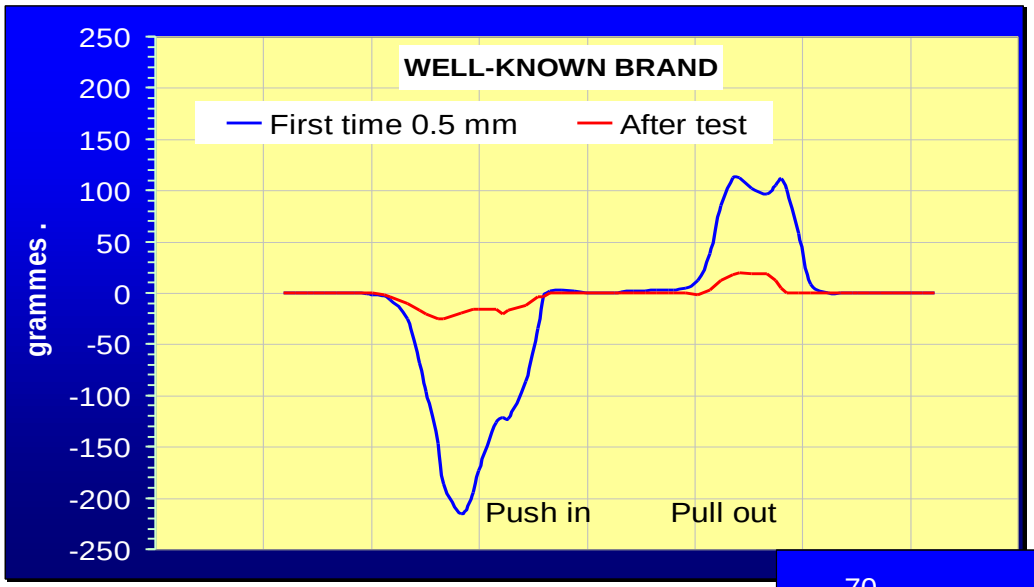
Testpin 0,5 mm



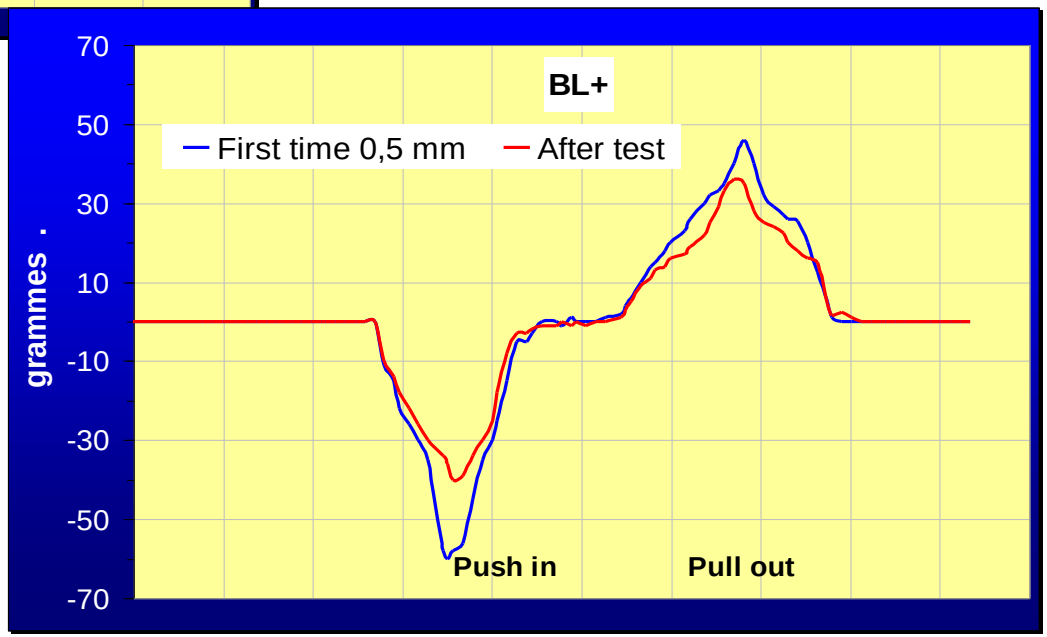
Testpin 1,63 mm



Inner Spring Testing Results at Technetix



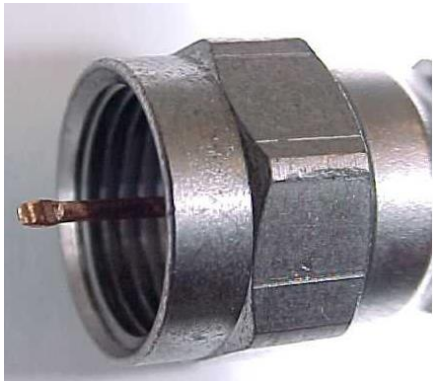
- **Test Pin 0,5 mm**
- **5 Inserts with Test Pin 1,5 mm**
- **Test Pin 0,5 mm**

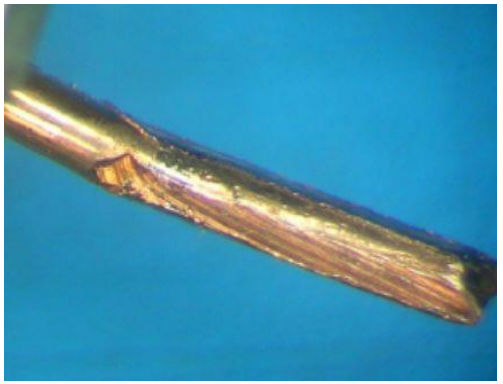


Bad Connectors

Incorrectly Installed Connectors May Cause Intermittent Disturbances (CPD)

- Use proper tools and High Quality Connectors
- Cleanliness is Paramount
- Cutting Tools
- Cable Preparation Tools
- Torque Wrench (Technetix Tests “Withstanding” at 8Nm)*





Incorrectly Mounted Connectors

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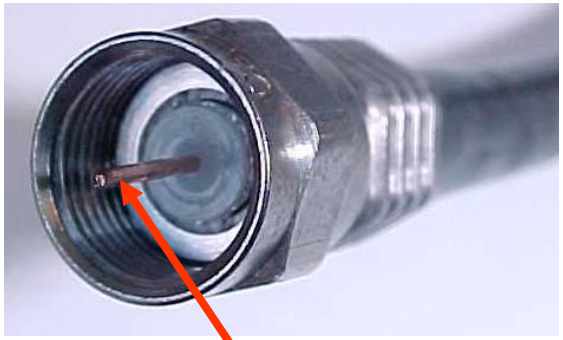
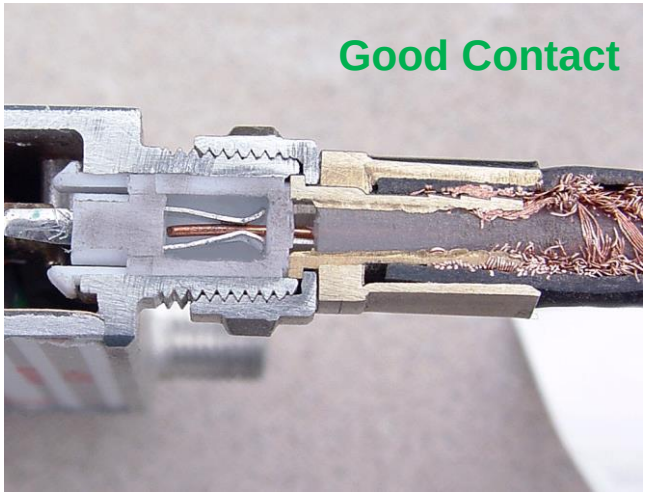


Dielectric Too Long May Result in Bad Contacts



Snakes in the ETB

A householder who called out an engineer after his TV became faulty was stunned to find a family of reptiles living in his cable box.

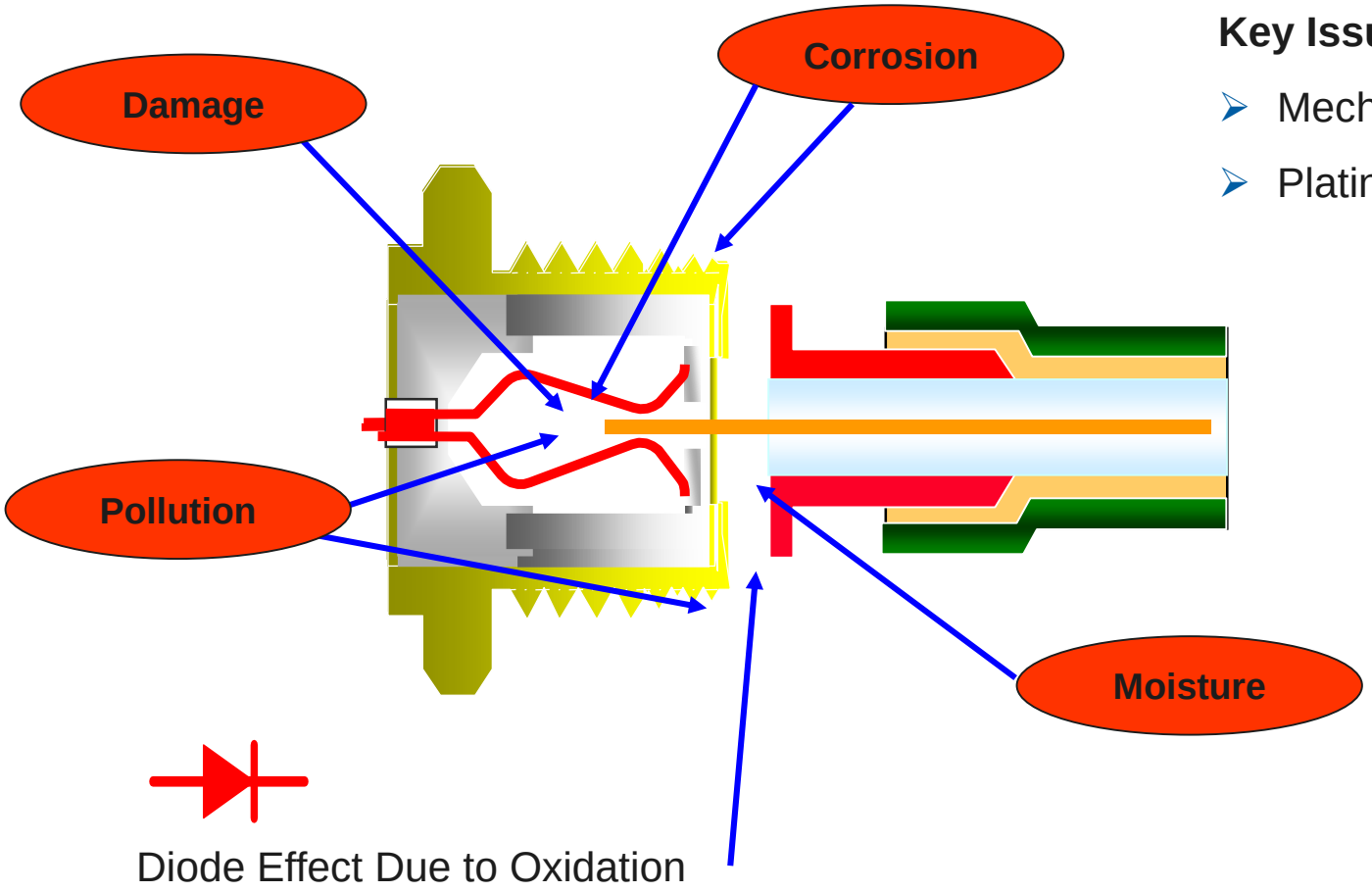
The engineer found a nest of what he believed to be snakes when he opened the Virgin cable box to investigate interference with television, internet and telephone connections. Martin Burgess-Moon, of Whitleigh, Devon, said the first indication of a problem came when their television signal started to break up…

'The internet at our home in Whitleigh went down and our TV picture was dodgy, so we called Virgin who sent an engineer out.

'When he opened the box outdoors he discovered what looked like a nest of snakes. The problem has now been repaired, and the creatures are free to stay as long as they like.

Common Path Distortion CPD

- CPD can be a big problem, and has many causes
- CPD can be reduced significantly by using high quality components



Key Issues

- Mechanical Construction
- Plating NiSn

Inter-modulation (Passive)

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Splitters, Taps, Wall Outlets, Isolators etc. all Contain Ferrite

- Ferrite is a magnetic material
- Transfer characteristic is only linear in a small operating area
- If the ferrite is magnetised (saturated) the operating area shifts and transfer characteristic is no longer linear

A device with a non linear transfer characteristic acts like a mixer.

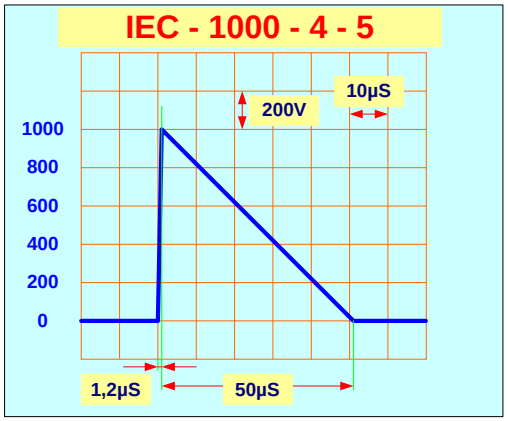
This will cause Inter-modulation…both in upstream and downstream

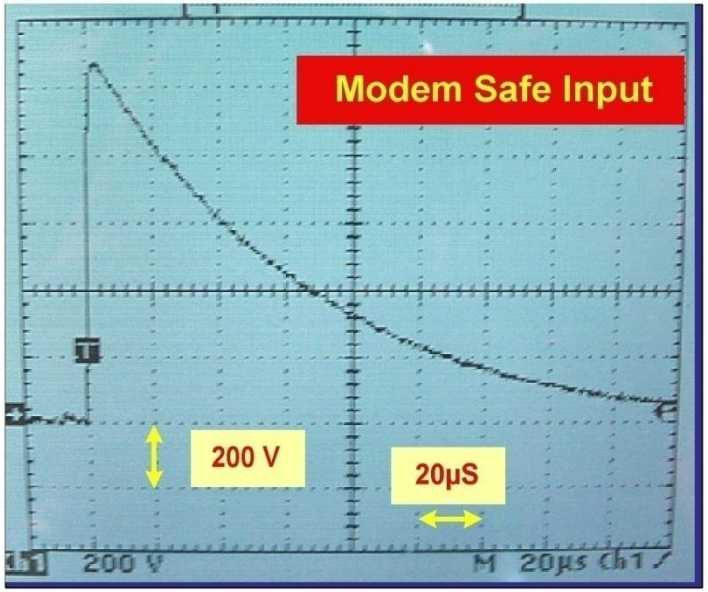
Ferrite becomes magnetised by: -

- **Lightning strikes**
- **Voltage surges**
- **Varying earth potential (equalising currents)**

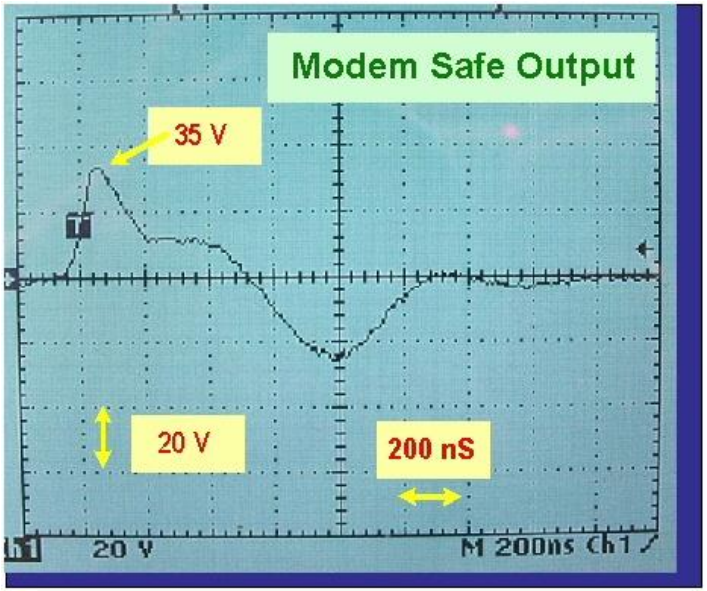
Inter-modulation (Passive)

- **Technetix developed Modem Safe® to avoid the ferrites becoming magnetised**
- **Products with Modem Safe® are protected against voltage surges according IEC-1000-4-5**



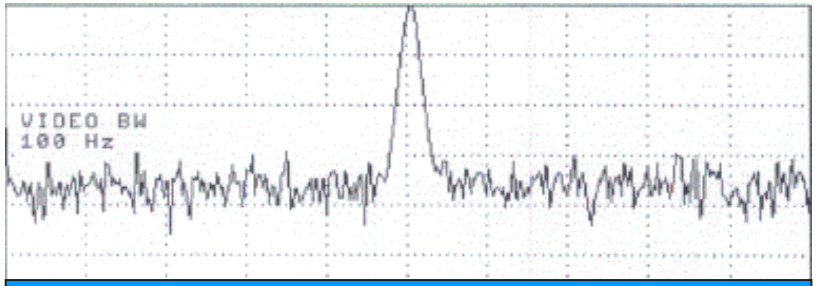


MODEM SAFE

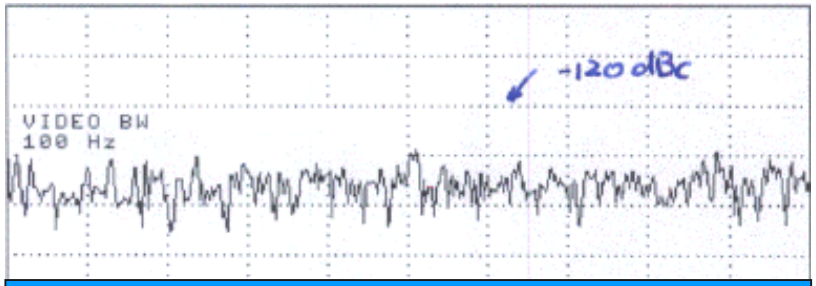


High Quality Ferrite and Modem Safe® Reduces Inter-modulation

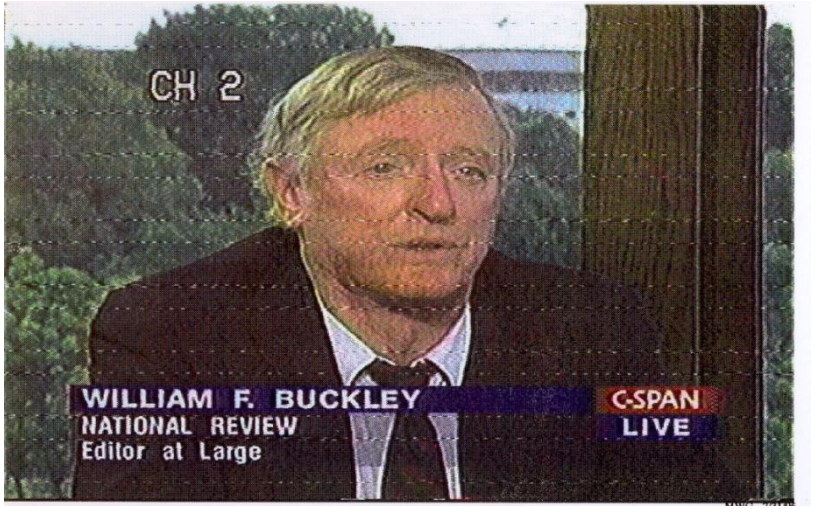
Splitter Inter-modulation



After 10 pulses of 25V DC on all ports



After 10 pulses of 25V DC on all ports



Analogue TV picture with Intermodulation

Overcoming inter-modulation effects…

…to improve TV picture quality

Noise Ingress

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80 to 90% of Noise Ingress is Caused by Subscribers

- Using plastic connectors at radio and TV sets
- DIY shop amplifiers, splitters etc.
- DIY shop coaxial cable

Common Characteristic is Inadequate Screening (-25 to -40dB)

What kind of signals do we find?

- Short Wave Radio
- Wireless telephones (30-50 MHz)
- Home appliances (Marconi spark transmitters)

Common Characteristic is that Ingress Occurs at a Single Source

Case Study

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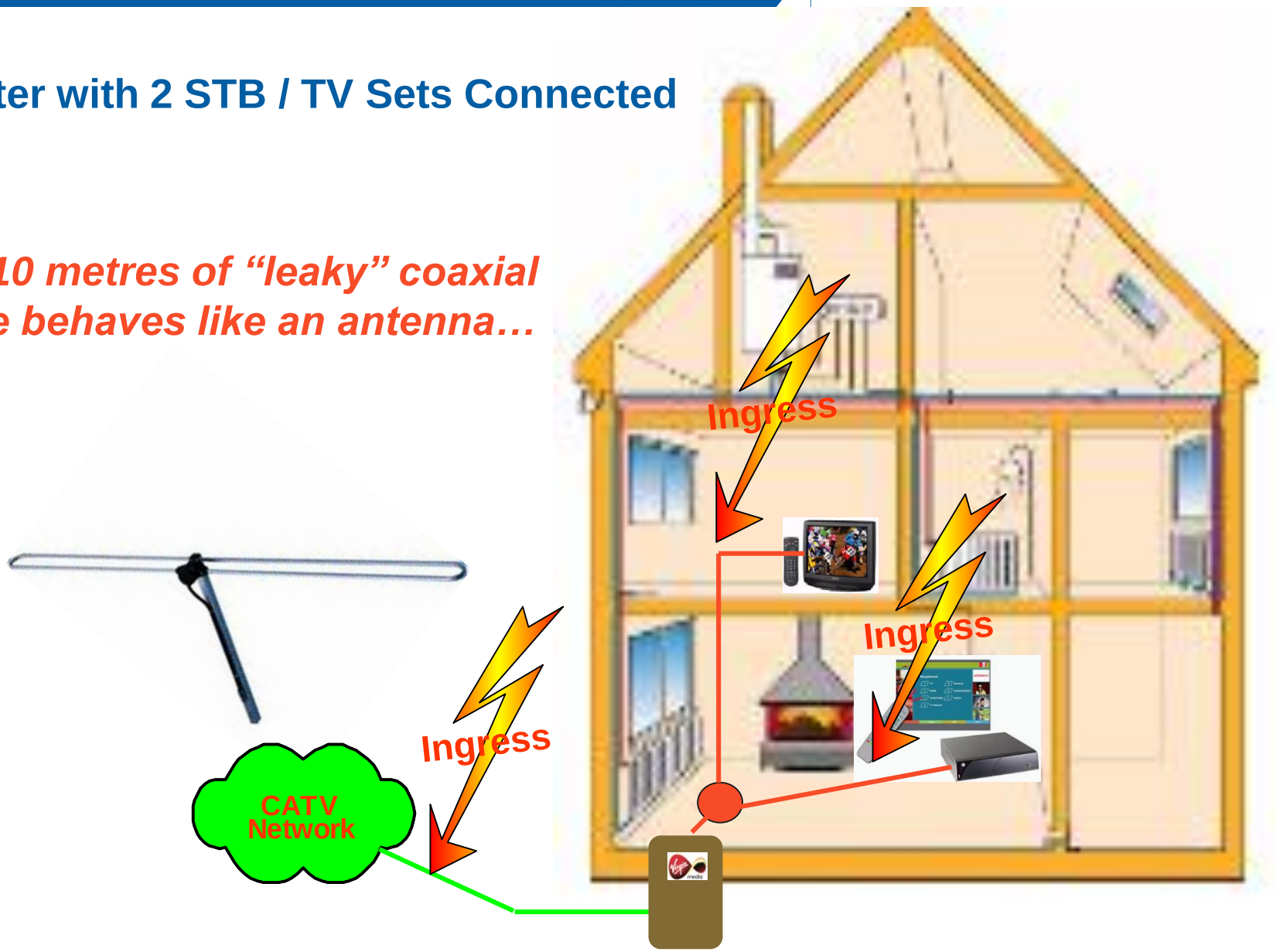
Splitter with 2 STB / TV Sets Connected

5 to 10 metres of "leaky" coaxial cable behaves like an antenna…



The RF Splitter & How it Works

- The standard CATV passive RF signal splitter has one common port and two (or more) input/output ports.
- The splitter divides the CATV signals, but also acts as a combiner for return path signals.
- Therefore the splitter also acts as a combiner for unwanted signals, ingress.

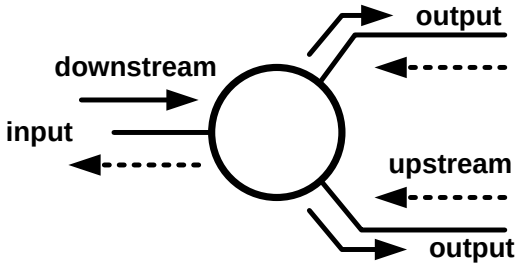


Fig.1 splitter with two outputs

- Assuming the combined ingress signals originate from the same source we can also assume the frequency is the same.
- Level and phase from the ingress signals are more or less the same, so two summed signals become a single signal with a level of more or less +6dB

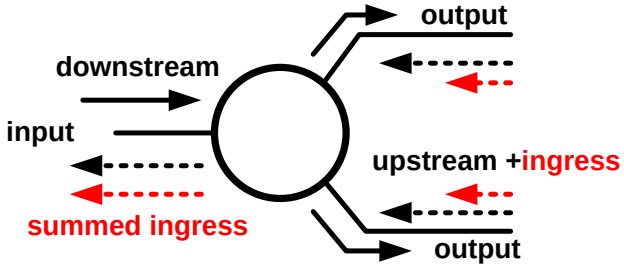


Fig.2 summing of ingress

Ingress Safe is a Passive Approach to Ingress Reduction

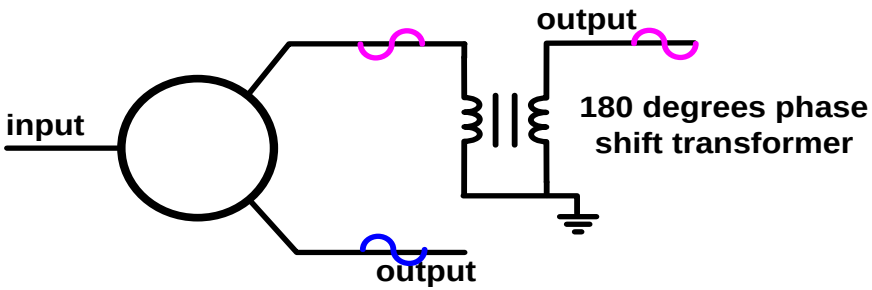
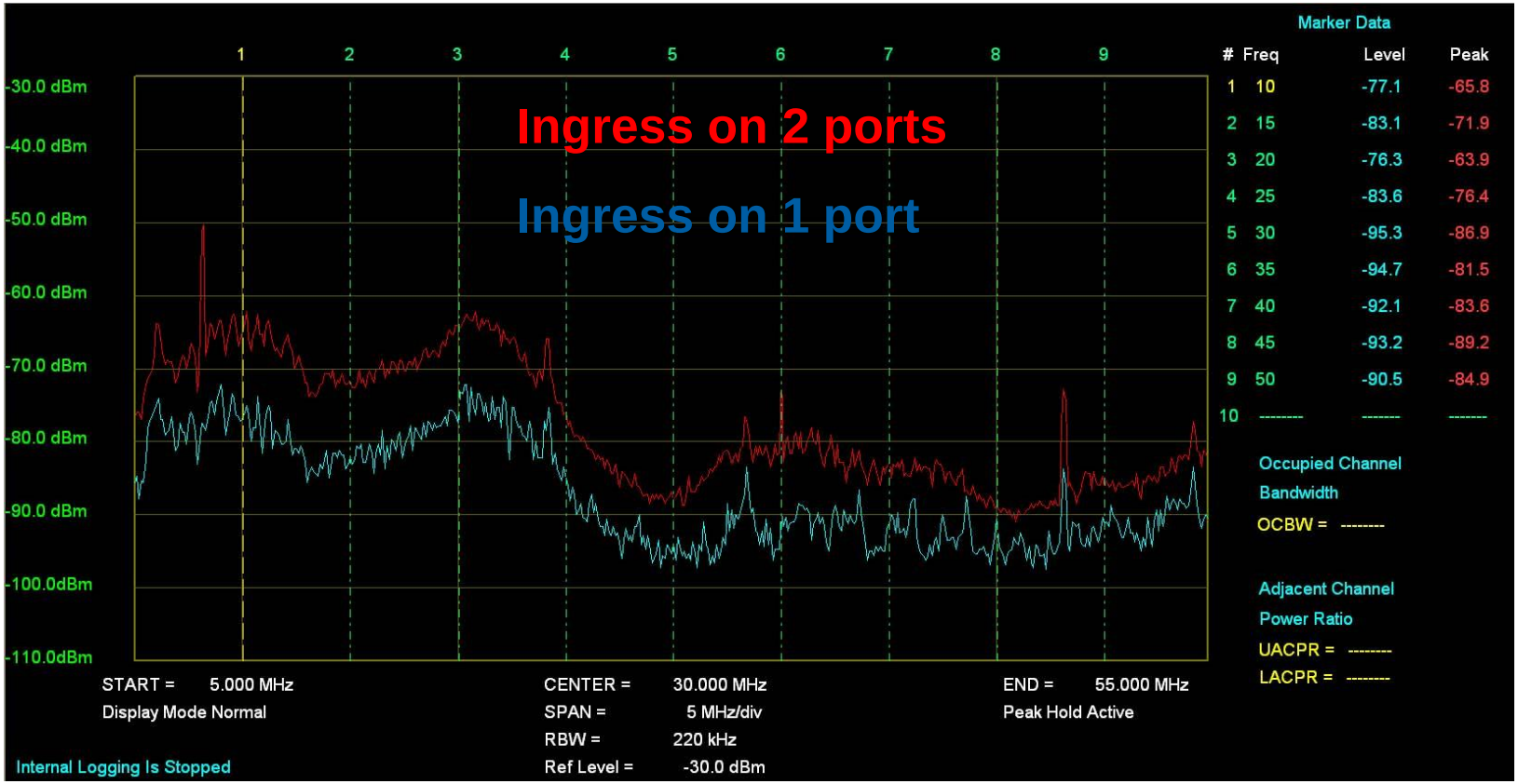


Fig.3 splitter with 180 degrees phase shift transformer

- The Ingress Safe Technology comprises a wideband phase shift transformer at one of the input/output ports.
- Only ingress signals that are in opposite phase before combining (since they originate from the same source) are cancelled out. Theoretically…no more ingress.
- All other signals, (divided or combined) are not affected.
- No phase or frequency relation.

Normal Ingress Summing

Measured Random Ingress via a 2 way splitter Normal Ingress Addition



Level - Peak
11,3 dB
11,2 dB
12,4 dB
7,2 dB
8,4 dB
12,5 dB
9,5 dB
4 dB
5,6 dB

Blue = 2 way splitter 1 port connected to ingress source

Red = 2 way splitter both ports connected to ingress source

Ingress Measured with Ingress Safe

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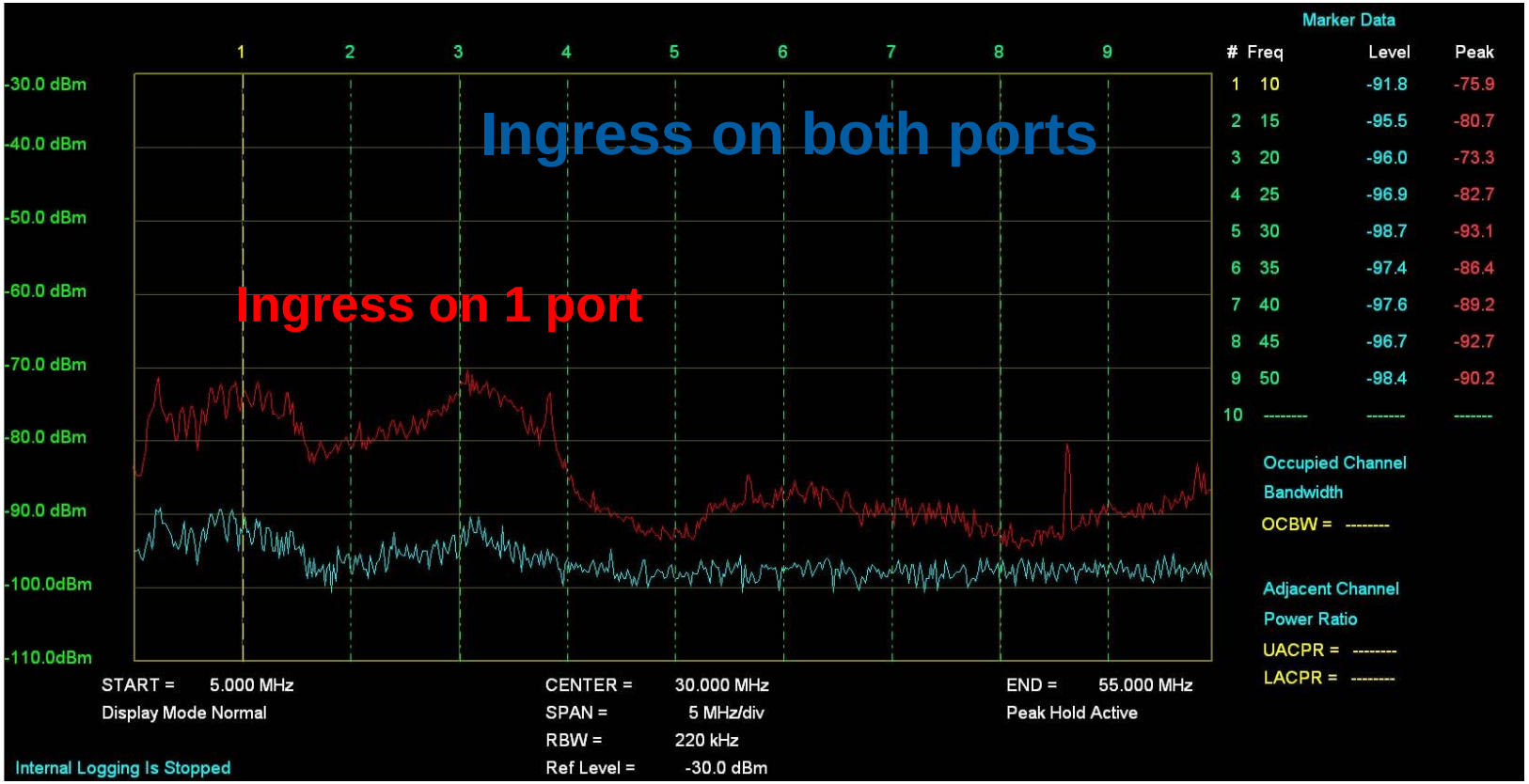
Measured Random Ingress via a 2 Way Splitter

WITH INGRESS SAFE



Level - Peak
15,9 dB
14,8 dB
13,3 dB
14,2 dB
5,6 dB
11,0 dB
8,4 dB
4 dB
8,2 dB

Addition of Ingress in an “Ingress Safe” Splitter.

Blue = 2 way splitter 2 ports connected to ingress source

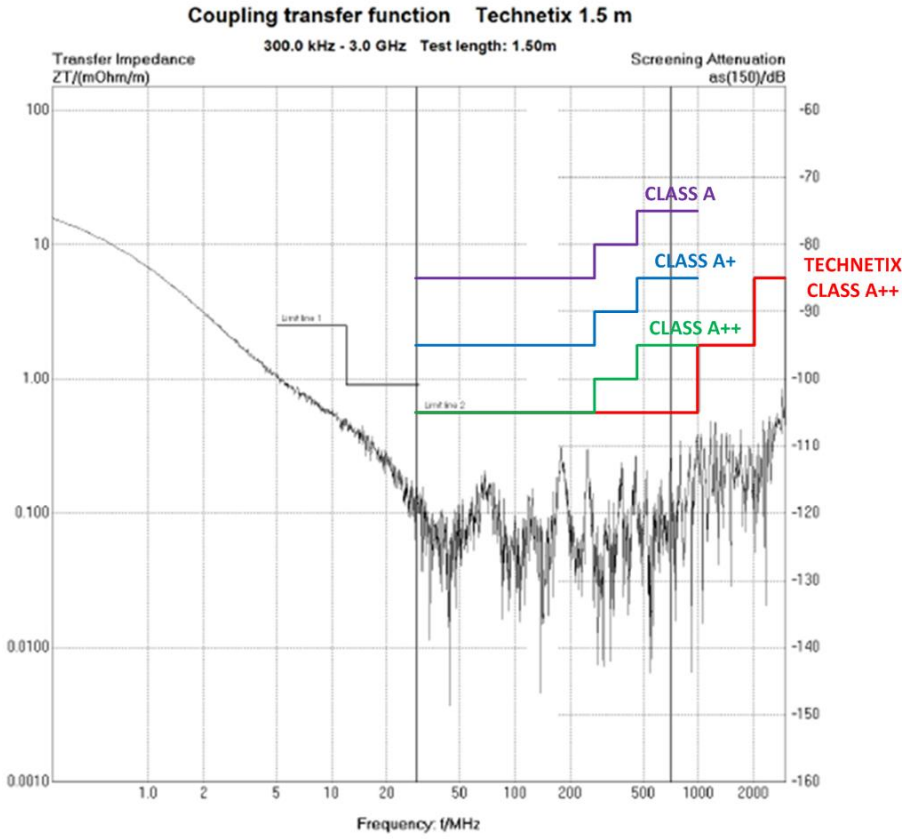
Red = 2 way splitter 1 port connected to ingress source.

ingress safe

RF Screening ≥ Class A

Excellent RF Screening is Vital Connected Home

- Splitters, taps, wall outlets, galvanic isolators and fly leads need to have a minimum of “Class A” screening efficiency…
- Technetix latest development “Class A++” screening



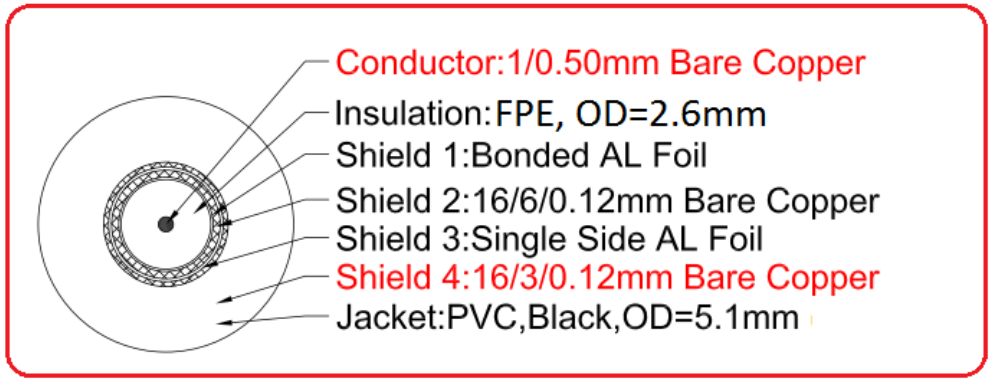
Frequency Range (MHz)	Class A	Class A+	Class A++	Technetix Class A++
5 to 30	85	95	105	105
30 to 300	85	95	105	105
300 to 470	80	90	100	105
470 to 1000	75	85	95	105
950 to 2000	55	65	75	95
2000 to 3000	55	65	75	85

Class A++ Flyleads

Current Variants

Part Number	Connector 1	Connector 2	Length Options
RLA++75-10	IEC-male	IEC-female	1.5m / 3m / 5m
RLA++75-40	IEC-female	F-male	1.5m / 3m / 5m
RLA++75-12	IEC-male	F-male	1.5m / 3m / 5m
RLA++75-30	F-male	F-male	1.5m / 3m / 5m

Cable Construction



LTE Safe Product Development

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- Current/imminent LTE deployment around Europe
- Required that the in-home network is protected against LTE interference
- Higher screening efficiency and filtering minimises the effects to STB and modem devices
- Technetix to offer a solution that focuses on the whole in home installation, not just one aspect

Features

- LTE filtering
- High screening efficiency:
  - Class A (3 MHz - 300 MHz – 85 dB / 300 MHz - 470 MHz – 80 dB / 470-950 – 75 dB)
  - Class A+ (3 MHz - 300 MHz – 95 dB / 300 MHz - 470 MHz – 90 dB / 470-950 – 85 dB)
  - Class A++ (3 MHz - 300 MHz – 105 dB / 300 MHz - 470 MHz – 100 dB / 470-950 – 95 dB)
- Passives
- Outlets
- Flyleads: officially selected by LGI for supply to the group.

DROP CABLE HANDLING ISSUES?

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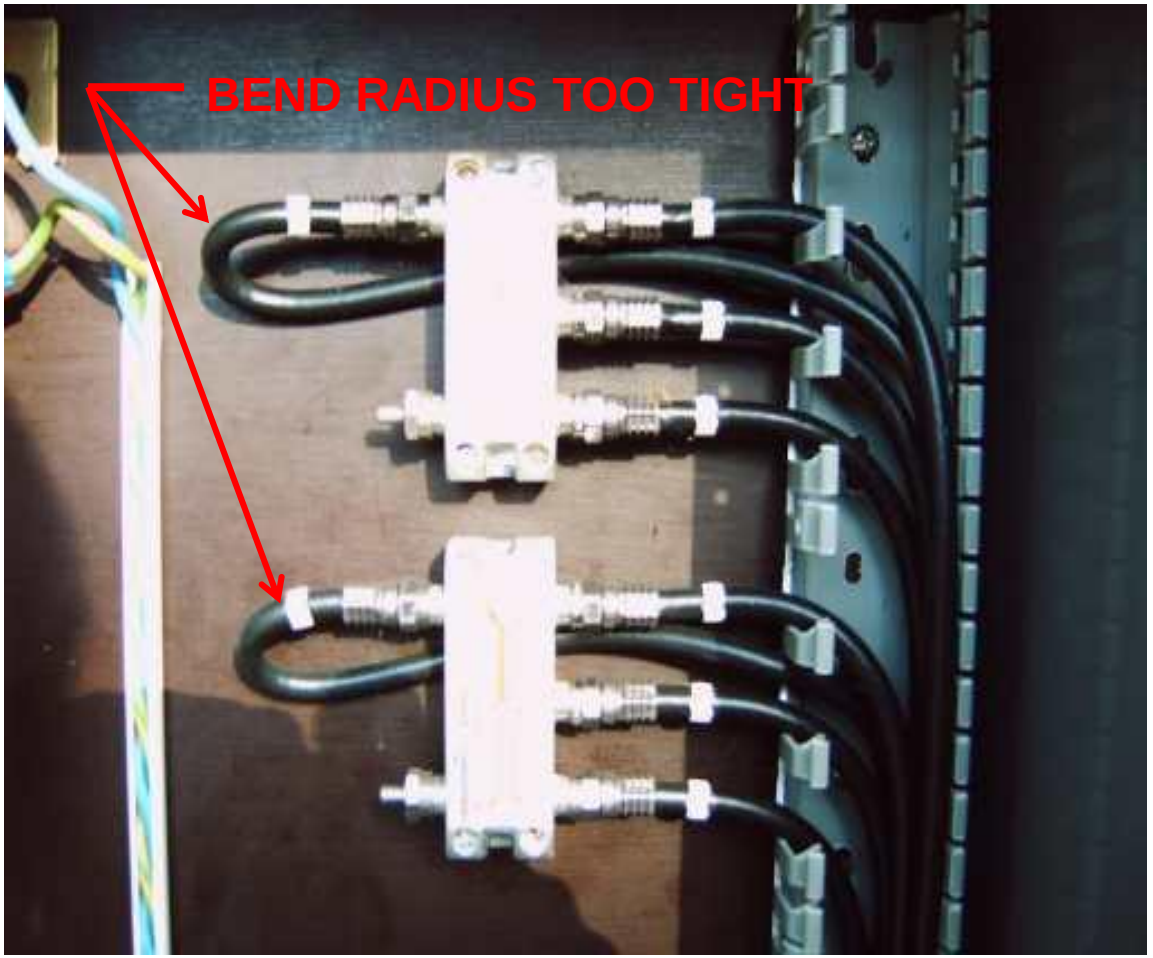
Coaxial Cable Bend Radius Should Not Exceed 10 x O.D. of Cable

- **Example**: RG6 Cable = 70mm maximum bend radius



- Excessively tight bend radius may damage the cable dielectric and change the cable's nominal impedance

Acceptable Drop Cable Bend Radii

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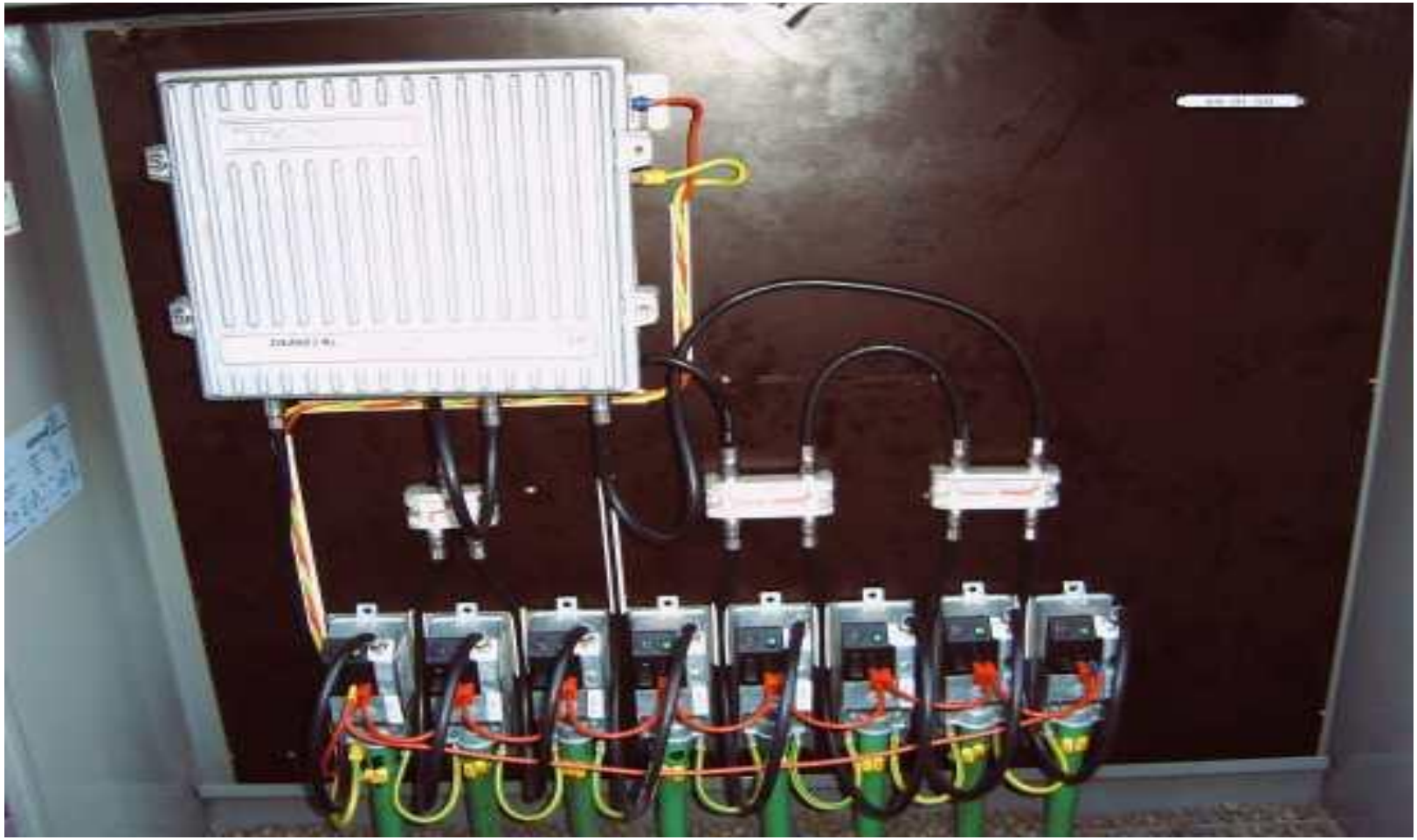
Please note bend radii greater than 5 x coaxial cable outside diameter (O.D.)



Coaxial Cable Pulling (Tension)

RG6 Typical Maximum Pull Tension = 150N (34lbs)

- **Excessive cable pull tension may damage the cable dielectric and foil tape resulting in reduced RF screening.**
- **Ingress noise and signal egress levels increase.**
- **Reduced return path performance.**

Bend Radius - Subscriber Installation

Installation Care Required !

- **Bend Radius?**
- **Is the Cable Minimum Bend Radius 10 x Cable Outside Diameter?**

Tap Bank Installations

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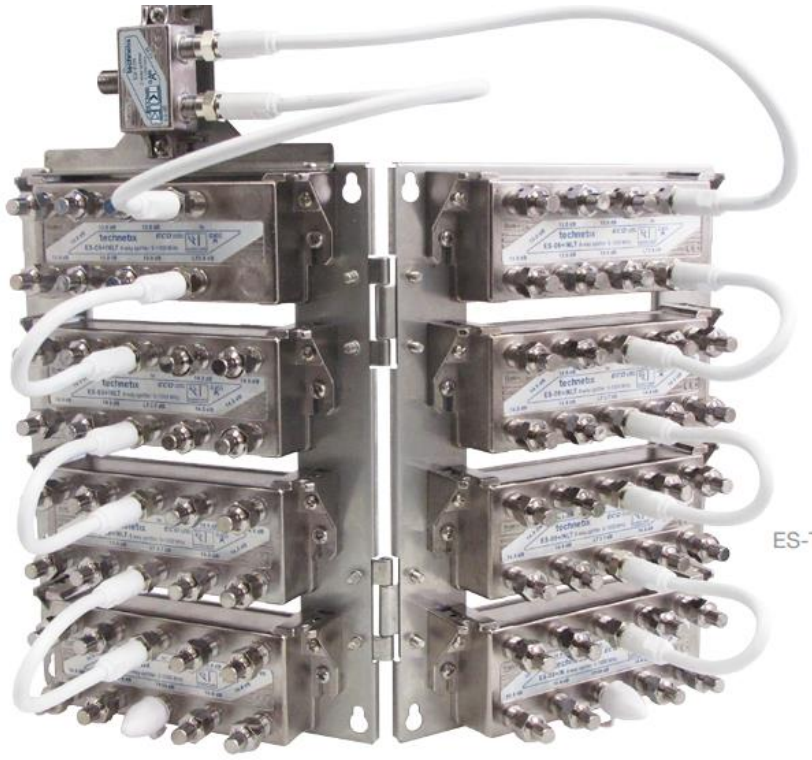
- Ingress Safe – unique passive ingress reduction technology
- Modem Safe – unique surge protection and intermodulation reduction solution
- CPD Safe – robust zinc die-cast housing with NiSn plating
- Exceeds EN Class A screening requirements
- F-connector inner spring accepts 0.56 mm to 1.30 mm inner conductors
- High port-to-port isolation performance
- Full 5 to 1006 MHz frequency range
- High density 64 port solution
- Designed to replace legacy tap banks, whilst expanding subscriber drop connection capacity



ES-TA-30-30AA

Cableless Tap Bank – The Future?

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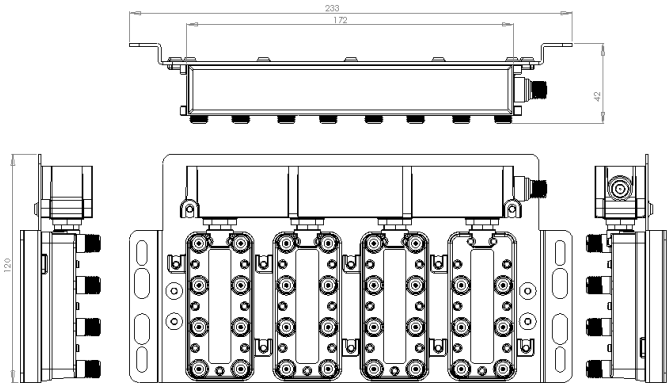
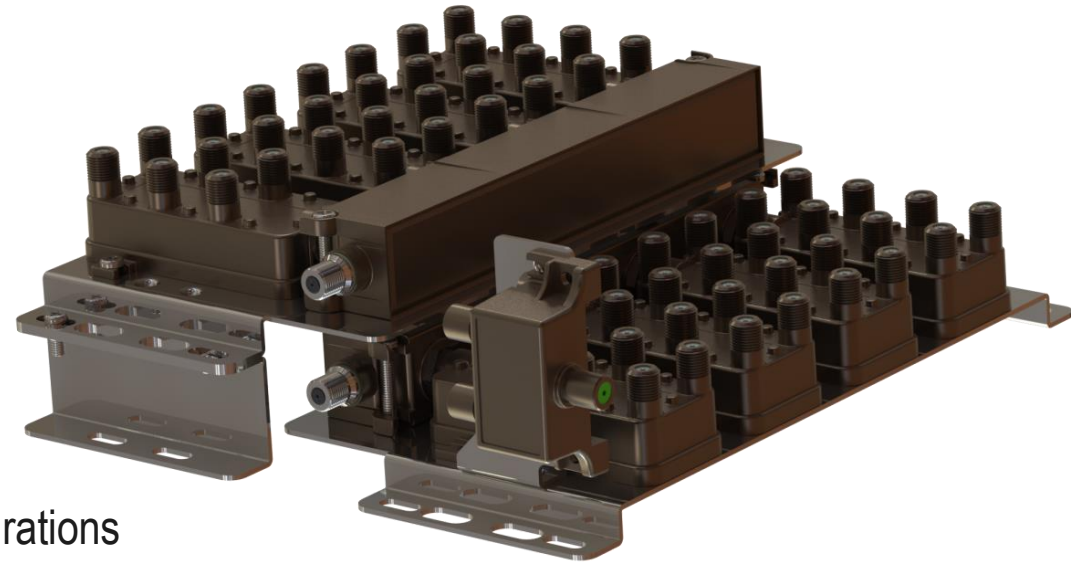
Background

- **In 2012 Virgin Media requested new version Cableless Tap Bank.**
- **Samples produced and VM approved, product tooling ready for mass production.**





- High density modular tap bank
- Cabinet fitment 60, 48 or 30 port configurations
- Signal conditioned inside module for optimum return path alignment
- Standard 6 and 8 port splitter modules with precision Class A+ push-on F connectors
- Stacking option for even smaller footprint

CPE CONNECTIVITY ISSUES

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This is intended as an example to illustrate a point…

An unhappy customer and a costly truck roll…

Is the set-top box (CPE) pushed up against wall or cabinet?

CPE CONNECTIVITY ISSUES

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Ribbon cables are more flexible than "standard" SCART cables…

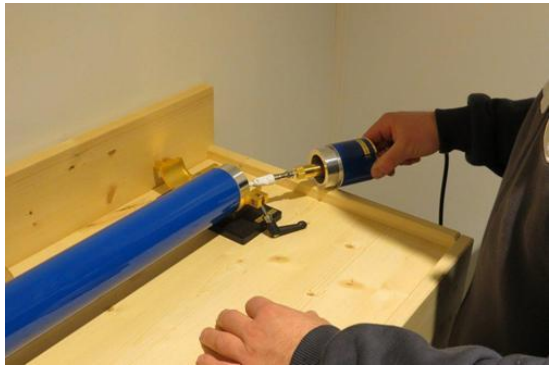
…so create no issues when pushed up against wall or back of cabinets

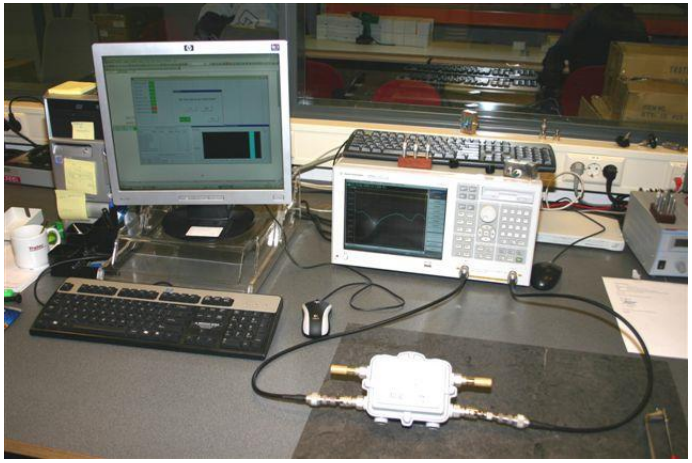
Importance of Quality Control

Quality Control is of the Highest Importance…

…to Deliver High Quality RF Passives Components…

… for the Subscriber "Gateway" Network Connection (Drop)





Broadband Network Evolution

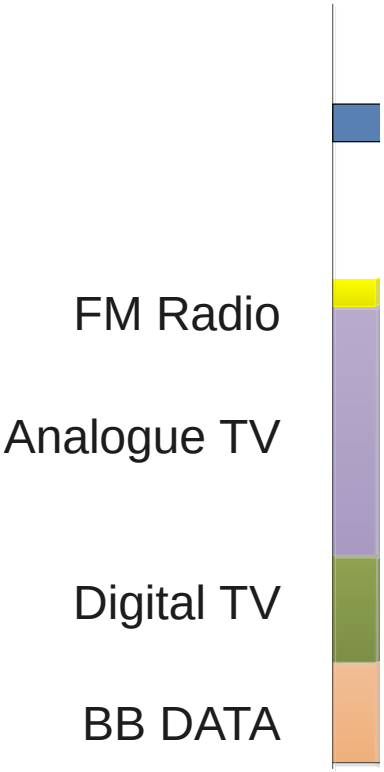
DOCSIS 3.1 and CCAP are technology drivers that will improve customer capacity: -

- This will bring more capacity in the upstream and downstream
- This will introduce denser modulation schemes (OFDM) and expansive channel bonding
- Discrete video and data platforms will transition to CCAP
- Setup boxes will become “Gateways”
- … and so on

Are our networks ready?

How can HFC operators upgrade with minimal CAPEX spend?

Capacity demand in the Access network



Access network upgrade considerations

Operators have several options available for evolving their HFC networks:

- Introduce smaller segments using fibre deep or FttLA
- Extend downstream and upstream bandwidth

Today: (DOCSIS 3.0)

- DS 860/1006 MHz
- US 65 MHz
- Upgrading US 85 MHz will need diplexer upgrade

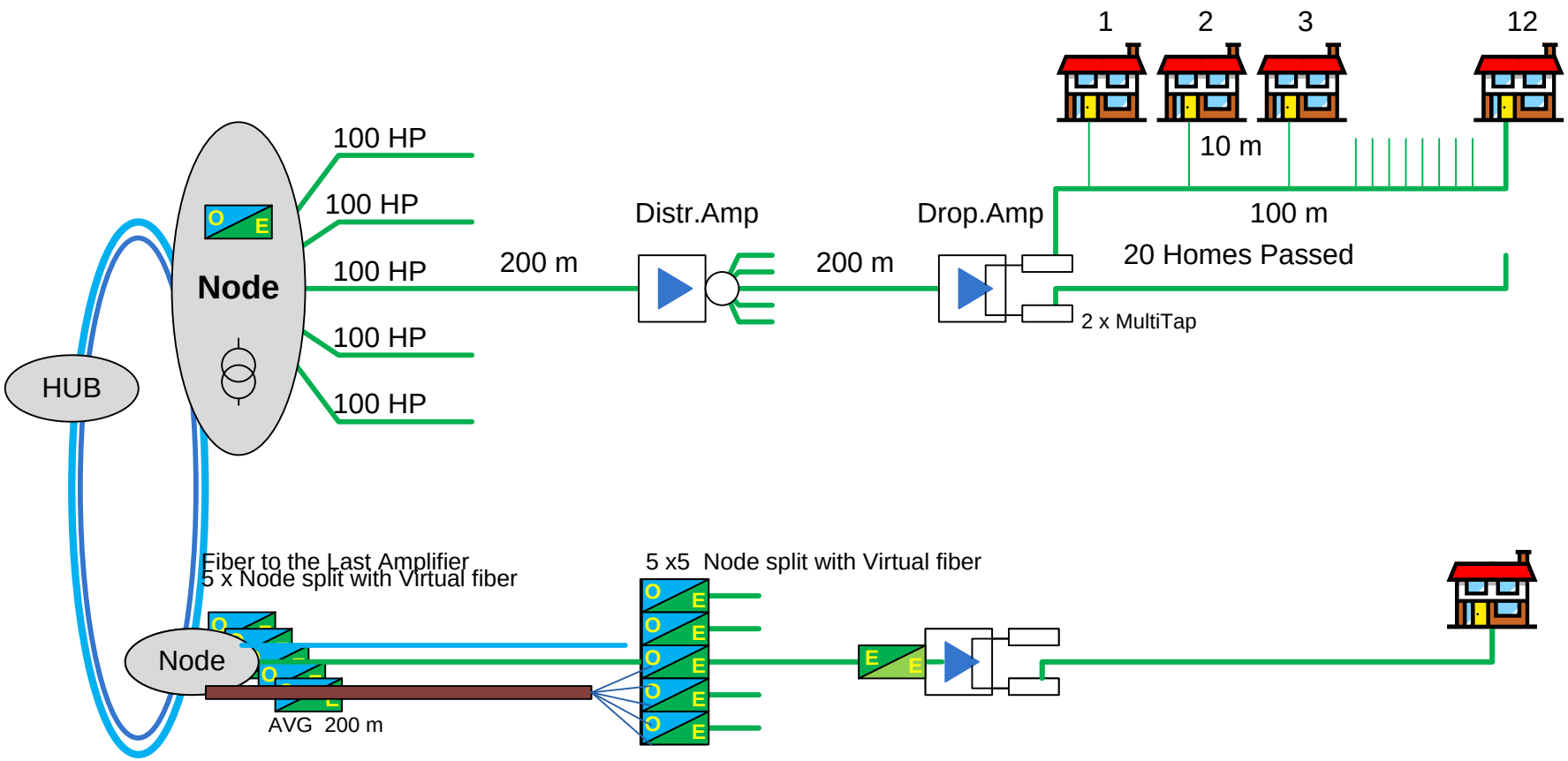
Short Term: (DOCSIS 3.1)

- DS 1.2 GHz
- US 200 MHz
- Will require active and passive upgrade

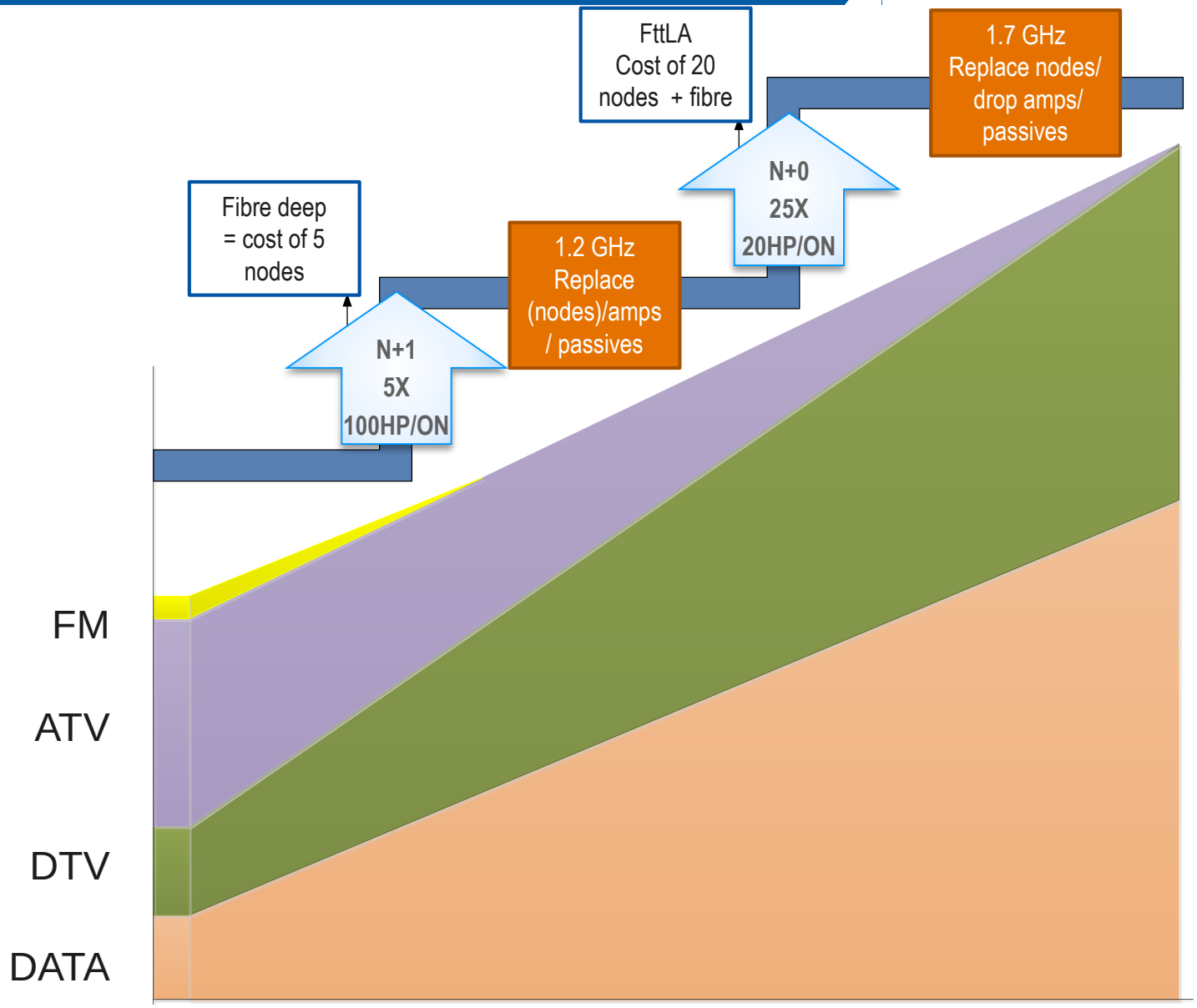
Future: (DOCSIS 3.1)

- DS 1.7 GHz
- US 400MHz
- “Active upgrade”

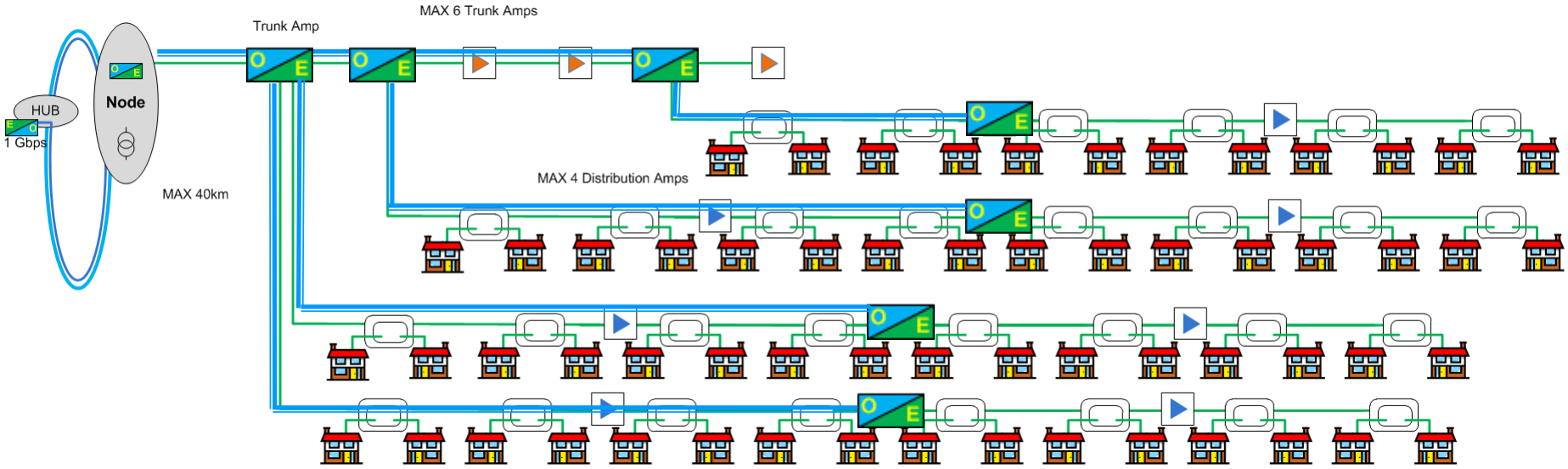
Typical star network – upgrade path



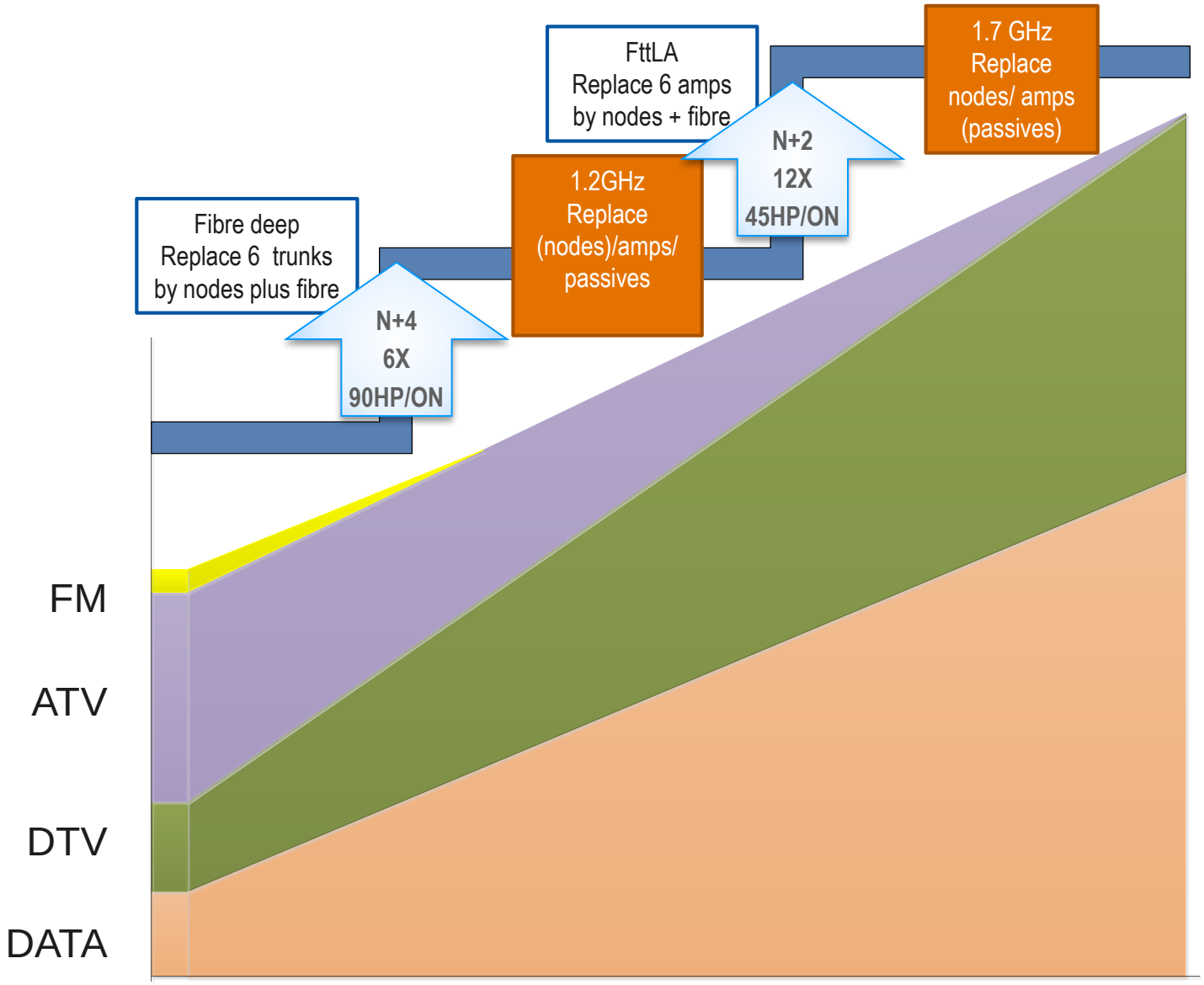
Typical star network – upgrade path



Typical tree & branch network – upgrade path



Tree & Branch Upgrade Path



Next Generation Access Platform

Operators should be preparing their long term HFC network upgrade plans NOW

The Access platform is the most critical aspect of the Access network

When selecting technology consider the following: -

- Must be future proofed
  - Platform with 1.2 GHz DS / 200MHz US
  - Latest GaN technology (3dB more output)
  - Remark : Long term access platform with 1.7GHz DS / 400MHz US

- Modular platform
  - Field upgradable to increase the bandwidth (DS & US)
  - Field upgradeable to an deep fibre node to protect your investment (JIT CAPEX)
  - Reduce significantly the time to upgrade
  - Reduce maintenance & OPEX costs
  - Reduce the need for spare parts

The Next Generation Access Platform

technetix

- **Fully software controlled**
  - Electronic setup
  - Integrated Ingress detection switches
  - Remote control trough FSK/Docsis/HMS
  - Ingress finding management system

- **Lower power consumption**
  - GaN technology
  - Manageable power consumption

The DBx Family of Digital Broadband Amplifiers

DBA - Preamplifier

DBB - Building

DBC - Compact

DBD - Distribution

DBE - Edge

DBE – Development Model

The DBx Digital Broadband Amplifier & Fibre Node Range

DBB - Building		1 Active Output	1,0GHz Downstream 204MHz Upstream
DBC - Compact		1 Active Output Upgradeable to 1x1 Optical Node	1,0 or 1,2GHz Downstream 204MHz Upstream
DBD - Distribution		2 Active Outputs Upgradeable to 1x2 and 2x2 Optical Node	1,0 or 1,2GHz Downstream 204MHz Upstream
DBE - Edge		3 or 4 Active Outputs Upgradeable to DBF-1200	1,0 or 1,2GHz Downstream 204MHz Upstream

The DBx Digital Broadband Amplifier & Fibre Node Range – Strand-mounting “S”

DBC - Compact

1 Active Output
Upgradeable to 1x1 Optical Node

1,0 or 1,2GHz Downstream
204MHz Upstream

DBE - Edge

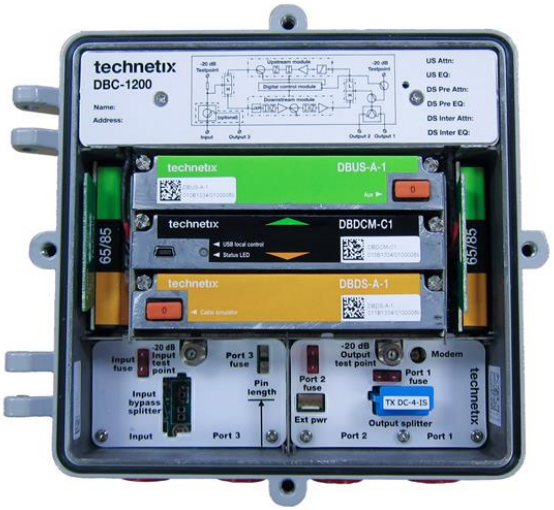
3 or 4 Active Outputs
Upgradeable to DBF-1200
1x2 and 2x2 Optical Node

1,0 or 1,2GHz Downstream
204MHz Upstream

The DBC-1200 cabinet or strand-mounting amplifier

Features

- Adaptable for one or two high level outputs
- Operates to 1200 MHz with a forward gain of up to 44
- Return path gain of up to 28 dB
- Field upgradable plug-in diplexers offer: -
  42/54, 65/85, 85/102, 85/105 or 204/258 band splits
- On-board Ingress detection facility
- Input bypass facility

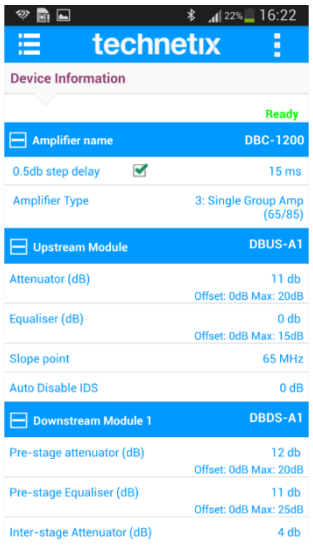


A guide to the DBx configuration

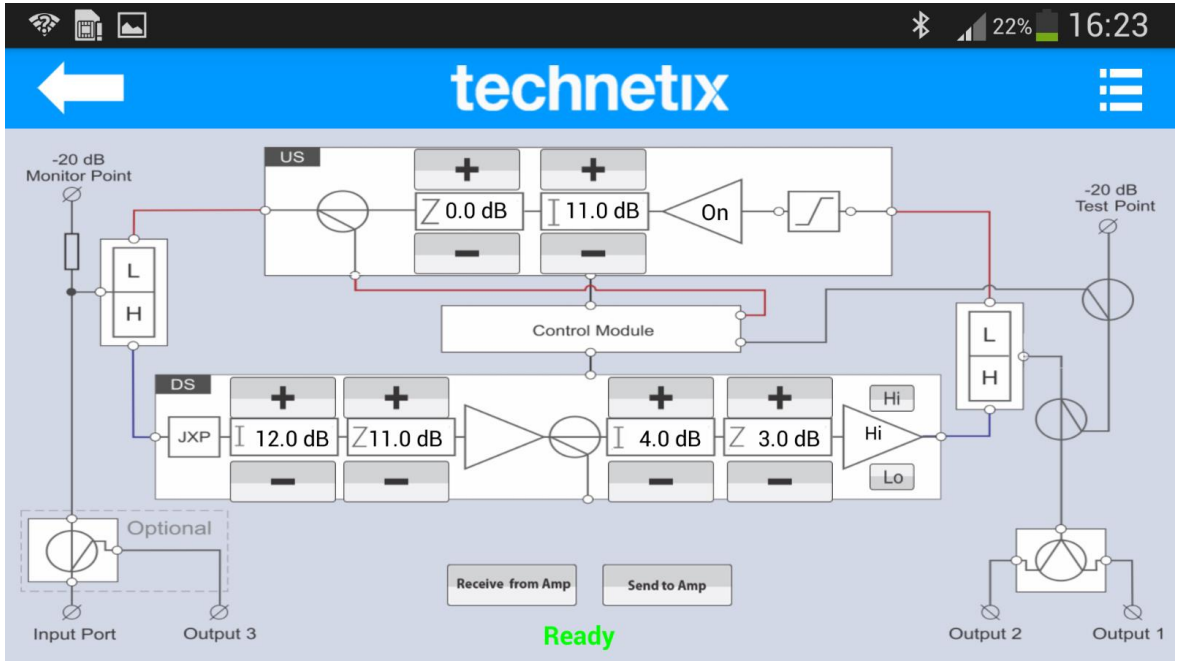
1. Removable power supply under cover plate
2. Optional local powering port (mains or 65 VAC)
3. Upstream amplifier module
4. Upstream auxiliary plug-in JXP attenuator location
5. Digital control module
6. Digital control module USB connection
7. Downstream amplifier module
8. Downstream cable simulator JXP location (can be used for other types of JXP plug-in)
9. Input and output diplex filters. 42/54, 65/85, 85/102, 85/105 and 204/258 options
10. Input bypass splitter location: 2-way splitter PI-SPL-2W-12G; directional coupler Tap 8dB TX DC-8; Tap 12 dB TX DC-12
11. Port power directors/fuses (micro2 automotive)
12. Input -20 dB test point (omnidirectional)
13. External powering point (special connector required)
14. Output downstream -20 dB test point (upstream injection -20 dB test point)
15. Output splitter location: 2-way splitter PI-SPL-2W-12G; directional coupler Tap 8dB TX DC-8; Tap 12dB TX DC-12
16. Input RF port- PG11 thread with optional 5/8" reducing ring for 5/8" threaded connectors
17. Port 3 RF bypass output port- PG11 thread with optional 5/8" reducing ring for 5/8" threaded connectors
18. Port 2 RF output port- PG11 thread with optional 5/8" reducing ring for 5/8" threaded connectors
19. Port 1 RF output port- PG11 thread with optional 5/8" reducing ring for 5/8" threaded connectors

DBx BLA control software

Android Application



ROTATE DEVICE 90°



Network upgrade conclusions

- HFC networks must expand bandwidth to cater for greater demands
- There are many options to increase the capacity of the HFC network and HFC networks will do the job for many years
- HFC networks can be upgraded in steps saving CAPEX

Upgrading Networks Using JIT CAPEX

Investing in platforms that are future-proofed today and selecting the technology driver that you require knowing you can upgrade with minimal CAPEX later...

Thank you!