THE FUTURE OF NARROWCAST INSERTION

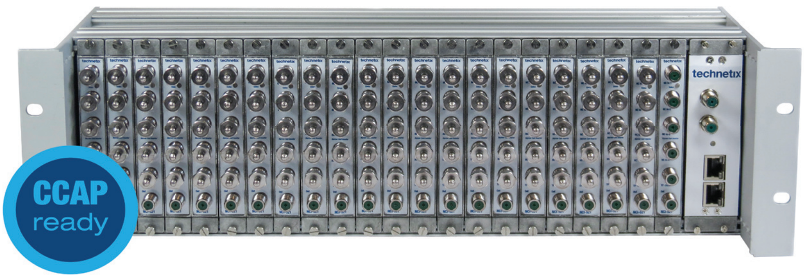
White Paper

technetix

May/2013

The future of narrowcast insertion

Next generation, CCAP compliant RF combining



This paper looks at the advantages of using the converged cable access platform (CCAP) standard to implement converged video and data services. It also explores ways of overcoming some of the challenges for headend combining systems which need to be considered in your CCAP migration roadmap.

The demand for high speed Internet and digital television means that headends are frequently modified, extended and upgraded in order to offer higher bandwidth to customers. Broadband cable networks can certainly compete with fibre to the home (FttH) but only if they stay up to date. A range of new technologies and platforms is available to ensure a winning proposition, including increasing the frequency spectrum to 1GHz or higher; deep fibre; higher modulation schemes; DOCSIS 3 channel bonding; and the CCAP standard.

However, in order to cope with new standards like DOCSIS 3.1 and CCAP, more combining and dividing of signals becomes necessary.

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DOCSIS 3

DOCSIS 3 offers increased capacity by using channel bonding, but channel bonding reduces the carrier levels, increasing the probable need for active combining.

A single DOCSIS carrier can be up to 120 dBµV but, as the total energy stays the same, when there are two carriers, they have to share this energy so each carrier can only use half the energy available.

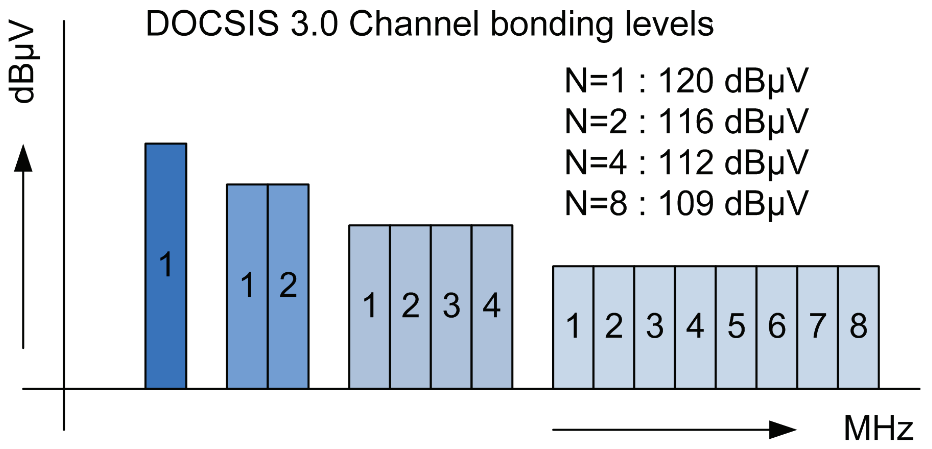


***Figure 1:** DOCSIS 3 carrier levels*

The level reduction can be calculated as N = n : 120 – ceil(3.6*Log2(n)) in dBµV.
With 16 channels, the carrier level is reduced to 105 dBµV and at 32 channels it is 102 dBµV.

This 18 dB reduction at 32 channels compared to a single channel also gives 18 dB less combining loss, so the likely need for amplification to provide an equal level at the input of the optical transmitter increases.

Converged cable access platform

CCAP, the new standard from CableLabs, was designed as a cost-effective means of migrating from conventional MPEG-based video delivery to IP video transport. It combines data and video delivery as a first step on the migration path. Today, cable operators implement data and video QAMs on separately managed and controlled platforms. CCAP offers combined CMTS and edge QAM functionality in one hardware solution. It also offers improvements in QAM channel density and the flexibility for cable operators to expand data and video services while also planning for all IP delivery in the future.

CCAP has a greater effect on the downstream, so this paper will concentrate on the two types of downstream signal – broadcast and narrowcast. Broadcast signals include analogue TV, digital TV and switched digital video (SDV), all of which are distributed to large groups of customers. Narrowcast signals include high speed Internet (HSI), video on demand (VOD) and local content, which are mainly distributed to a single or just a few nodes where they are added to the broadcast signals.

It's worth noting that offering higher bandwidth to customers requires an increasing amount of node splitting. Introducing a greater number of smaller nodes into a network necessitates additional headend equipment such as optical downstream transmitters and upstream receivers. As a result, valuable rack space often becomes a scarce commodity.

Advantages of the CCAP standard

CCAP is expected to offer multiple 10, 40 and/or 100 GigE interfaces to support a 150 Gbps downstream capacity. This capacity will be used by up to 12 downstream RF ports with up to 158 QAM channels.

CCAP provides a number of advantages to the operator:

- Service multiplexing flexibility – a flexible number of narrowcast and broadcast QAMs on each RF port (SDV/VOD/DOCSIS)
- Bandwidth capacity and density gains - line card up to 12 RF ports and up to 158 QAMs
- Configuration and management simplification
- Rack space reduction - double density compared to a typical cable modem termination system (CMTS)
- Power savings of more than 50%
- RF combining simplification*

** In the downstream radio frequency interface (DRFI) an isolation of ≥ 70 dB from 50 to 550 MHz and ≥ 65 dB from 550 to 1006 MHz is required.*

Migrating to CCAP

Figure 2 shows a typical headend combining solution today.

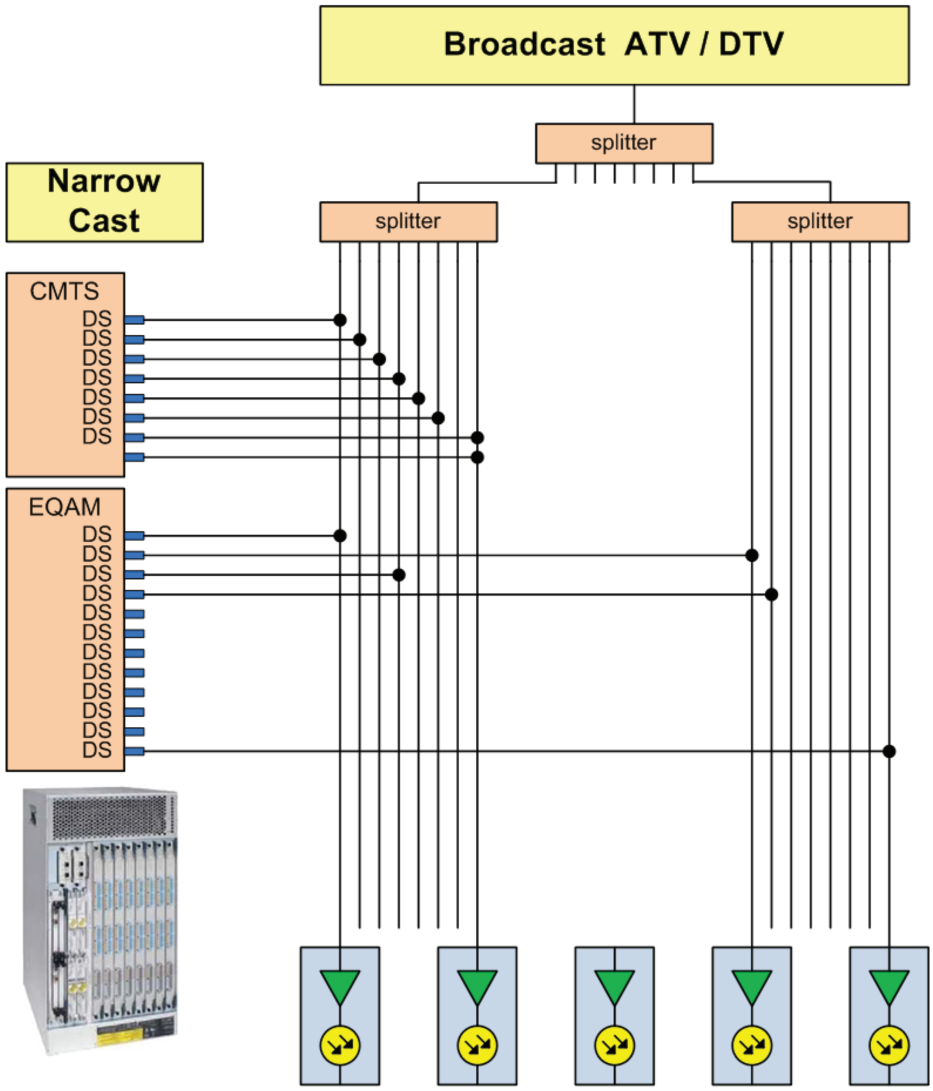


***Figure 2:** A typical solution today*

When all signals are provided from a CCAP platform, there is no need for a combining system. However, it will take some years for CCAP to become fully integrated in this way as most cable operators will not replace all their existing CMTS and edge QAMs with CCAP immediately. Gradual integration is a more realistic scenario.

In general, today's headends will be built with different platforms for different services and a combining system will be needed to feed the different service groups.

Figure 3: A typical headend using different platforms

The ideal situation is where a CCAP platform feeds a single node per port but, in situations where analogue TV is still offered, a combining system is needed.

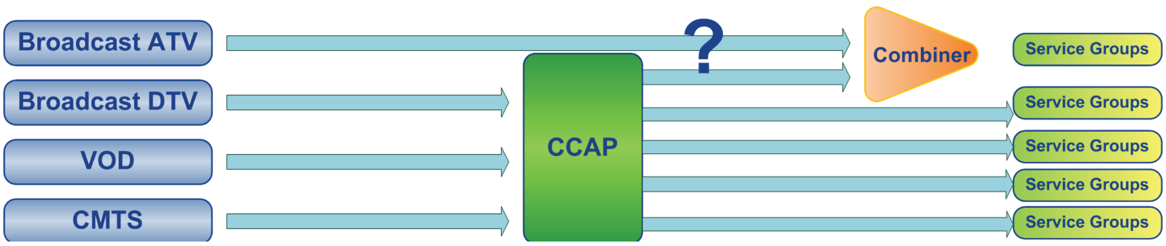


Figure 4: CCAP platform with analogue TV

If an operator was gradually integrating CCAP into its headend, for example changing the CMTS to CCAP followed by other services like VOD and DTV, its headend might evolve as shown in figure 5.

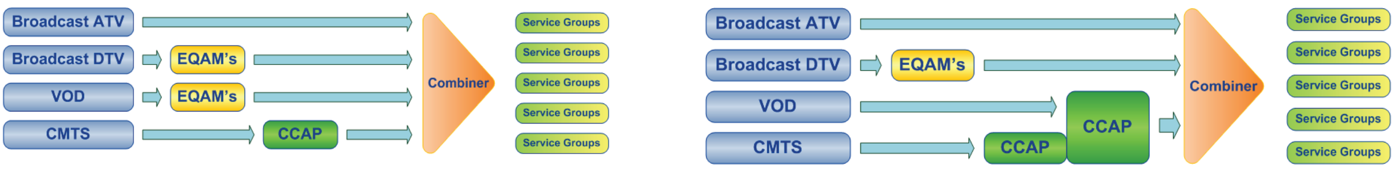


Figure 5: Gradual integration of CCAP

It's also likely that, as nodes become smaller and smaller, operators will need to invest in new combining and insertion equipment. New platforms such as CCAP enable broadband cable networks to stay ahead of the competition but will existing headend combining systems built with splitters and directional couplers be able to meet CCAP requirements particularly around isolation? It's prudent to consider investing in combining equipment which meets CCAP standards so that it will be fit for purpose for many years to come.

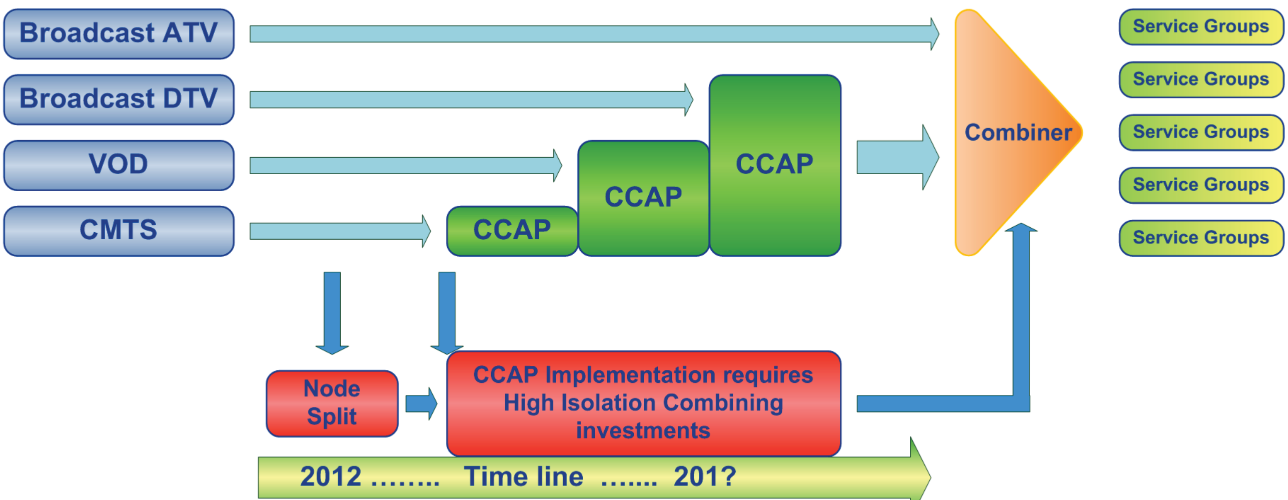


Figure 6: Investing with the future in mind

The importance of isolation

Combining QAM signals from a CMTS with QAM signals from a VOD system and then combining the output with broadcast signals to feed a node requires isolation between the ports. As the output stage of a QAM modulator is generally a transistor, it is sensitive to signals which appear on the output of that transistor. And because QAM modulators are non-linear devices, signals will cause intermodulation when they reach a certain level. To avoid this requires isolation, the level of which depends on the frequency and modulation schemes present.

- QPSK to QPSK = 33 dB minimum
- 64 QAM to 64 QAM = 54 dB minimum
- 256 QAM to 256 QAM = 61 dB minimum

As the modulation scheme gets higher, more isolation is required because there is less distance between the modulation states and therefore they can tolerate less interference.

The downstream RF interference specification from CCAP requires a minimum port to port isolation of 70 dB from 50 MHz to 550 MHz, and > 65 dB from 550 MHz to 1002 MHz. If the port to port isolation on a CCAP EQAM must be ≥ 70 dB, then the combining device also needs to have this level of isolation.

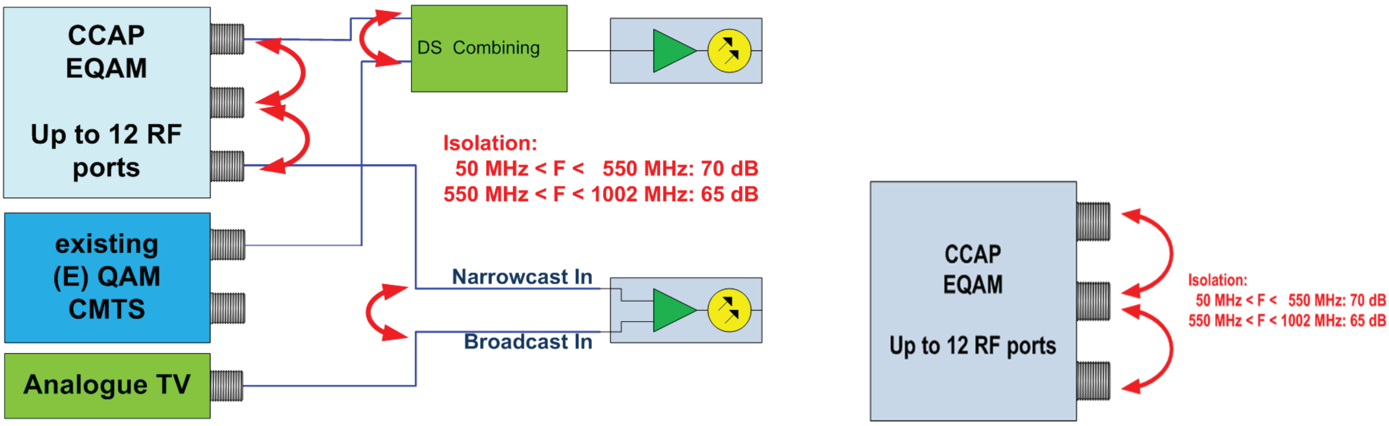


Figure 7: Isolation requirements

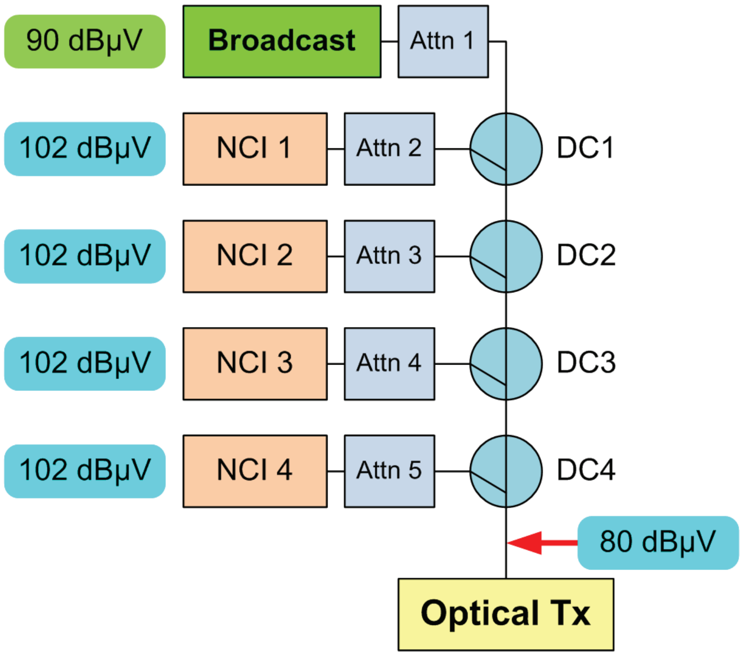
As shown in Figure 7, the downstream combining solution must have ≥ 70 dB isolation between the ports to comply with the CCAP standard. When optical transmitters are used with separate broadcast and narrowcast inputs, these must also have this level of port to port isolation.

Standard splitters and directional couplers will not give you this level of isolation. A splitter will have a port to port isolation of approximately 26 dB maximum, and when using a 20 dB directional coupler, isolation will be approximately 39 dB. In general, a directional coupler has an isolation of the tap value plus the directivity.

Under CCAP, every port is expected to feed a node. This means that all ports on a CCAP compliant QAM modulator will contain the full frequency spectrum, that is, port 1 of the modulator allows the full spectrum from 50 to 1006 MHz to be used to feed a node, port 2 of the modulator allows the full spectrum from 50 to 1006 MHz to be used to feed a node and so on for all 12 nodes. Through the combining system, these signals find their way back from port 1 to port 2 and so on through to port 12.

Exploring the isolation problem

To better explain the isolation problem, we will explore the issues that arise when trying to build a narrowcast inserter that combines a broadcast signal with a number of narrowcast signals to feed the optical transmitter. To provide the highest possible levels of isolation, the combiner will be made with directional couplers and will use extra attenuators for setting the correct levels and providing even further levels of isolation.



Assumptions:

- Broadcast level = 90 dBµV
- Narrowcast level =102 dBµV
- 32 bonded channels to be prepared for the future
- Input level for the optical transmitter = 80 dBµV

***Figure 8:** Example of a passive narrowcast inserter*

We can have an insertion loss of 10 dB for the broadcast (90 dBµV - 80 dBµV).

The insertion loss for NCI 1 is 102 dBµV - 80 dBµV = 22 dB.

The insertion loss of the directional couplers is 1 dB each.

This means for DC1 we can use a 16 dB coupler + 3 dB (DC2, DC3, and DC4) plus 3 dB (Attn2) to provide 80 dBµV for the optical transmitter.

For NCI 2 we have a similar situation, except that Attn3 can be 4 dB.

If we calculate the isolation between NCI 1 and NCI 2 we will have only 58 dB (Attn 3 + isolation DC2 + insertion loss DC1 + Attn2 = 4 dB + 35 dB + 16 dB + 3 dB = 58 dB).

As a result, we cannot meet the CCAP isolation requirements with passive solutions and so will have to use isolation amplifiers to increase the isolation. This is not a normal headend combining solution.

A new solution

Technetix has developed a new narrowcast solution which complies with the CCAP isolation requirement of ≥70 dB. This solution consists of up to 22 NCI-521 narrowcast inserters, a central controller (the NCC-1222) and a 22-way broadcast splitter on the back plane. It has been designed to deliver maximum flexibility for minimum rack space, along with low power consumption and high isolation.

The narrowcast inserters are hot swappable plug-in modules. No connections have to be made from the back, as everything is accessible from the front. Each input port on the narrowcast inserter has gain control from 0 dB - 30 dB in 0.5 dB steps, and slope control from 0 dB - 10 dB in 0.5 dB steps, with the combined output level also adjustable.

The central controller in the rack controls all 22 modules via a web browser. Setting slope and gain electronically means there are no signal disruptions while these changes are being made. For integration into a network management system, an Ethernet port with an SNMP interface is available as standard.

NCI-521 – narrowcast inserter

Figure 9 shows how the NCI-521 operates. There is one broadcast input and four narrowcast insertion points.

NC Input 4 has an additional switch so that this port can be used as a switchable redundancy port in future applications.

Every port has gain and slope control and can be controlled via a web browser or remotely via SNMP.

The NCI-521 is built into a small cassette housing. Its height is 3 RU and its width is only 3.5 TE.

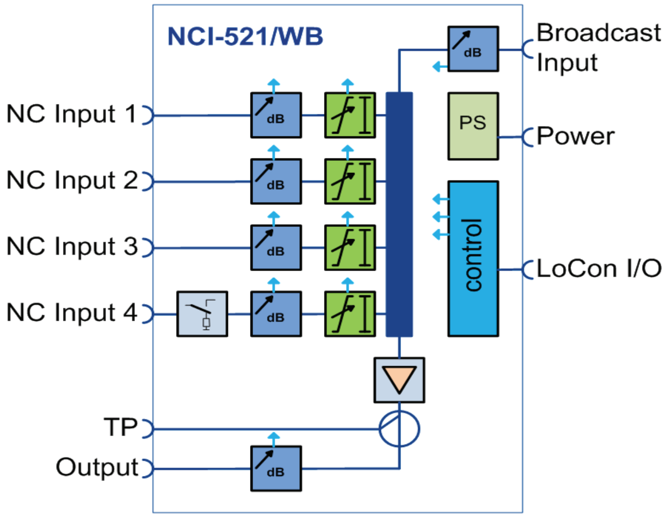


Figure 9: Operation of the NCI-521

NCC-1222 – Controller

The NCC-1222 is the central controller. It also contains the broadcast input with level and slope control, a 3-way splitter, and amplifiers to feed the back plane.

The RF input level is measured and monitored by the controller. When the broadcast signal misses, the controller displays an optical alarm and sends an SNMP trap to the network manager.

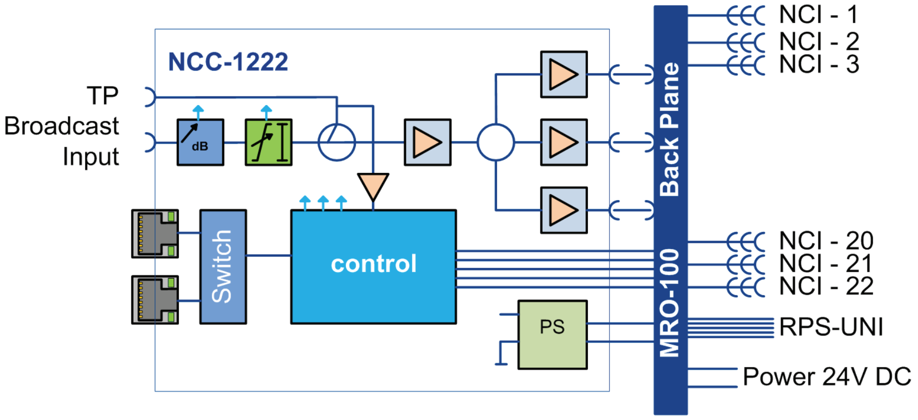


Figure 10: Operation of the NCC-1222

All narrowcast inserters can have their RF input level and slope levels set via the controller. The NCC-1222 controller polls all narrowcast inserters in the rack and checks that they are operating correctly. In case of anomalies, an alarm will be generated and shown on the unit and an SNMP trap will be sent to the network manager.

A power supply for the solution, RPS-UNI, is connected to the controller and all voltages, temperature and cooling fan performance is monitored. Alarms are generated and sent as SNMP traps. This power supply can feed up to four full narrowcast inserter solutions.

The controller has two Ethernet ports so that local use via the built-in web browser will not disturb the SNMP connection with a network management system.

The NCC-1222 is built into a 7 TE wide, 3 RU cassette, which plugs into the back plane. The three broadcast outputs are connected to the back plane. The controller is hot swappable from the front and controls up to 22 NCI-521s via the back plane.

Figure 11 is a diagram of a complete 3 RU rack with 22 narrow cast inserters and the controller. It offers maximum flexibility, high density and full control of each RF signal.

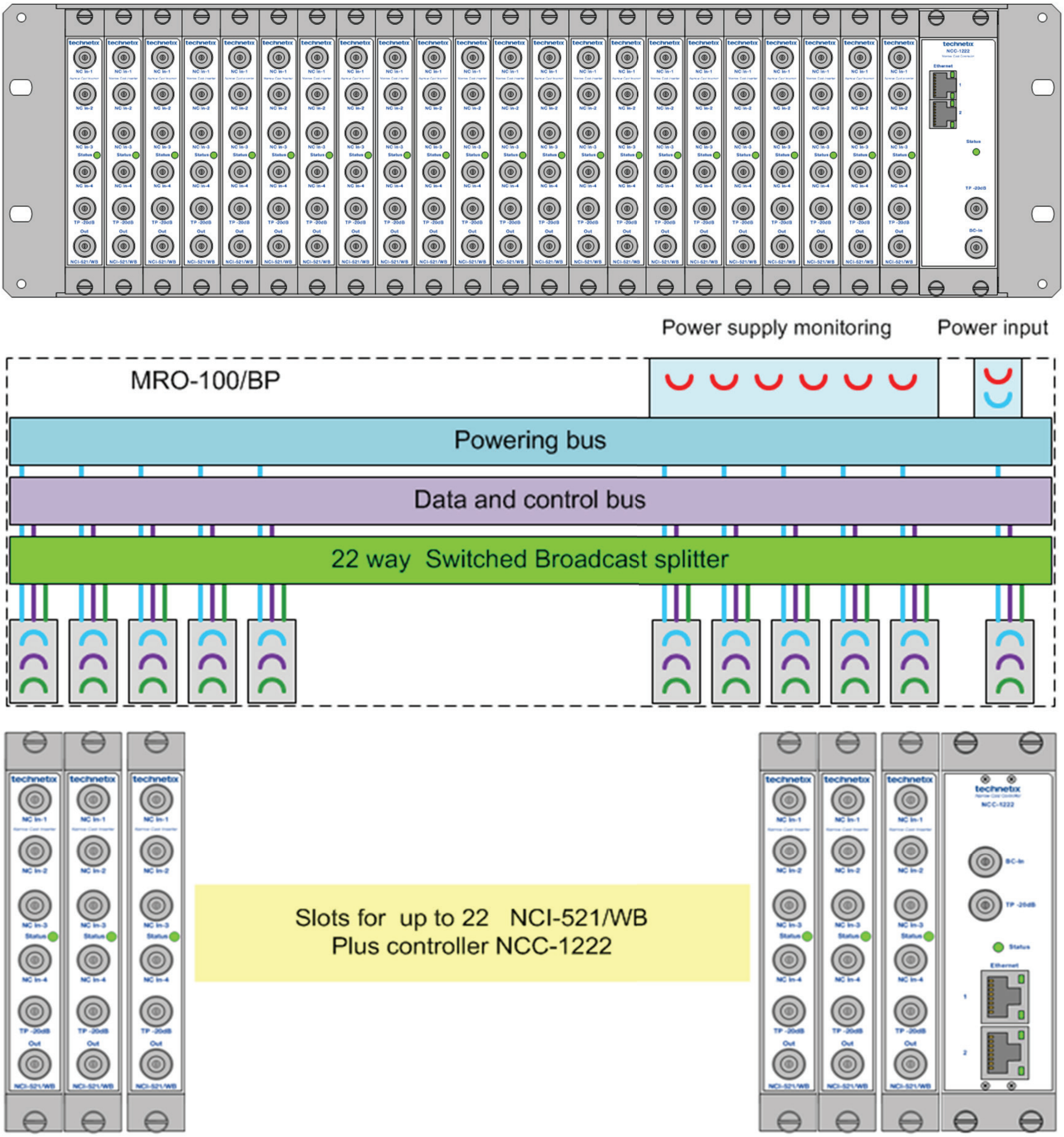


***Figure 11:** A complete 3 RU rack with 22 narrowcast inserters and the controller*

The back plane has a powering input and the I/O for monitoring the RPS-UNI power supply. There is a triple bus system, a powering bus to feed all narrowcast inserters; a data bus to control the narrowcast inserters; and the RF bus.

The RF bus is a switchable 22-way RF splitter which feeds the narrowcast inserter.

A built-in system detects when a narrowcast inserter is connected to the solution, informs the NCC-1222 controller and it is automatically placed in the polling list.

When a slot is open, the RF port is switched off and terminated to avoid radiation and screening issues.

A complete solution in a 3 RU rack will be configured as shown in figure 12 with one NCC-1222 controller and 22 NCI-521 narrowcast inserters.

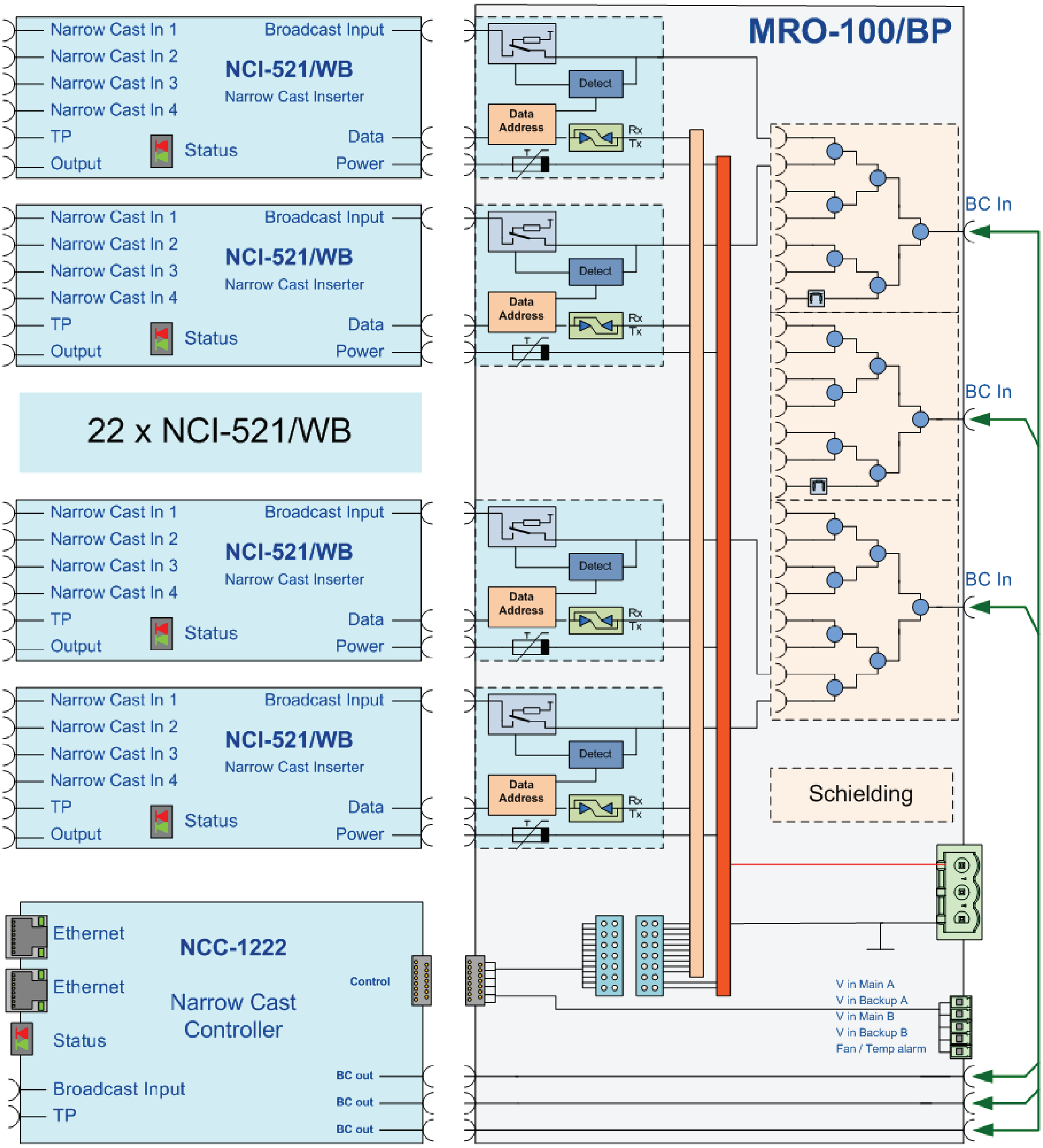


***Figure 12:** Configuration of a complete NCI solution*

By meeting CCAP isolation requirements, the NCI-521 solution enables you to gradually integrate CCAP into your cable network at your own pace. Your network can continue to provide excellent service to your customers by avoiding the interference problems that can occur when signals need to be combined in a hybrid CCAP and non-CCAP headend environment.

For more information about our narrowcast solutions, or to speak with someone about how Technetix solutions can keep your broadband network up to the minute, please call one of our team on +44 (0)1444 251 200 or email us on pm@technetix.com.

About Technetix

Technetix works in partnership with broadband cable network operators to truly understand their needs, and to provide intelligent, customised solutions that help them deliver reliable, innovative services to their customers.

Our Headend solutions are designed for density and modularity; giving maximum flexibility, freeing up critical headend space, and making future upgrades simple and cost effective.

Our Access Network solutions enhance signal quality; reducing operator callouts and minimising maintenance costs.

Our Connected Home solutions enable high quality signals to be received at multiple points within a home; reducing or eliminating operator installation and maintenance costs.

An industry leader for more than 20 years, we're the tried, tested and trusted supplier to more than 1,100 customers in 55 countries.

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