



WHITE PAPER

DIGITAL BROADCAST SATELLITE SYSTEMS: THE BENEFITS OF CHANNEL STACKING SWITCH TECHNOLOGY

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1 *Executive Summary*

Digital Broadcast Satellite (DBS) operators continuously strive to improve their Average Revenue Per User (ARPU). The ability to bundle and add new services and key cost elements such as installation and service costs are critical to their business for growth and customer retention. In particular, operators know that they can increase ARPU by making content more available in additional viewing locations in the home.

Technologies that can increase the number of viewing places in the home, while simultaneously minimizing installation and service costs, are the most sought-after solutions for maximizing ARPU and profitability.

Recent technologies and services under evaluation or being deployed include support for multi-viewer packages, digital/personal video recorders (PVR), high definition (HD) content, and home media centers. Each requires new or additional set-top boxes (STBs) or multi-tuner STBs in the home, and an efficient method to receive the content from the satellite outdoor unit¹ (ODU). Traditionally, multiple tuners have meant an increase in cabling into the home to connect the ODU to each tuner. New tuners or STBs, each requiring a new cable drop, introduce substantial cost burdens and a barrier for achieving higher ARPU.

This white paper presents a solution to these cabling challenges. Channel Stacking Switch™ (CSS™) technology reduces installation cabling complexity and cost for new DBS installations, and provides a simple upgrade capability for add-on STB installations or replacement of multi-tuner STB installations. This technology also creates new markets for both operators and free-to-air installers and retailers by making satellite television viable for many more multi-dwelling units (MDU).

¹ The ODU includes the satellite dish and a low-noise block (LNB) converter.
The ODU can also include a switch mechanism to support multiple connections.

2 Media Trends Contributing to CSS Sales Opportunities

Digital and high-definition broadcasting trends drive demand for STBs and other multi-tuner media center devices. Viewing preferences are simultaneously changing, as consumers discover the freedom of being able to view content at the time and place of their choosing. Content providers are fueling these demands with an ever-increasing array of high-definition programs and event broadcasts. The advertising revenues associated with these high-end broadcast events further drive the industry in the direction of more content-rich, viewer-controlled programming.

All of these trends depend on the proliferation of a wide variety of STBs and PVRs, many equipped with multiple tuners. Each tuner requires a separate channel feeding it. Without CSS, this means a separate cable from the ODU to each tuner. PVR-STB combinations and multi-tuner STBs require multiple cables per box. With CSS technology, a single cable can run to the house with splitters installed to feed multiple STBs and multi-tuner STBs.

Central servers that enable true entertainment enthusiasts to enjoy satellite TV throughout the home are currently being produced. CSS technology combined with a media server solution provides the easiest of all installations with a single cable running from the ODU to the multi-tuner media server. The media server can then process multiple channels from the single cable for display, storage, or distribution to networked devices around the home.

Many avid consumers are willing to upgrade and add-on to take advantage of the latest viewing technologies, but are hampered by complex cabling of non-CSS configurations.

3 *The Cable Challenge*

As mentioned above, in a traditional DBS installation, each tuner is connected directly to the ODU with a separate coaxial cable. Cabling must be added in situations where additional STBs or multi-tuner STBs (e.g., simultaneous watch and record) are added or services are extended to numerous units in an MDU.

Installing additional cabling introduces many drawbacks:

- Installation visits (truck rolls) are very expensive.
- Wiring and installation procedures become more complex and time consuming.
- Potentially ugly wiring is introduced around the dwelling.
- Some customers become unserviceable due to access limitations or other wiring restrictions imposed by home owners' associations or local ordinances.

4 CSS Technology: Stacking Channels on a Cable

All of these drawbacks are eliminated by the use of channel stacking systems. CSS technology implements a channel-stacking scheme — multiple channels can be transmitted on a single cable based on the demands from multiple STBs and tuners connected to that cable. A single cable drop from the ODU provides each STB tuner with dedicated channels, eliminating the need for multiple cables. (See Figure 1.)

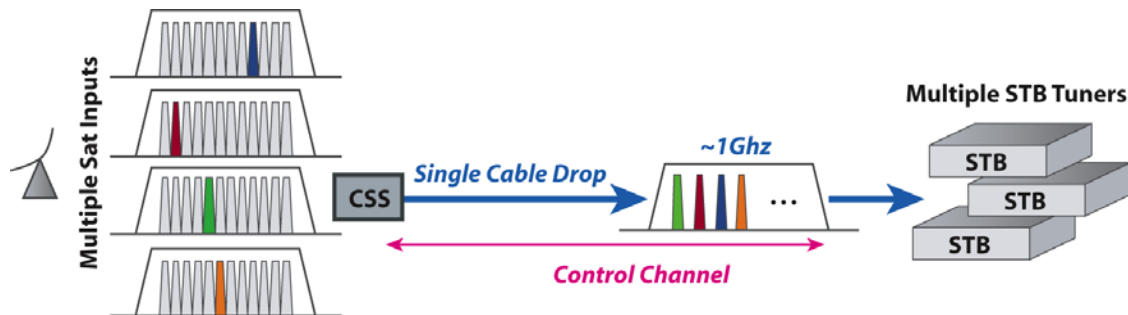


Figure 1: CSS technology enables a single cable to drive multiple STBs and tuners.

In-home receivers communicate with a CSS-enabled ODU to request specific channels. The CSS translates a particular satellite channel of interest and passes thru a dedicated SAW filter. The desired channels are then combined, or in other words, 'stacks' them, onto the single cable. The ODU also tells each receiver where a requested channel is located.

4.1 Bandwidth and STB Capacity Per Cable

These DBS systems typically transport programming from the ODU to STB using a frequency range of 950 to 2150 MHz, which provides a useable bandwidth of 1.2 GHz. Individual transponders are typically only 20 to 36 MHz wide, depending on satellite transmission symbol rates. For example, if a CSS system converts and passes desired channels with a typical surface acoustic wave (SAW) bandpass filter, about 12 individual channels can be stacked on a single cable. This translates into the ability to support at least 12 separate, active STBs or tuners on a single cable drop. With narrower separation between SAW filters, up to 30 channels can be stacked on a single cable.

4.2 Industry Standards

Stacking channels on a single cable requires an extension to the existing communications protocol between the STBs and the ODU. CENELEC, the European Committee for Electrotechnical Standardization, is currently ratifying a proposed extension of a Digital Satellite Equipment Communications (DiSEqC) standard incorporating CSS technology into the specifications that define communications between an STB and the CSS ODU. STB manufacturers have already endorsed the emerging standard, and currently marketed STBs incorporate support for CSS technology. Firmware upgrades will enable the functionality. Other efforts are under way, driven by interested companies and consortiums, to develop a standard for performance requirements pertaining to the ODU.

The standards efforts uniformly recognize CSS technology as a viable solution. Additionally, CSS technology will be included in emerging satellite broadcast standards. As such, broadcast service operators and installation service companies alike can confidently take advantage of the more intelligent cabling options enabled by CSS technology.

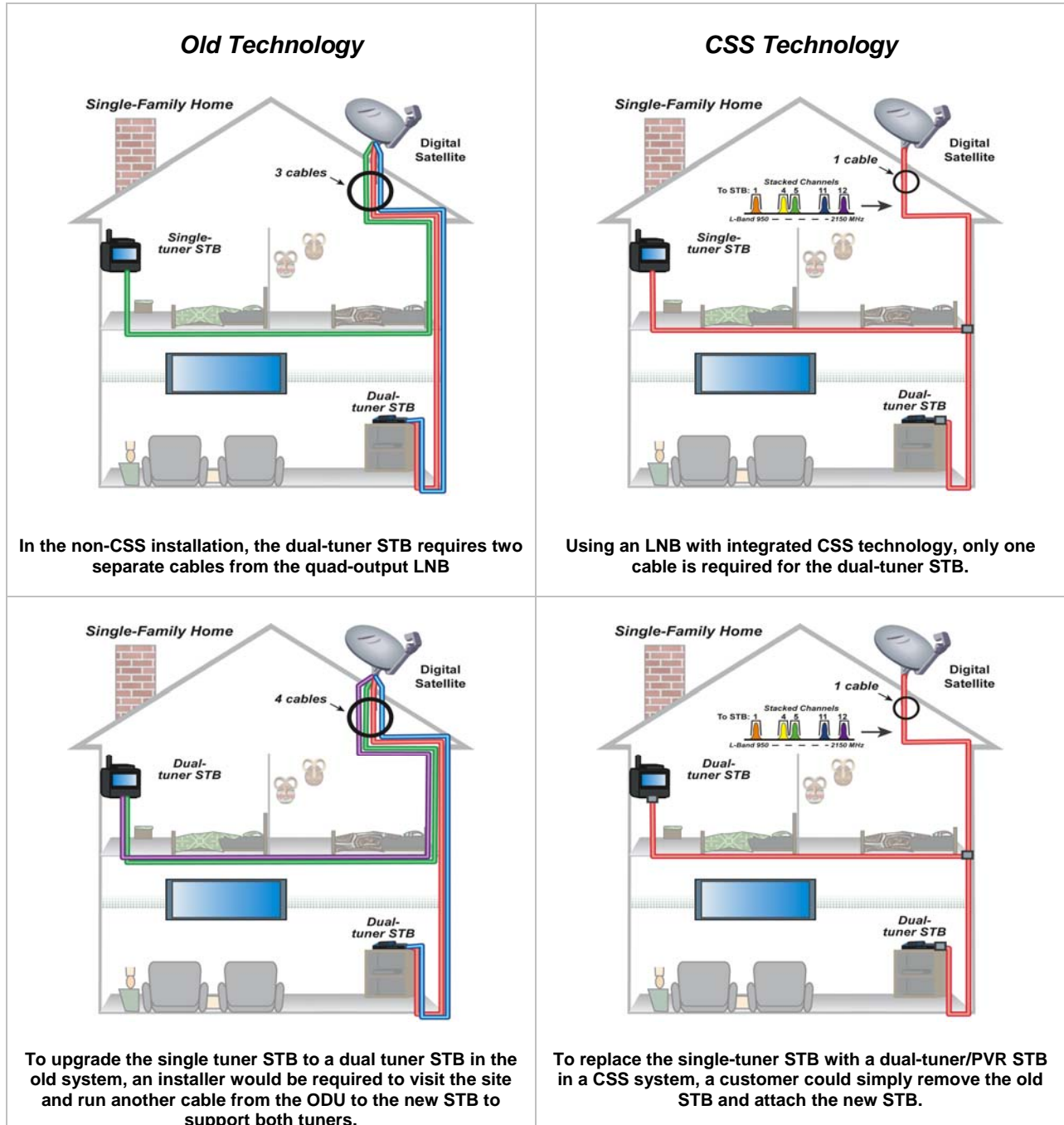
5 Sample Installations

To really see the advantages of CSS, it is useful to review some examples.

5.1 Single-Family Home (SFH)

Below are examples of a SFH with one dual-tuner/PVR STB and a single-tuner STB that is upgraded to a dual-tuner/PVR STB with traditional technology and with CSS technology. (see Figure 2.)

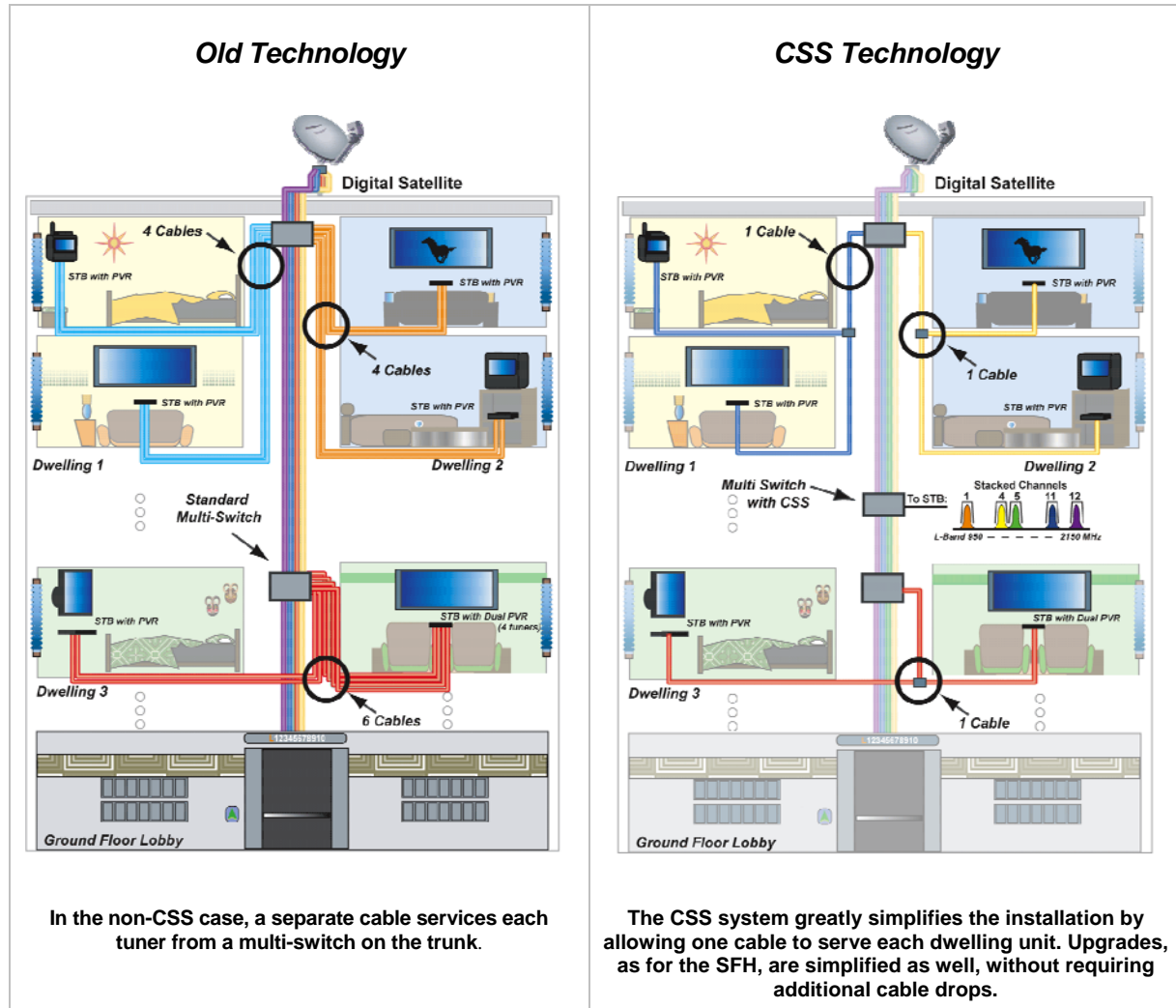
Figure 2 A Typical SFH Installation



5.2 Multiple-Dwelling Unit (MDU)

A small MDU can be treated much like the previous SFH example. For a larger MDU, a trunked system is commonly used. (see Figure 3.)

Figure 3 A Typical MDU Installation



6 Economic Opportunities Driven by CSS Technology

The ease of installing new satellite TV systems and adding STBs to existing systems with CSS as shown above enable new opportunities for operators, installers and retailers to generate revenue.

6.1 Increased Sales to the SFH

The simpler cabling and installation procedures encourage the proliferation of 2nd and 3rd room viewing sites within homes. Additional viewing sites translate into sales of additional content and equipment. Upgrades, such as replacing basic STBs with PVRs, will be more attractive to consumers as additional cabling will not be necessary. Upgrades from basic STBs to PVR recorders allow sales of higher priced equipment and can be used to leverage sales of more time-shifted content to subscribers.

6.2 Increased Sales to MDUs

In MDUs, wiring access is often problematic. Now, with channel stacking, a single cable running from the MDU trunk line can run into an apartment to service multiple receivers. Apartment dwellers can now be approached very much as SFH dwellers — with promotions for 2nd and 3rd room services as well as PVR upgrades.

In smaller MDU configurations (perhaps 4 to 8 apartments, total), CSS technology can eliminate the traditional trunk line in lieu of a single cable drop. Each apartment can have dedicated channel slots assigned to them on a route and branch cable configuration.

7 ARPU and Profit: Revenue and Cost Considerations

Both situations above enable increased content, equipment sales, and fees for equipment use.

From current posted pricing information, BSkyB charges nearly 66€ (99£) for each Standard Definition PVR STB and nearly 200€ (299£) for a High Definition PVR STB. Sky Italia's price for renting additional PVR STBs is a 7€ premium.

Along with the rental or usage fees for STBs and PVRs, CSS technology directly affects the ability to drive increased ARPU from content sales. Additional viewing locations, made more attractive to the consumer with simpler and therefore more affordable cabling and installations, drive the demand for more content. With more STBs and PVRs per site, consumers are also more likely to order premium channels, sports packages (especially with HD), and special event broadcasts such as the current World Cup competitions that are hugely popular in Europe. These additional channel packages can range from 8€ to 35€ and more.

In addition to driving up revenues, CSS technology also drives reductions in costs. This serves to lower customer acquisition and upgrade costs resulting in increased profitability.

- Lowering costs of STB upgrades and add-ons
 - In a traditional system upgrading a single tuner STB to a dual tuner PVR STB or adding a new STB requires a service visit to run an additional cable from the ODU to the new STB. This can cost the installer/customer on the order of 100€. In a CSS system, the customer can simply replace the old STB with the new STB or add the new STB using the existing cable run in both cases. The installation cost for this upgrade is zero.
- Lowering costs of initial installations
 - This depends much on the extent of existing in-home wiring, the number of STBs/tuners, and the local labor rates. The cost savings can be substantial for installations with several STBs/tuners that would traditionally require several cable runs from the ODU (e.g., an Octo LNB).
- Lowering costs for MDUs
 - Since many MDUs already have in-flat cabling, the cost difference for adding or upgrading DBS service to a flat off a traditional trunk system versus a CSS trunk system is substantial. For the traditional system, new cables must be run into the flats when more than one STB is installed. For the CSS system, no new cabling is required.

8 Other Benefits

While increasing revenues and lowering costs are strong drivers for using CSS technology, there are some other benefits as well.

8.1 Aesthetics

CSS technology eliminates unsightly cables that run from the ODU to a variety of points into the home. It can also eliminate the use of satellite dishes on the balconies of MDUs that create a cluttered appearance.

8.2 Scalability

There are no real limits to the number of units served by a single dish or multiple dishes when using a trunked CSS system.

For SFH or small MDUs, systems can cascade additional inputs and outputs to stack more channels on the single cable to service more STBs/tuners from that cable.

8.3 Simplicity, Reliability

Cable connectors are often the weakest points of reliability in a DBS system. Fewer cables and connectors provide simplicity and increased reliability compared to non-CSS configurations.

8.4 Self Installation

This simplicity also facilitates self installations, an important factor in FTA markets. Installing a 4 or 8 output channel CSS LNB with a single cable from the ODU into the home is vastly easier than installing a traditional Quad or Octo LNB with 4 or 8 separate cables running from the ODU into the home.

9 Conclusion

CSS technology offers satellite service providers and free-to-air installers significant opportunities to:

- **Increase subscriber and equipment revenues:** Simplified cabling scheme eliminates barriers for adding multi-tuner STBs and add-on STBs in homes and MDUs. New STBs, with support for value-added features like PVR and HD content, drive up ARPU for operators and equipment sales to FTA customers.
- **Simplify and lower cost of upgrades:** No new cable drops are needed for new STBs so upgrades are significantly easier and much less expensive.
- **Simplify new installations, lower costs, better system reliability and improve aesthetics:** Much less cabling and connectors are required compared to non-CSS installations.

These CSS benefits are critical with the growing number of viewing locations and opportunities to offer more content with increasingly available feature rich STBs that include functionality like simultaneous watch and record (PVR or DVR), high definition, and in-home redistribution of content (media centers). Also, by eliminating the extra cabling into the home and MDU, CSS systems make DBS more marketable against cable and terrestrial TV systems. CSS technology is available now to meet the needs of DBS operators and FTA retailers and installers.