



Concept:

DTV Broadcast / 4G Radio Base Station Integration

**CONFIDENTIAL**

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## **Current Situation**

### **Case #1: Cable TV in Transition**

- Cableco monopolies/territories are being deregulated.
- Costs for new entrants to overlay on an incumbent's territory are prohibitive in most instances.
- Incumbents, however, may want to leverage their infrastructure by extending their territory.
- Extending the incumbent's HFC (Hybrid Fiber Co-ax) network could prove to be cost prohibitive.
- DTV (Digital Television) broadcast; combined with 4G wireless technology<sup>1</sup> could be a way of affordably extending triple play access.

### **Case #2: TV Broadcasters Transitioning from Analogue to Digital Television Broadcast**

- In countries such as Canada, Cable TV & Direct-to-Home satellite penetration is extremely high (~ 90%)<sup>2</sup>.
- Many TV broadcasters are resisting the transition to Digital Television broadcast because the cost of offering an ATSC transmitter/antenna is hard to justify for ~10% of their viewing audience.
- The transition to DTV broadcast could be made more palatable if the TV broadcaster could compliment their off-air broadcast signal by also having a premium WISP offering.

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<sup>1</sup> WiMAX or LTE (Long Term Evolution).

<sup>2</sup> There is an uptick in over-the-air (OTA) reception because of the quality of DTV Broadcast.

## Concept

- Use DTV broadcast<sup>3</sup> as means to delivering video services.
- Use a 4G wireless technology (WiMAX or LTE) as means of delivering Internet service and VoIP.
- Both technologies, disparate up to this point, would be combined into a single radio frequency (RF) platform at each base station.

## Advantages for a Cableco

- Capex: Wireless infrastructure cheaper than extending a cableco's HFC.
- Opex: Lower network maintenance costs.

## Considerations for the Cableco

- Video services are limited by the amount of DTV broadcast spectrum held by the operator<sup>4</sup>. Replicating "Basic Cable" in SD could be bandwidth intensive.
- Could be mitigated through the use of low power, cellular style network topology that benefits from the efficiency of frequency re-use.

**NOTE:** The larger opportunity may be for the cableco to not be concerned with extending its video services and instead focus on a dual play extension – where they wirelessly extend Internet service and VoIP. This is believed to be happening in the US with the cablecos who have invested in Sprint's CLEAR WiMAX business.

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<sup>3</sup> Could be ATSC or DVB-T.

<sup>4</sup> Assume 4-6 program streams per 6 MHz ATSC channel.

### **Advantages for the DTV Broadcaster**

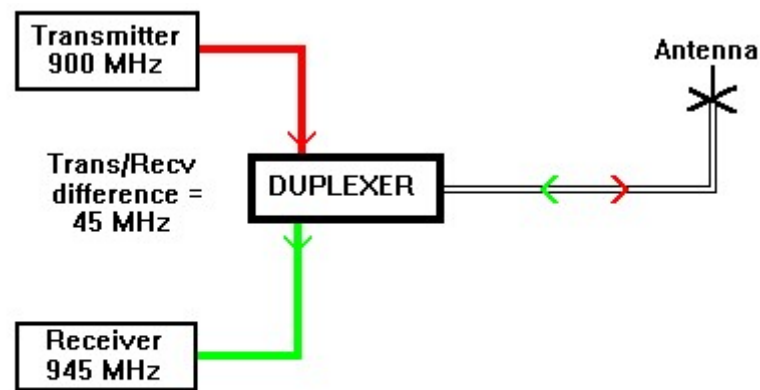
- New service model with new revenue source.
- Significant cross-promotion opportunities between the DTV broadcast & Internet services.

### **Considerations for the DTV Broadcaster**

- Transformation from a broadcaster to a hybrid broadcaster and wireless internet service provider is a paradigm shift from a marketing & regulatory perspective.
- Issues/opportunities around spectrum. Use of DTV spectrum for both services (DTV & 4G) is technically possible. A more realistic approach would be for the broadcaster to acquire spectrum dedicated to WiMAX.
- This model is likely most applicable to small market broadcasters with large coverage and plenty of rural viewers who do not have satisfactory internet access under current offerings.
- Large market stations are less financially burdened by the DTV transition and therefore may be less desperate for new revenue streams. Large market stations would also face immediate competition from incumbent ISPs (typically DSL & DOCSIS).

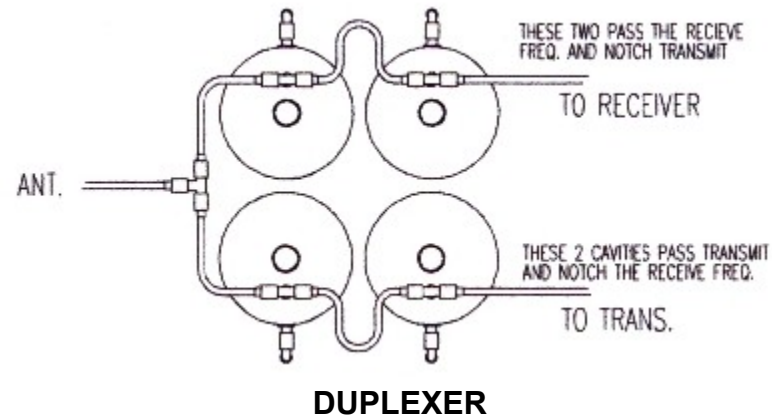
## Addressing Technical Challenges

- 4G wireless is two-way (Send/Receive  $\Leftrightarrow$  Uplink/Downlink) between Base Station and Customer Premises Equipment (CPE)/subscriber equipment.
- When using a single antenna, a duplexer is needed to isolate the uplink radio frequency (RF) energy and downlink RF energy.



SIMULTANEOUS SIGNAL FLOW THROUGH A DUPLEXER

A duplexer is a type of RF filtering system and is standard equipment at a 4G wireless base station.

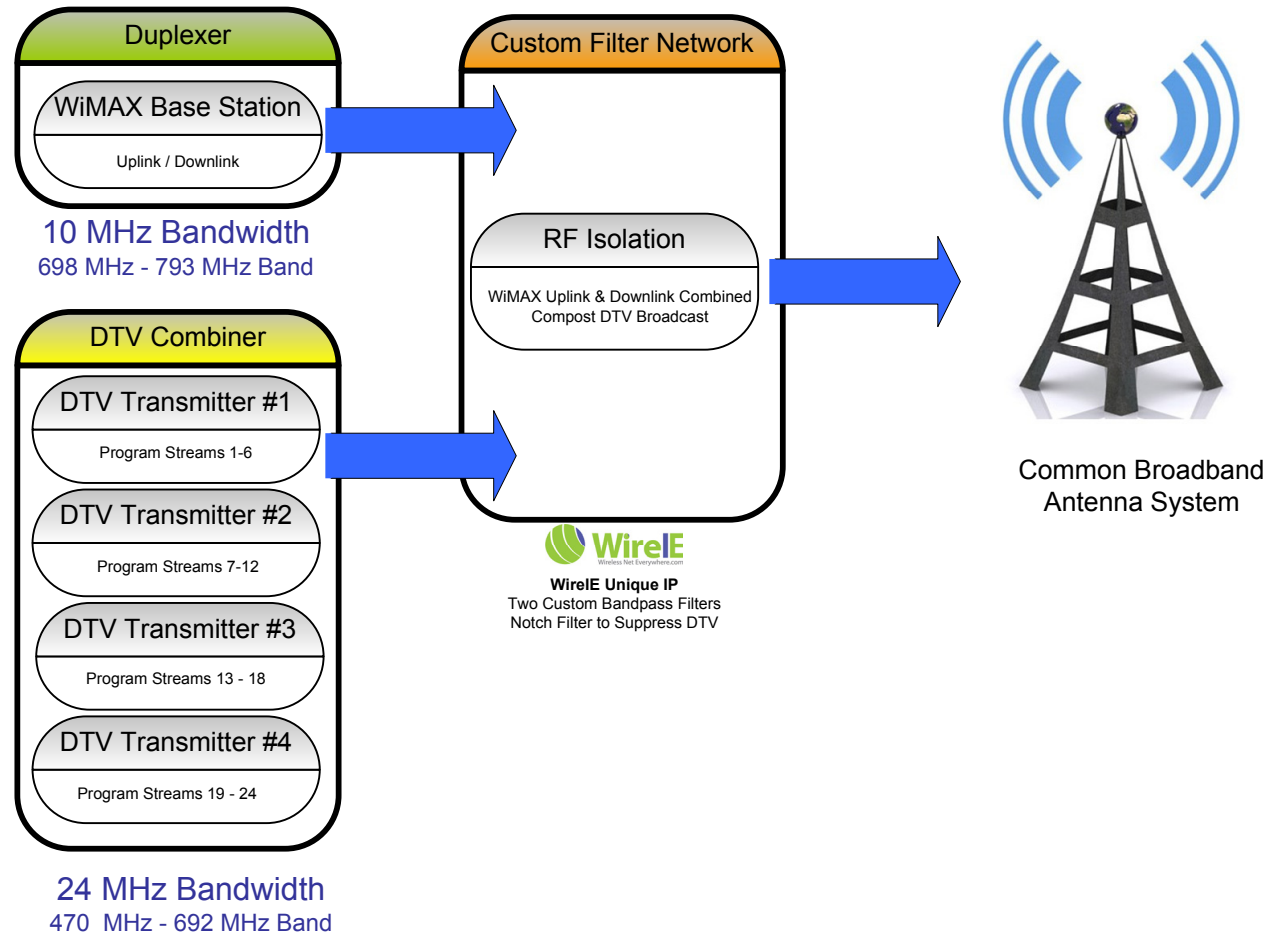


- Unlike 4G, DTV broadcast is one-way (*downlink* from transmitter to TV set or set-top box).
- As such, the RF signal path of 4G wireless is not inherently compatible with DTV broadcast.
- Where more than one DTV broadcast channel is feeding a single antenna system, a combiner is required.
- A combiner is a type of RF filter.
- Unlike a duplexer (which isolates transmit and receive RF energy), a combiner isolates transmit energy from two or more sources using the same antenna.

## Sharing a Common Antenna System Amongst 4G Wireless & DTV

- If a DTV broadcast transmitter is to share a common antenna with a 4G wireless base station, RF energy of the DTV broadcast must be isolated from that of the 4G wireless base station.
- Isolation between the 4G wireless uplink and downlink must also be maintained.
- There are now three RF paths using a common antenna
  1. 4G transmit (downlink)
  2. 4G receive (uplink)
  3. DTV transmit (downlink only)
- A custom filtering network needs to be built to accommodate 1, 2 & 3 in combination.
- Additional considerations resulting in a unique filter system are:
  1. The high power of the DTV transmitter (relative to the WiMAX transmit power).
  2. Multiple RF channels for the DTV transmitter (contiguous broad, band pass)
  3. Multiple RF channels for the DTV transmitter (noncontiguous band pass requiring each channel to be filtered independently)

## High Level of WireE's DTV Broadcast / 4G Network Filter Concept



- The solution is accomplished through custom designed filtering – the specifications of which would be unique to WireE.



- Without isolation through filtering, RF energy to and from the antenna is lost – significantly impacting service. Site transmitter and receiver equipment is also at very high risk of being damaged.
- What is unique in the WireE solution is we will specify a network of filters which go beyond the standard combiner (multiple DTV channels) & duplexer (WiMAX uplink & downlink).

### **Caveat**

4G network equipment vendors are moving in the direction of tower-top installed RF Head Units (RFU). The RFU is an integrated system with an antenna, duplexer and a transmit power amplifier. It may also have a pre-amplifier to improve the uplink (receive) performance.

The RFU is fed the intermediate frequency (IF) baseband via CAT5e cable and can be powered using Power over Ethernet (PoE) or other dedicated means. This means duplexing occurs at the tower top – away from the DTV filtering at the bottom of the tower.

In order for the concept of incorporating 4G wireless and DTV broadcast on the same antenna system to be viable, equipment vendors must offer non-RFU configurations. Specifically, the 4G wireless base stations must be capable of delivering RF to the tower top (via heliax cable), as opposed to delivering IF to an RFU at the tower top.