Distributed Transmission System
MFN vs. SFN

January 13, 2010

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CTB DTS vs. Traditional Broadcasting System

- A Distributed Transmission System uses many strategically placed low power broadcasting stations while a Traditional Broadcasting System uses a single high power station with very tall tower. Advantages of the DTS are:
  - Better coverage:
    The designated broadcasting areas are evenly lit up.
  - Lower cost:
    A typical transmitters are 5 to 25 W instead of 15 KW.
  - Scalable deployment:
    The area coverage can be flexible based on the terrain.
- There are two types of Distributed Transmission Systems. One is the CTB Multi-Frequency Network (MFN) which uses multiple frequency channels. The other is Single Frequency Networks (SFN) which uses only one frequency channel.

MFN	ADVANTAGES:	Unlimited Bandwidth by Frequency Reuse. Scales to Demand. Enables Micro-Location Based Services
	DISADVANTAGE:	Requires Multiple Channel Licenses.
SFN	ADVANTAGE:	Uses Only One Channel.
	DISADVANTAGES:	Fixed and Limited Bandwidth. High Cost of Engineering (Synchronous). Self-Jamming.

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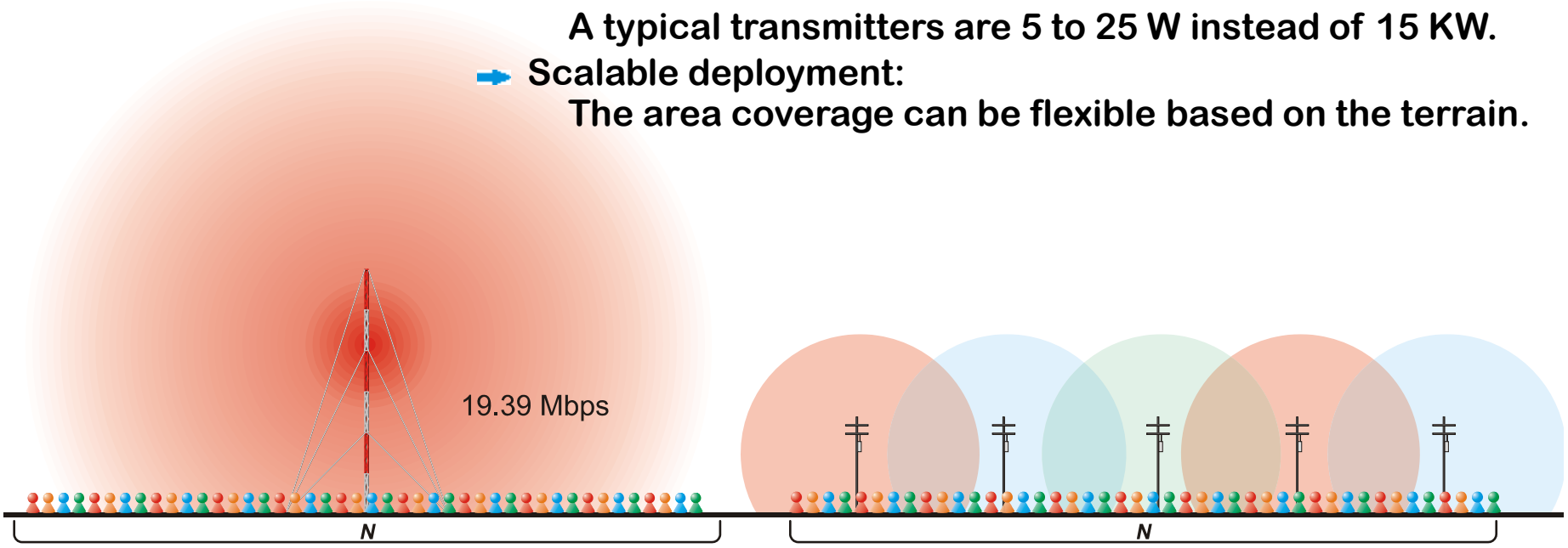

Traditional Broadcasting System Distributed Transmission System

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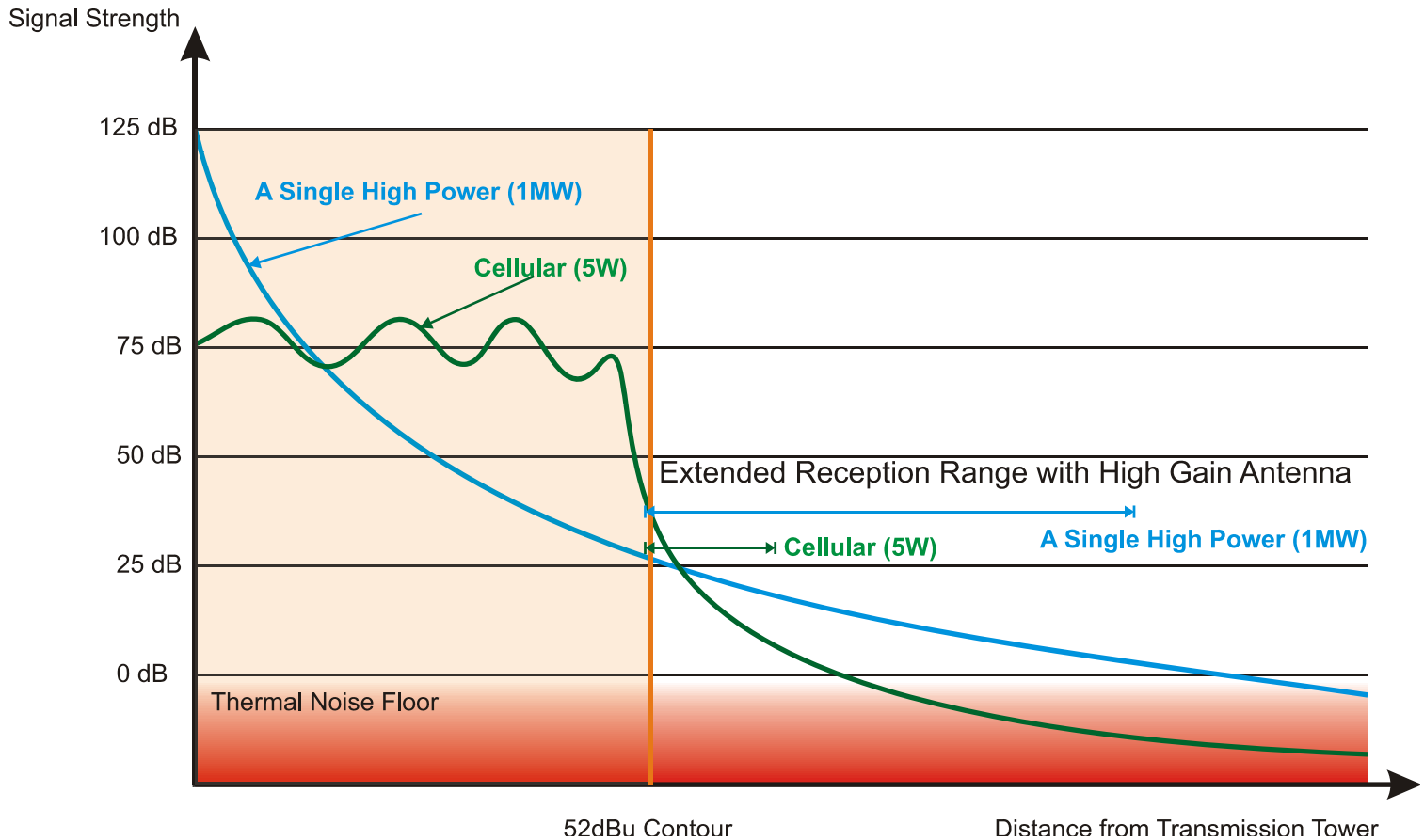
Distributed Transmission System Quality Advantage

Better Coverage

The designated broadcasting areas are evenly lit up, enabling mobile antennas to receive good signal quality equally over the service area using low power transmitters.



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MFN vs. SFN

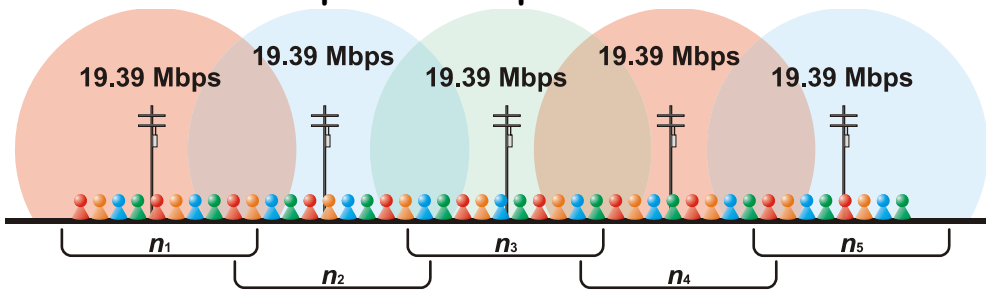
Multi-Frequency Network (MFN)

ADVANTAGES:

- Unlimited Bandwidth by Frequency Reuse.
- Scales to Demand.
- Enables Micro-Location Based Services.

DISADVANTAGE:

- Requires Multiple Channel Licenses.



$$N = n_1 + n_2 + n_3 + n_4 + n_5$$

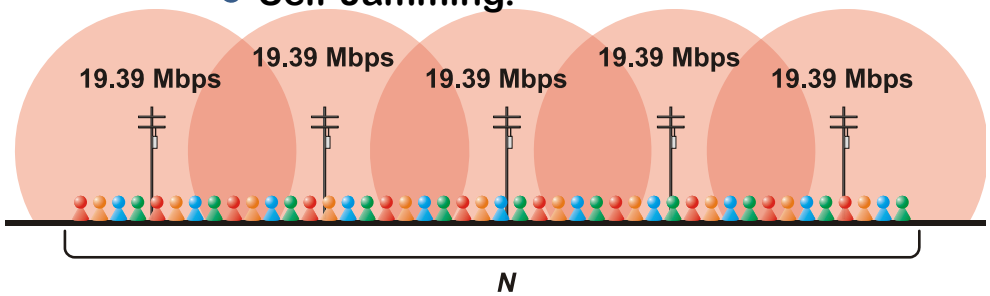
Single Frequency Network (SFN)

ADVANTAGE:

- Uses Only One Channel.

DISADVANTAGE:

- Fixed and Limited Bandwidth.
- High Cost of Engineering (Synchronous).
- Self-Jamming.



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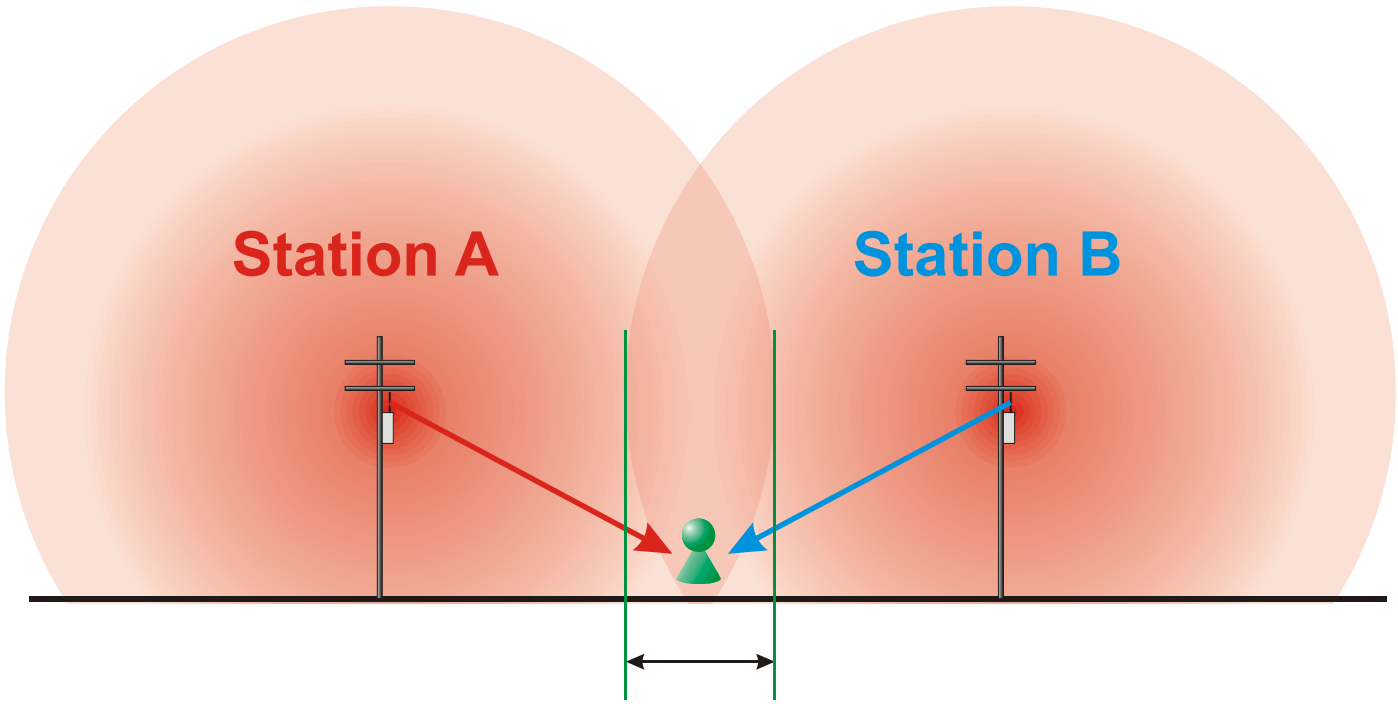
Problems with SFN Systems

- **Self-Jamming.**
  Signals from the other DTS stations create noise.
- **Higher Cost of Engineering and Deployment (Synchronous).**
  In order to avoid the self jamming, the other stations must be precisely coordinated and transmit their signals synchronously.
- **Constrained by limited bandwidth, NO Frequency Reuse.**
  The signal and contents for these stations must be identical.



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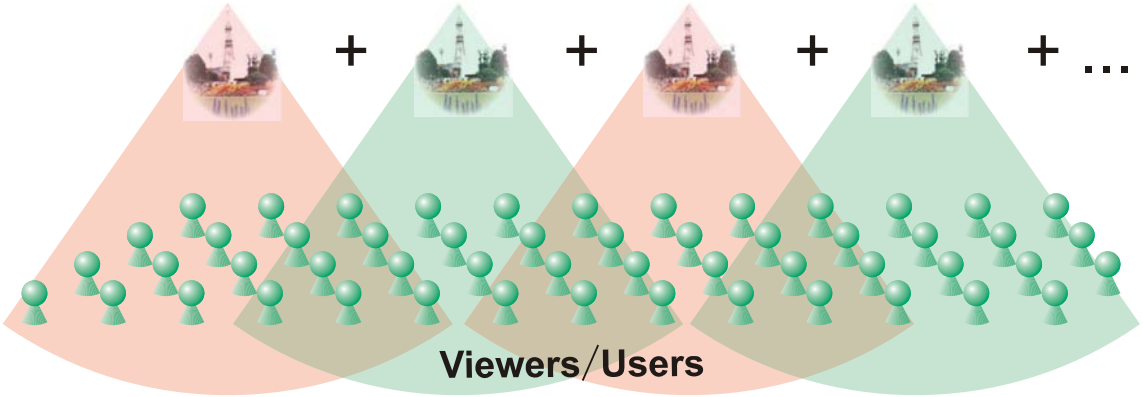
CTB Advantages Part 1

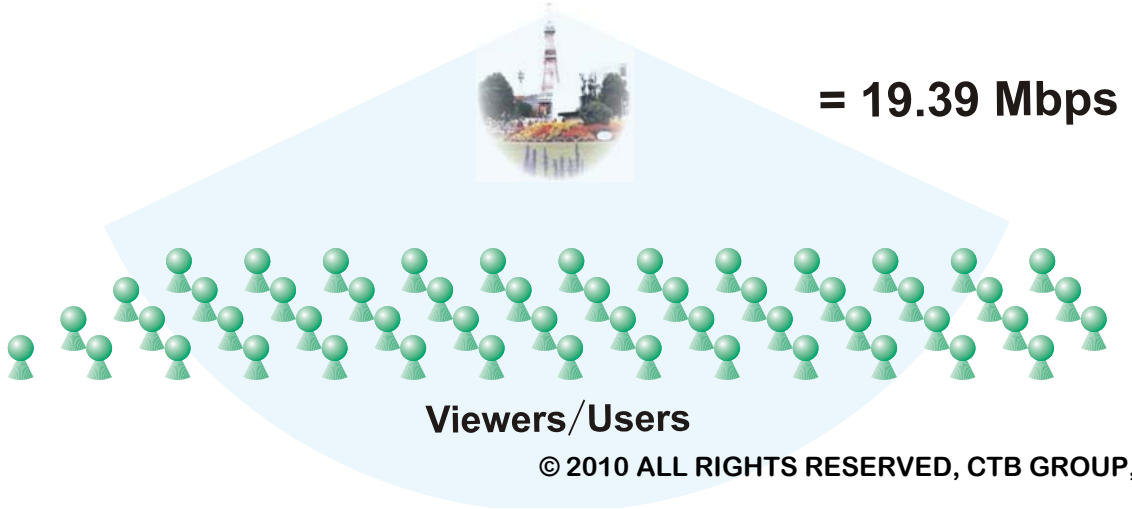
Cellular Terrestrial Broadcasting



- Unlimited Mobility
- Unlimited Bandwidth
- Flexible Coverage
- Low Cost Small Facilities
- No Bulky Antennas
- Location-Based Service

19.39Mbps + 19.39Mbps + 19.39Mbps +19.39Mbps + … = 77.56 Mbps + …

Conventional Broadcasting



= 19.39 Mbps

- Limited Mobility
- Limited Bandwidth
- Limited Coverage
- Costly Large Facilities
- High-Gain Antennas
- Not location-based

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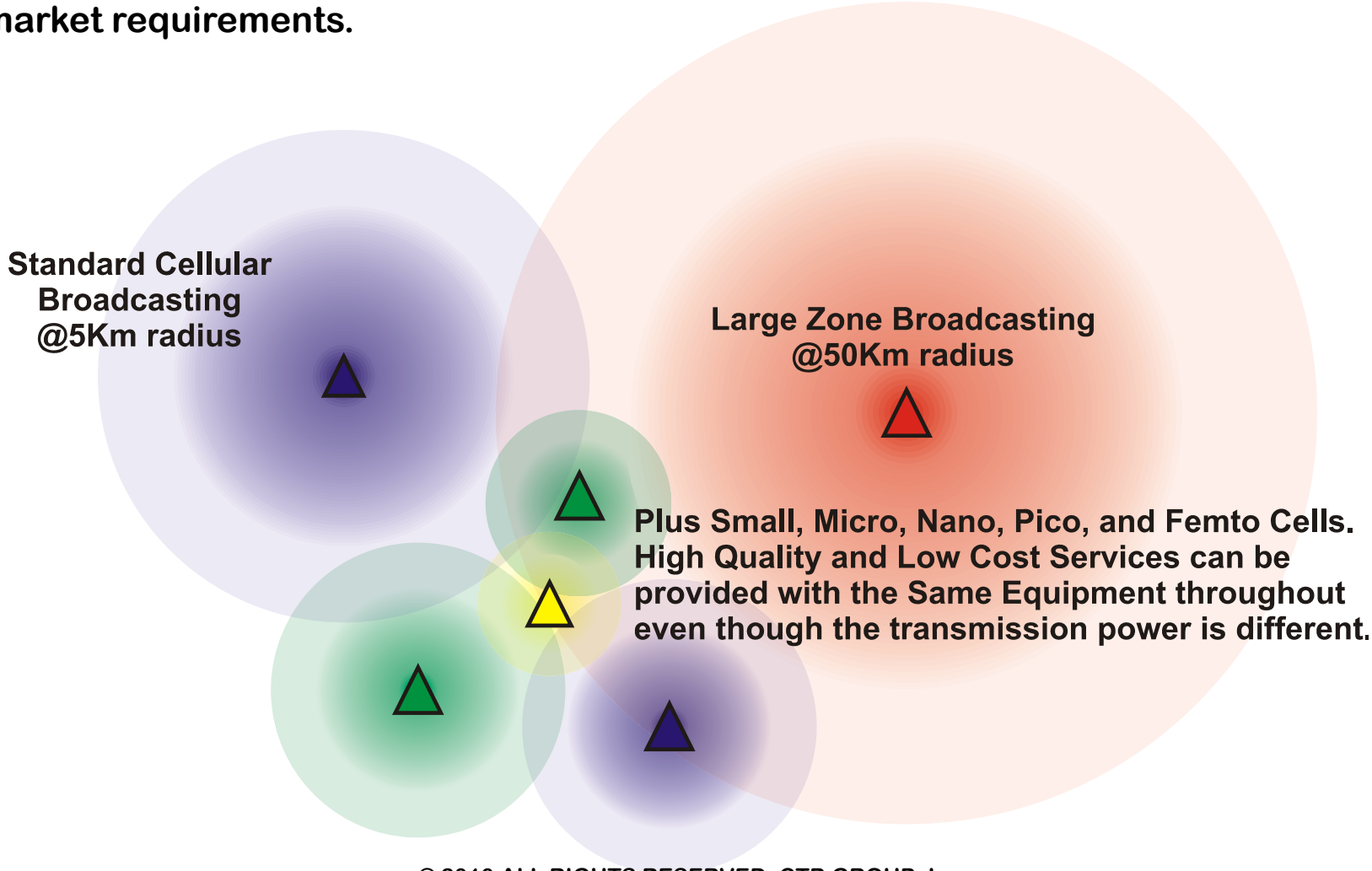
CTB Advantages Part 2

CTB is a Digital Broadcasting Service, Optimized for Broadband Down Links. Frequency reuse over multiple cells meets the various capacity demands required to serve the local population density. It scales to match both Urban and Rural market requirements.



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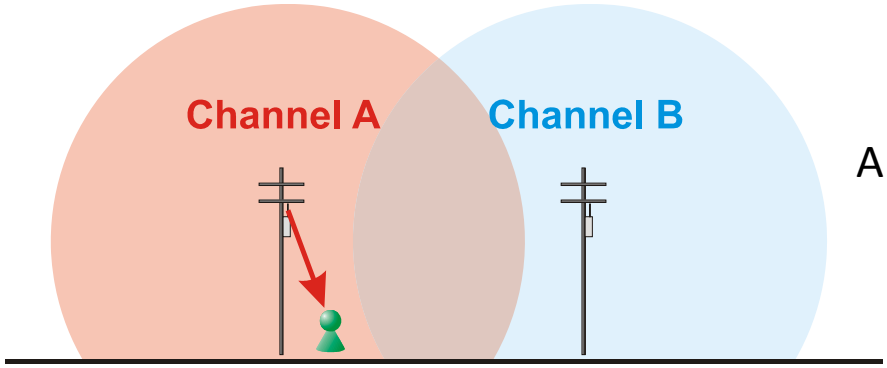
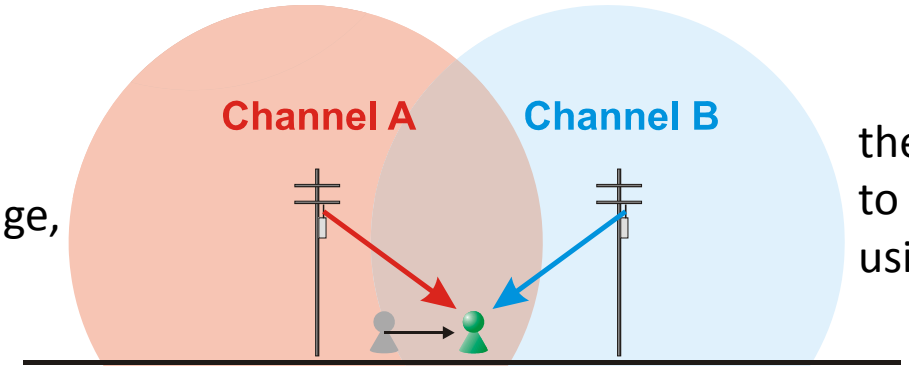
CTB Advantages Part 3

Cellular Terrestrial Broadcasting Supports Mobility with Hand-Over Technology.



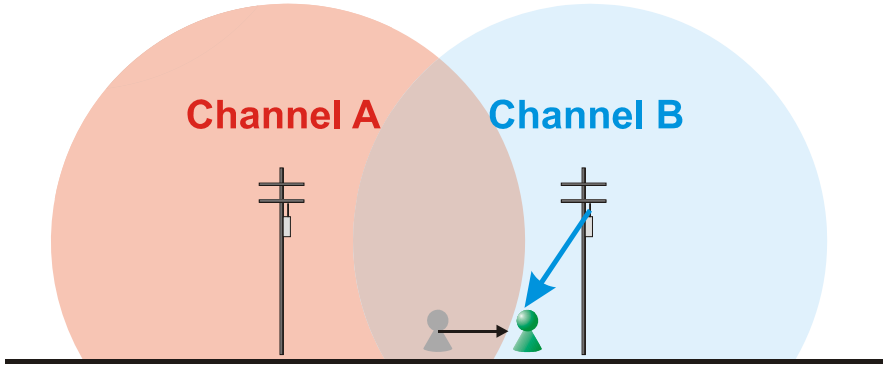
A CTB User watching via Channel A.

When the User moves to the cell edge,



the User Equipment knows to switch to Channel B using the Channel Map.

The User Equipment correlates the data stream from Channel A and Channel B, and the hand-over is completed.



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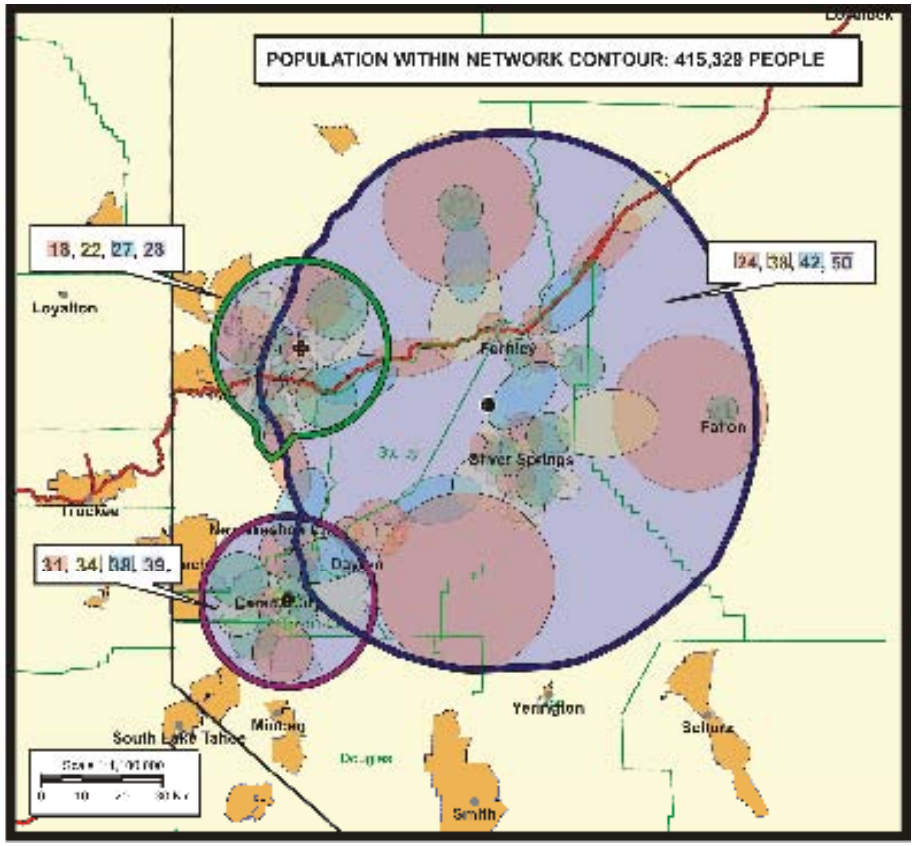
CTB Deployment Example Part 1

This Map of Reno depicts how multiple licenses can be deployed.



There are four licenses in each of the coverage areas in this picture. Reno (Ch.18,22,27,28), Carson City (Ch.31,34,38,39) and Silver Springs (Ch.24,38,42,50) have 12 licenses with 11 discrete channels aggregated.

One way to deploy DTS is to place homogeneous sized cells over each area.

In this example, <u>one</u> channel for each area is used as an umbrella cell to cover the entire licensed area. The rest of the channels are used for smaller cells placed where the population centers are located. Medium to larger cells are used to cover less densely populated areas and over the transportation corridors.

The deployment costs may be further reduced by installing multiple channel transmitters at the base stations using directional antennas (Sector Implementations).

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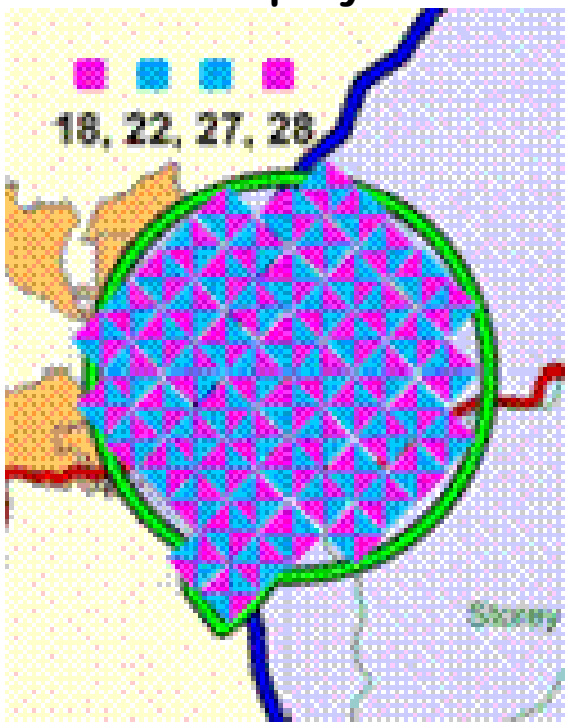
CTB Deployment Example Part 2

Close-up section of the Map of Reno, illustrating how a four 90° sector cellular frequency reuse plan can be deployed.



There are four licenses in the Reno coverage area. Channels 18,22,27, and 28 are used as two channels per sector in this example. Any modular number of channels pairs can be used to increase capacity.

In this example, one channel for each area is used as an umbrella cell to cover the entire licensed area. The rest of the channels are used in smaller cells placed over the high density locations of the population.

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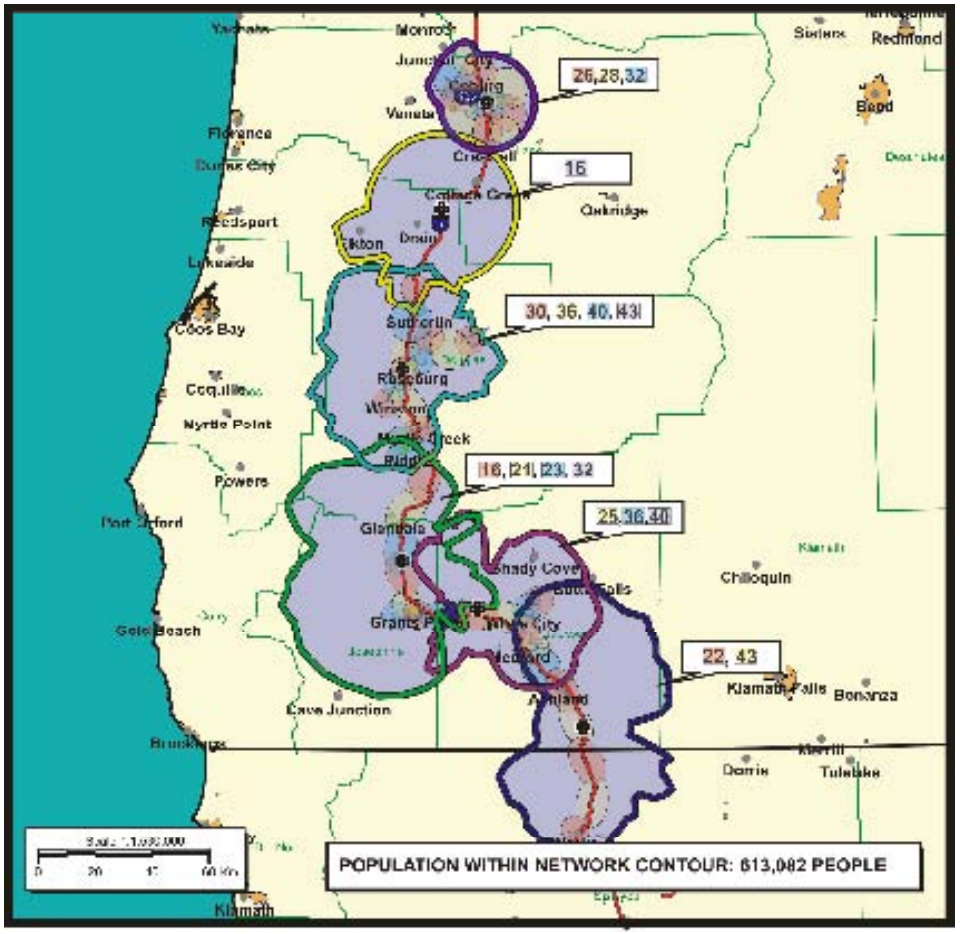
CTB Deployment Example Part 3

The Map of I-5 in Oregon, is an example of how to deploy over the highway corridors.



There are one to four licenses each for six Licensed areas in this region. Coburg (Ch.26,28,32), Cottage Green (Ch.16), Roseburg (Ch.30, 36,40,43), Grants Pass (Ch.16,21,23,32), White City (Ch.25,36,40) and Ashland (Ch.22,43) have 17 licenses with 14 channels aggregated.

Cottage Green has only one license. Therefore, we treat the entire area as one very large cell.

In this example, small cells are used in the high density population centers. Medium to large cells are used to cover the less densely populated areas and the transportation corridors.

One channel is used as an umbrella cell to cover the entire area when more than four channels licenses are available (e.g., Roseburg, Grants Pass).

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