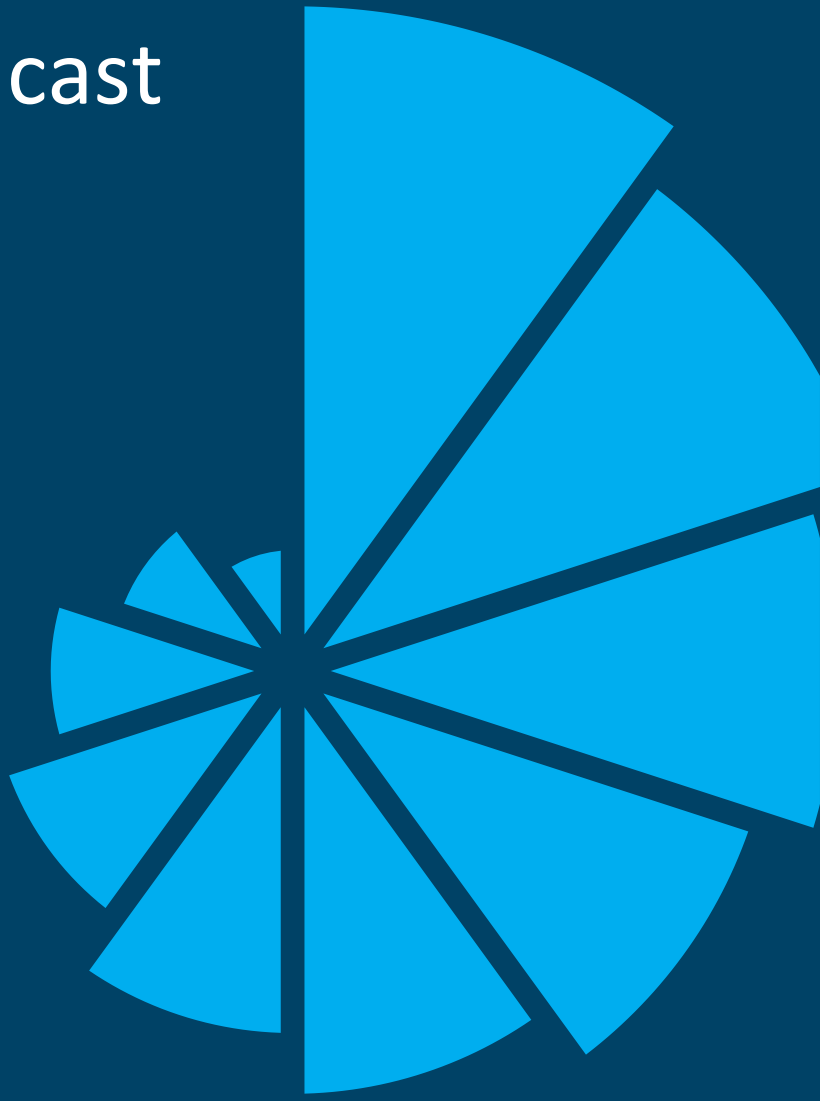
elenos group
DEDICATED RELIABLE CREATIVE

Elenos Group World Broadcast

You've got gaps…

We've got solutions!



Innovation lives here

Webinar Schedule

- The Million Dollar Question
- About Elenos Group
- What are gaps?
- Gap solutions
- Translator varieties and theory
- On channel digital repeaters
- Single frequency networks explained
- Our complete range of solutions
- Q&A

Your host:
Chuck Kelly
VP Market Development

Special Guest:
Perry Priestley
COO / CSO Broadcast Electronics

Type any questions you may have at any time in the GoToWebinar interface.

SBE

Remember, watching this webinar qualifies for ½ credit towards SBE certification under Category 1.

The Million Dollar Question

The Elenos Group:

60,000 Installations

130 Countries

90 Years of Experience

Elenos

Founded in **1977** in Ferrara, Italy

Itelco

Broadcast began in **1962** in Orvieto, Italy

Broadcast Electronics

Established in Quincy, lllinois in **1959**

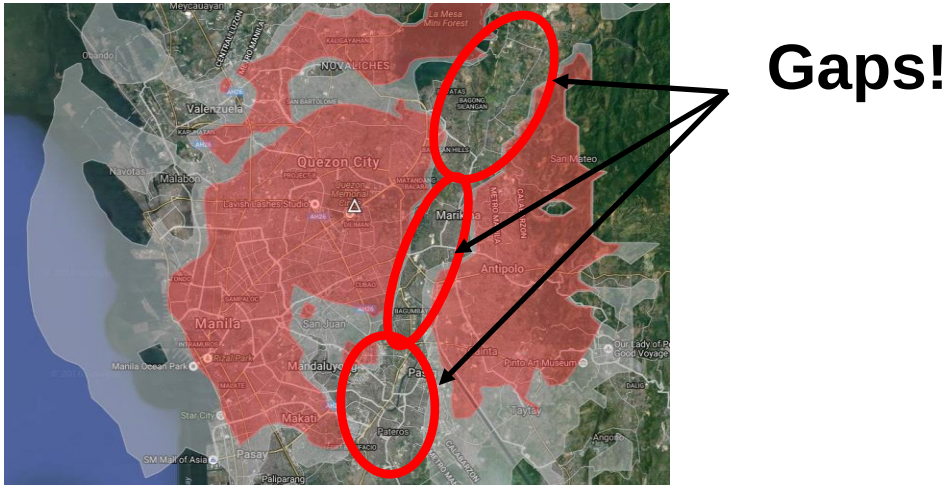
Pro Television Technologies

Established in Denmark, over **50** years of experience

What are gaps – and what causes them?

Gaps are areas where your coverage does not meet minimum requirements. They can be caused by:

- Terrain blockage (hills or mountains)
- Building blockage
- Antenna H or V pattern nulls
- Areas between the coverage of main transmitters

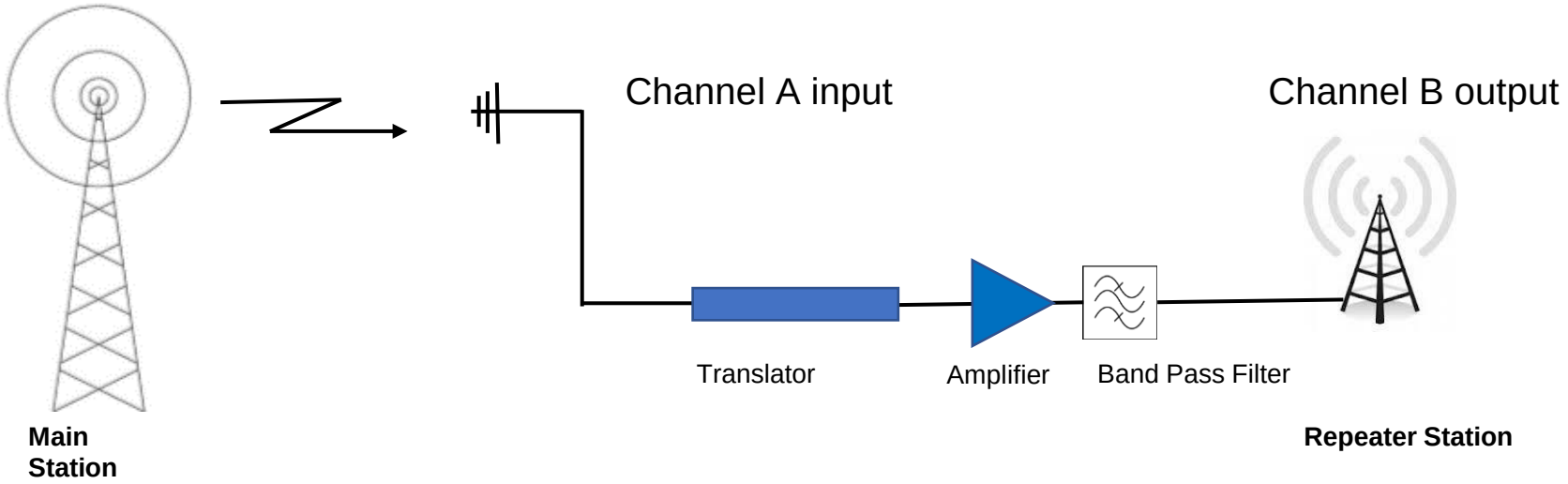


What solutions exist?

There are a number of technologies that can be used to fix gaps:

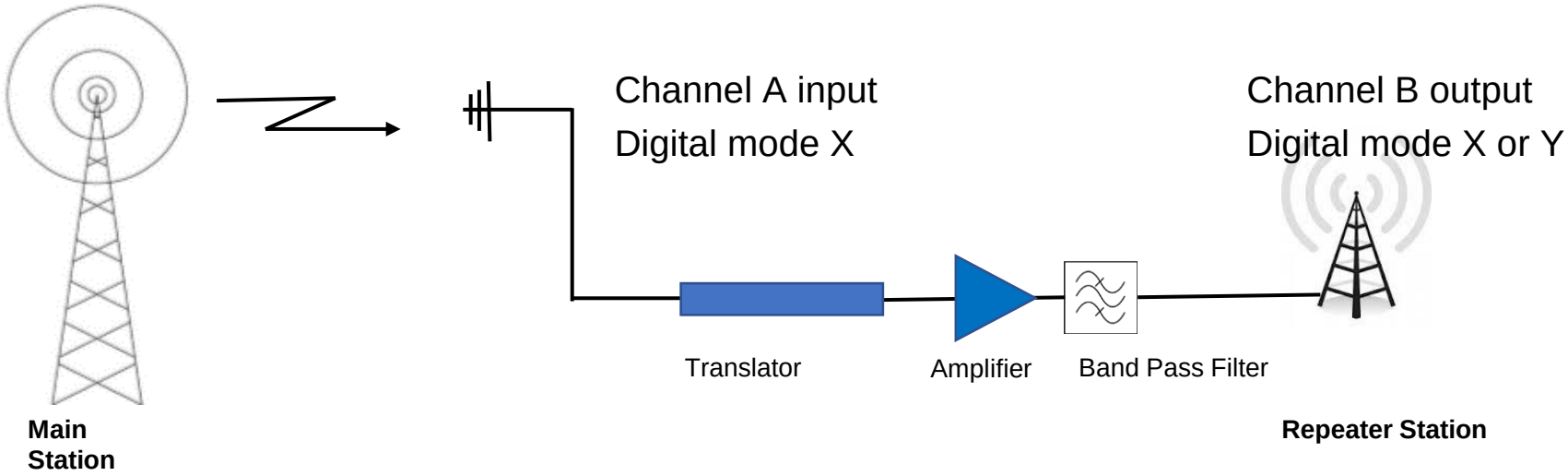
- A translator using a new frequency and the exact same modulation
- A converting translator using a new frequency and different modulation
- An on-channel digital repeater using the same frequency and exact same modulation
- A single-frequency network transmitter using the same frequency and regenerated modulation

What is a Translator?



A TRANSLATOR receives and decodes on one RF channel “A” (1 or more programs) and re-modulates on a different channel “B”

What is a Converting Translator?

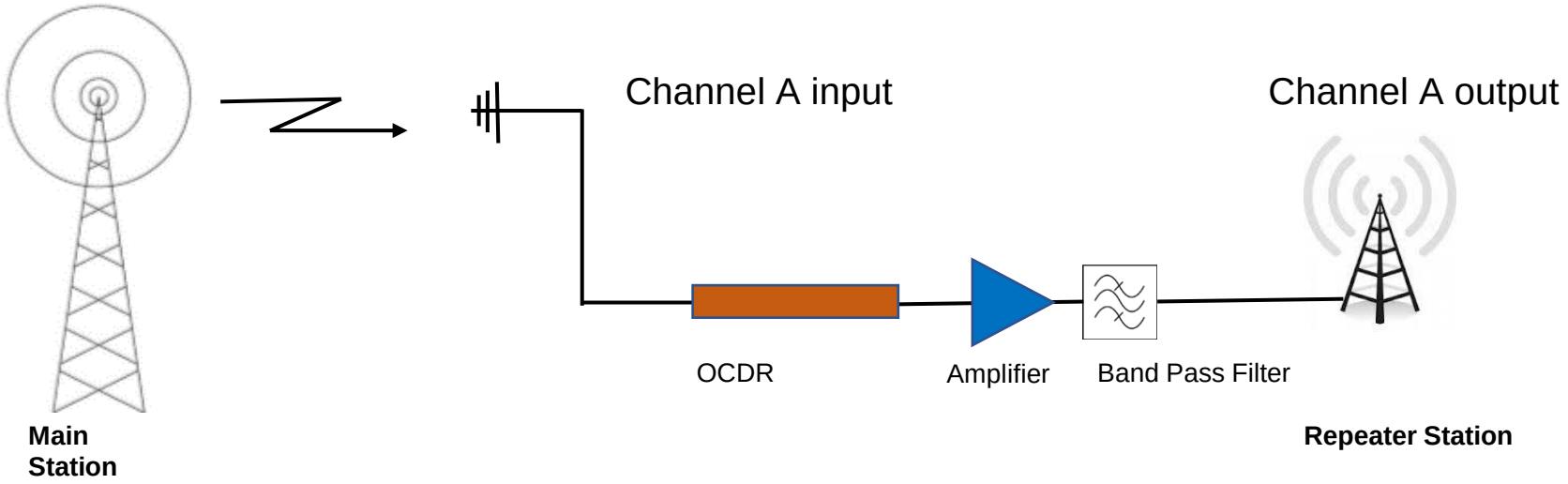


A converting translator receives and decodes on one RF channel “A” (1 or more programs) and re-modulates (with the option of a different transmission mode) on a different channel “B”

Translator advantages

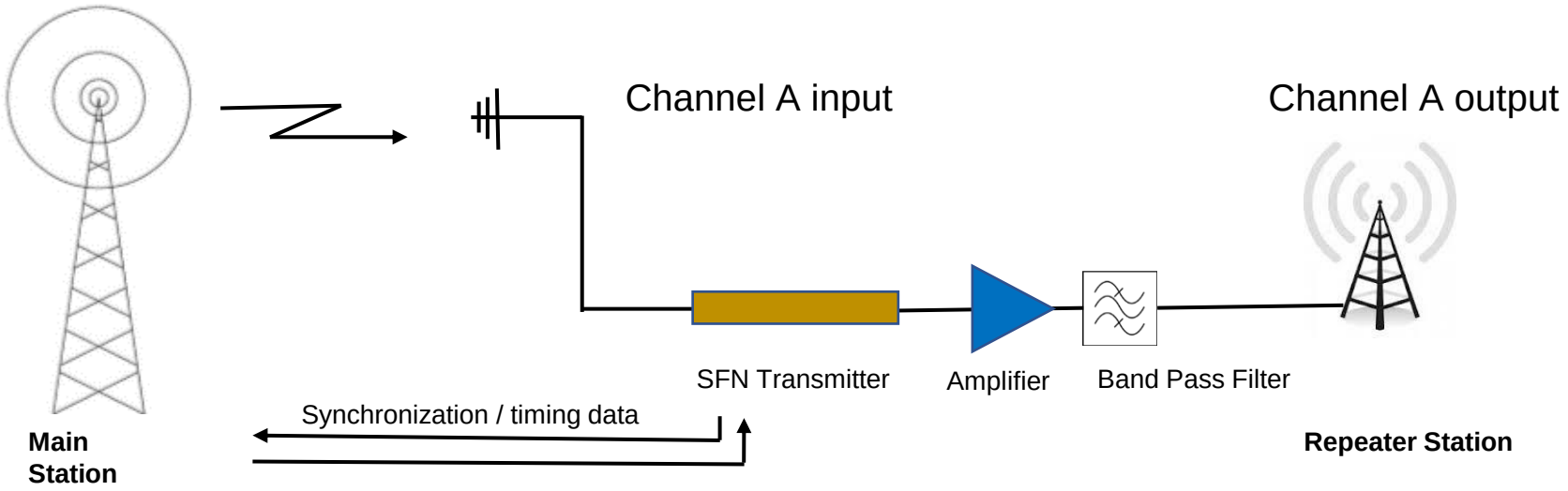
- A translator is the most cost effective and practical method of filling gaps.
- Unfortunately, it utilizes an entire new channel which is not always available.
- It is the best choice because it does not require
  - Echo Cancellation
  - Synchronization
  - Guard interval adjustment
  - Interference adjustment.
- It offers the best Signal to noise (SNR) ratio and shoulder (IMD) performance
- It is easier to install
- Far less field coverage and interference planning
- The converting translator allows the flexibility of transmitting in a different digital standard that the received signal.

What is an On-channel digital repeater (OCDR)?



An OCDR receives one Channel A, processes the input signal (1 or more programs) by eliminating the “echo”, amplifies it and then re-sends it at the same channel A

What is a single frequency network repeater (SFNR)?



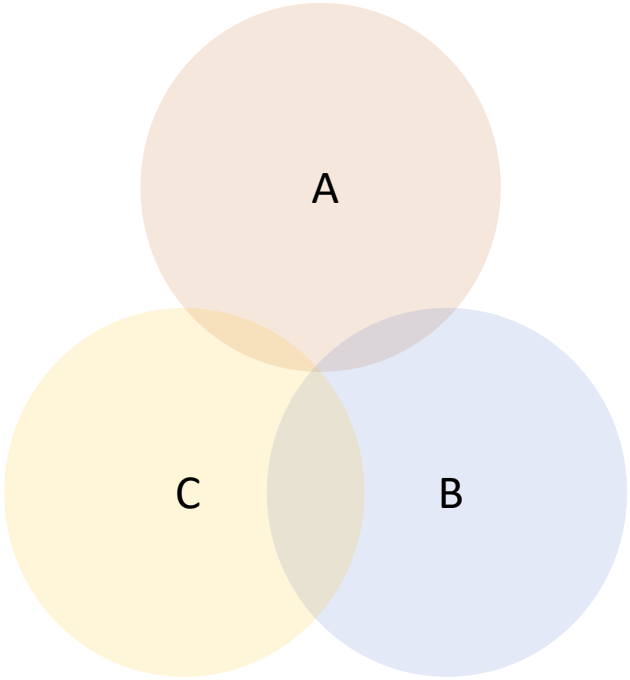
An SFNR receives and decodes on one RF channel A (1 or more programs) and re-modulates on same channel A, but synchronizes with the transmitting signal based on field reception data

Single frequency network advantages

- Better use of the frequency spectrum allowing growth for TV channels.
- Uniform distribution of radiated power
- Increases system availability and reliability.
- The presence of multiple transmission points gives the receiver an:
  - Additive gain through the addition of multiple signals
  - and a statistical gain - more uniform coverage.

However, to implement SFN, i.e. synchronize the signals, key parameters shall be observed:

1. Precisely the same transmission frequency
2. Precisely at the same time
3. Precisely the same signal, bit by bit – No rearrangement of the MPEG stream

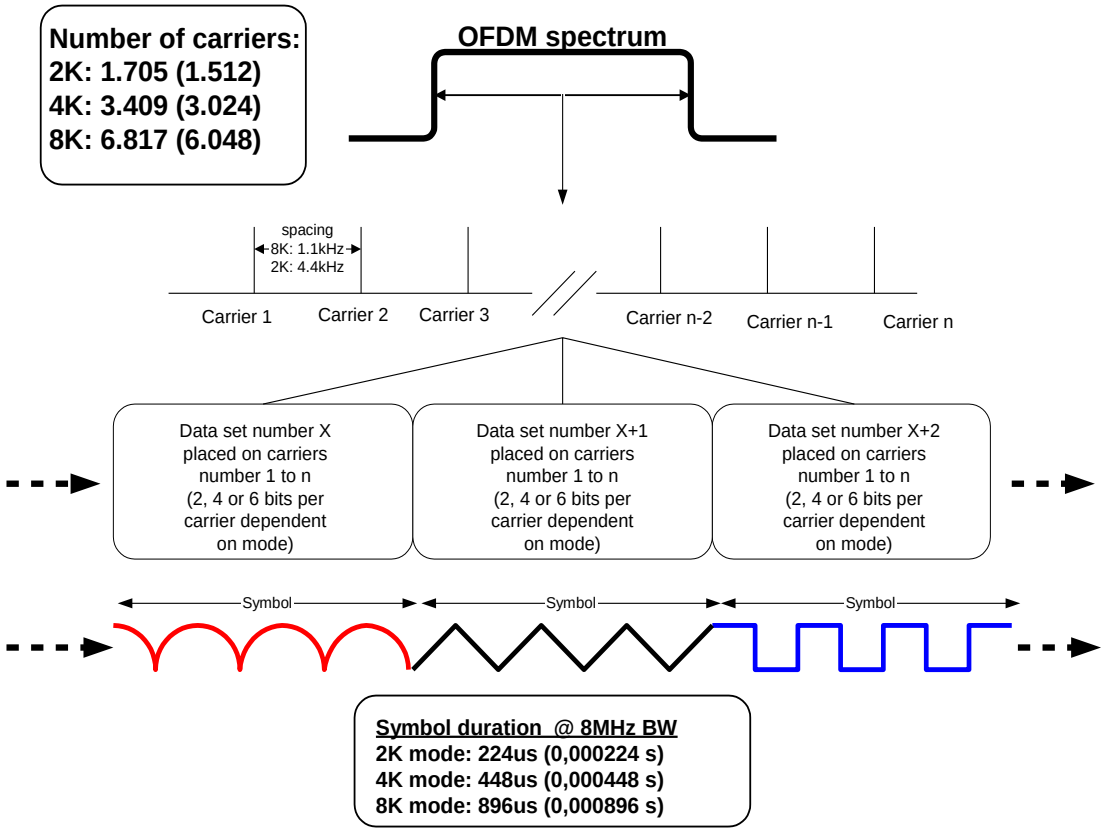


SFN key parameters

The main parameters that influence an SFN, besides transmitter power are:

- Delay adjustment is for making sure the signals arrive at the same time
- Guard Interval (GI) is an extra time period sent to allow for timing changes

Here's what happens with timing errors and no allowance for guard interval



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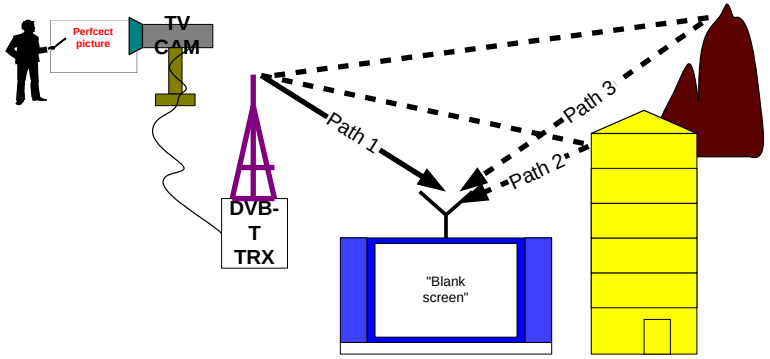
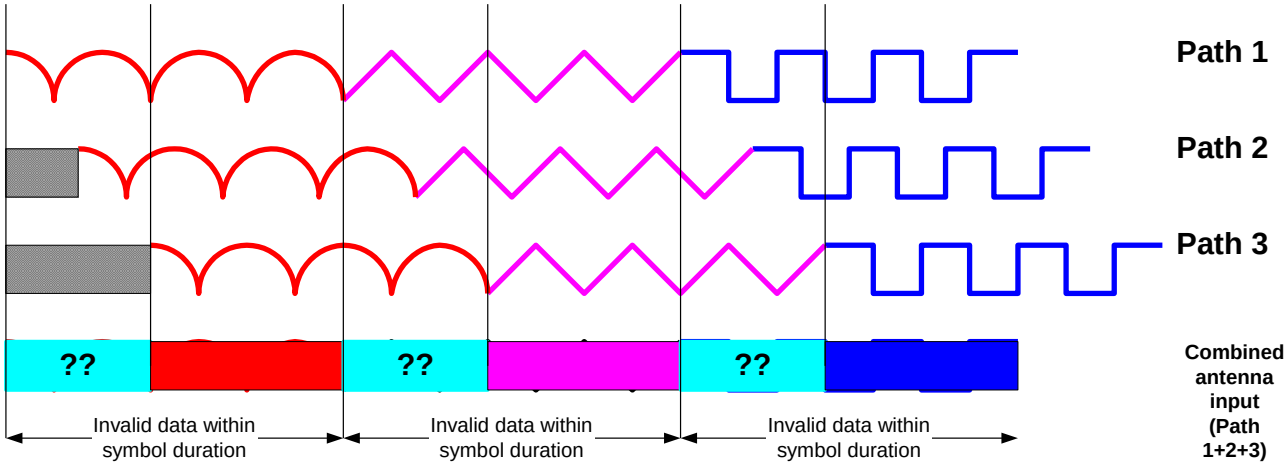


You end up with invalid data



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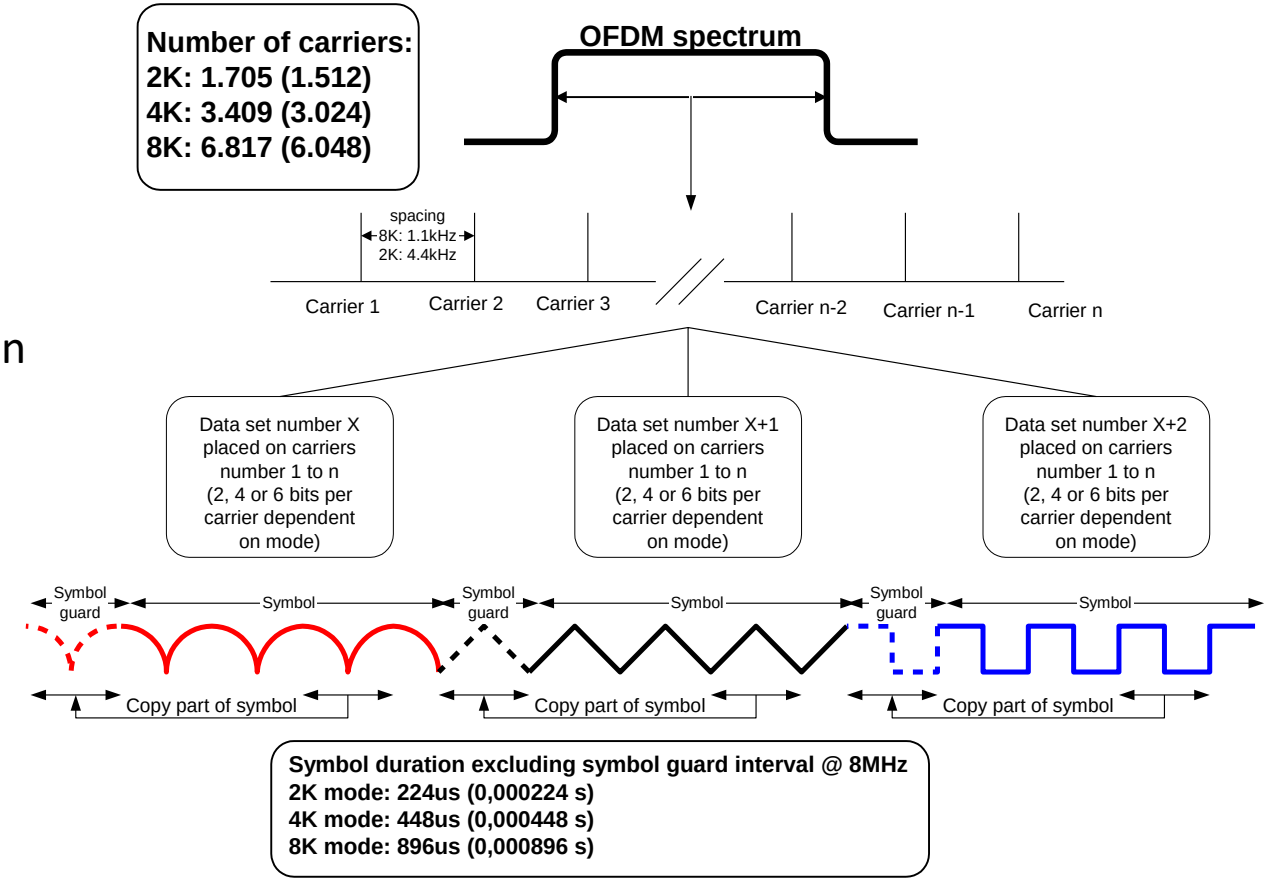
Now the same situation
WITH a guard interval



SFN key parameters

The main parameters that influence an SFN, besides transmitter power are:

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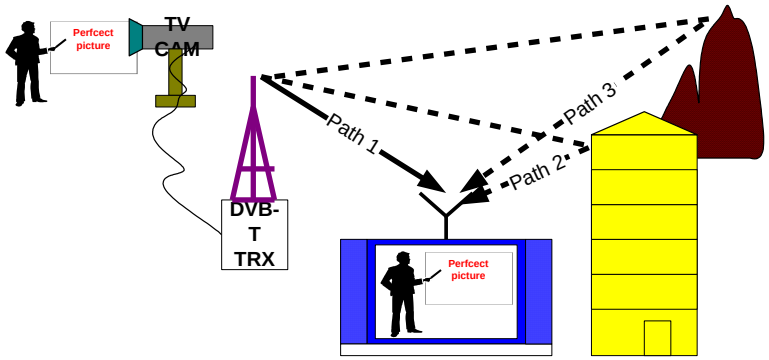
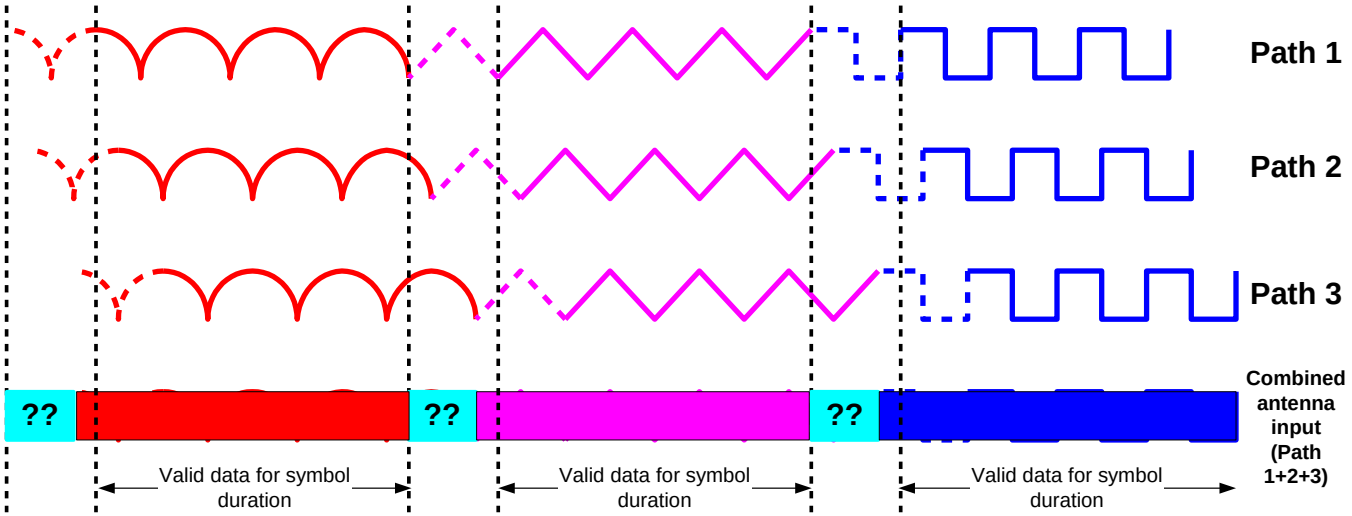
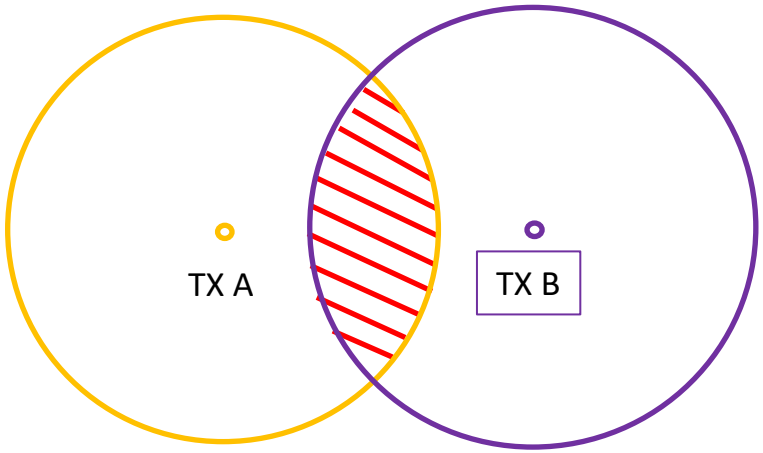
Valid data!

The bigger the guard interval, the lower the effective data rate, but the better protection against interference





Understanding SFN

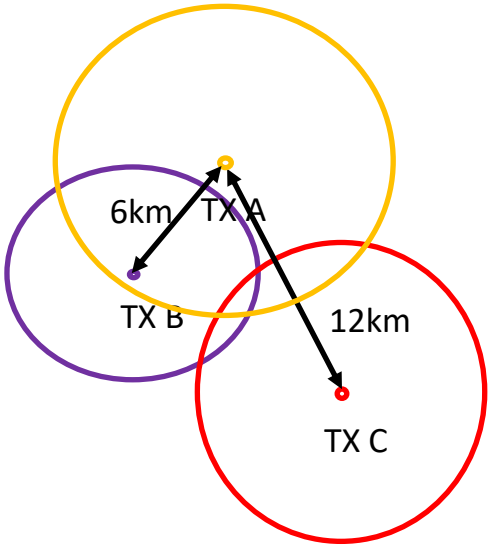


- The red area corresponds to the area that can't be larger than the area in which the delay falls inside the GI.
- Transmitters must be fed with same Broadcast Transport Stream at the same time

- A delay adjustment between transmitters allows the signal to be transmitted at the same time (or with a delay that falls within the GI), allowing the receiver to capture this signal, making an SFN possible.

Understanding SFN

- The delay calculations are made at the generating station
- Calculations must consider the necessary time for the BTS to arrive at the repeater station
- Once all stations are synchronized the SFN is established.
- This delay calculation can be made manually or automatically.



Example

- TX A is 6km from TX B and 12km from TX C.
- TX A is generator station
- Using the propagation speeds it can be determined that signal takes 20µs to get to B and 40µs to C

- Result :
- Delay on TX A = 40µs
- Delay on TX B = 20µs
- Delay on TX C = 0µs

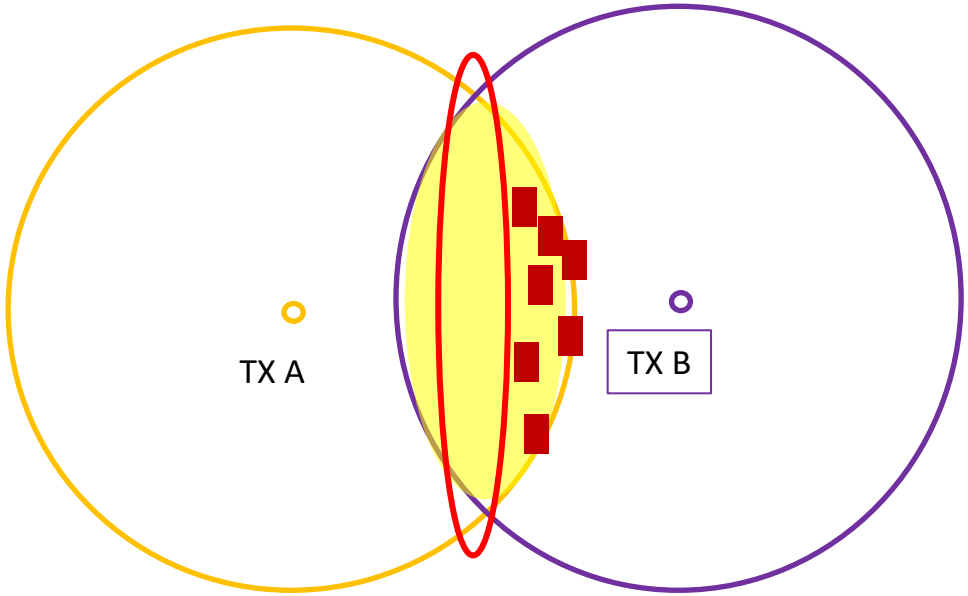
- Additional fine adjustment may also be required for :
  - Antenna phasing and directivity
  - Specific interference variation with each location

Understanding SFN

Example of GI adjustment
TX A + TX B gives interference designated by the yellow area

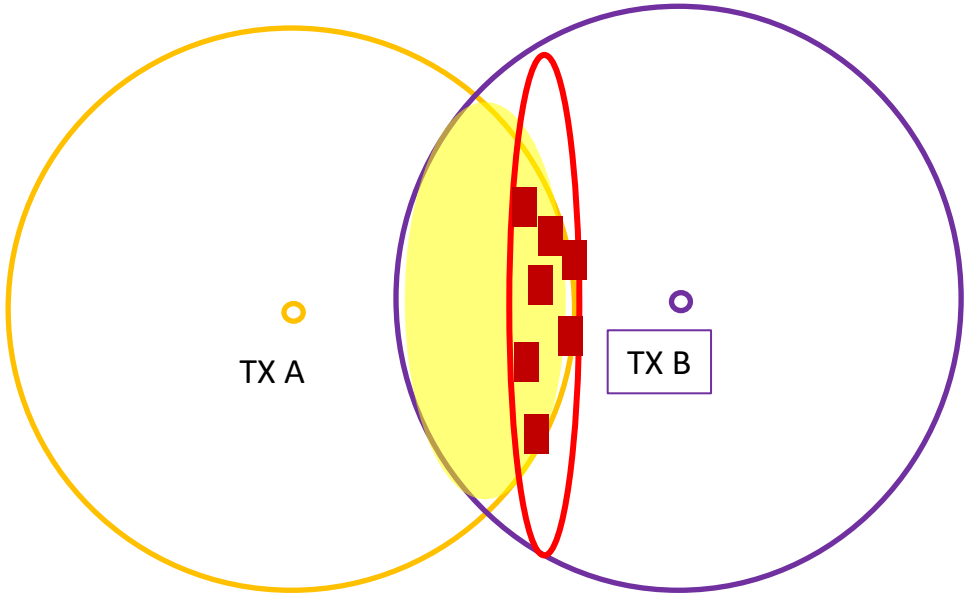
If there is a populated area outside of the GI adjustment area (red circle)

There are two solutions:
1. Increase the Guard Interval, but this will reduce the transmission rate (quality and possibly quantity of programs)



Understanding SFN

- Or adjust the delay to TX B to move the protected area
- Increasing the delay on TX B we make the region where these signals arrive together be closer to the transmitter B This allows the populated area to become protected by the GI.
- There was an intentional delay alteration to move a good reception area from a non-populated area to a more populated one



Understanding SFN

- Main SFN components
- An SFN is composed of various equipment's that have specific functions such as BTS generation (encoders), distribution networks (fiber or microwave), delay inserters, modulators (exciters) and synchronization systems.
- None of these additional items are required with OCDR
- Equipment used for BTS distribution must be transparent, meaning that the order of the multiplex frame packets is not modified. Equipment used include IP radios, Digital microwave equipment, fiber optic and satellite links for BTS distribution.

  IMPORTANT: Distribution equipment cannot alter content or packet order in the BTS!

On channel digital repeater: Advantages and disadvantages

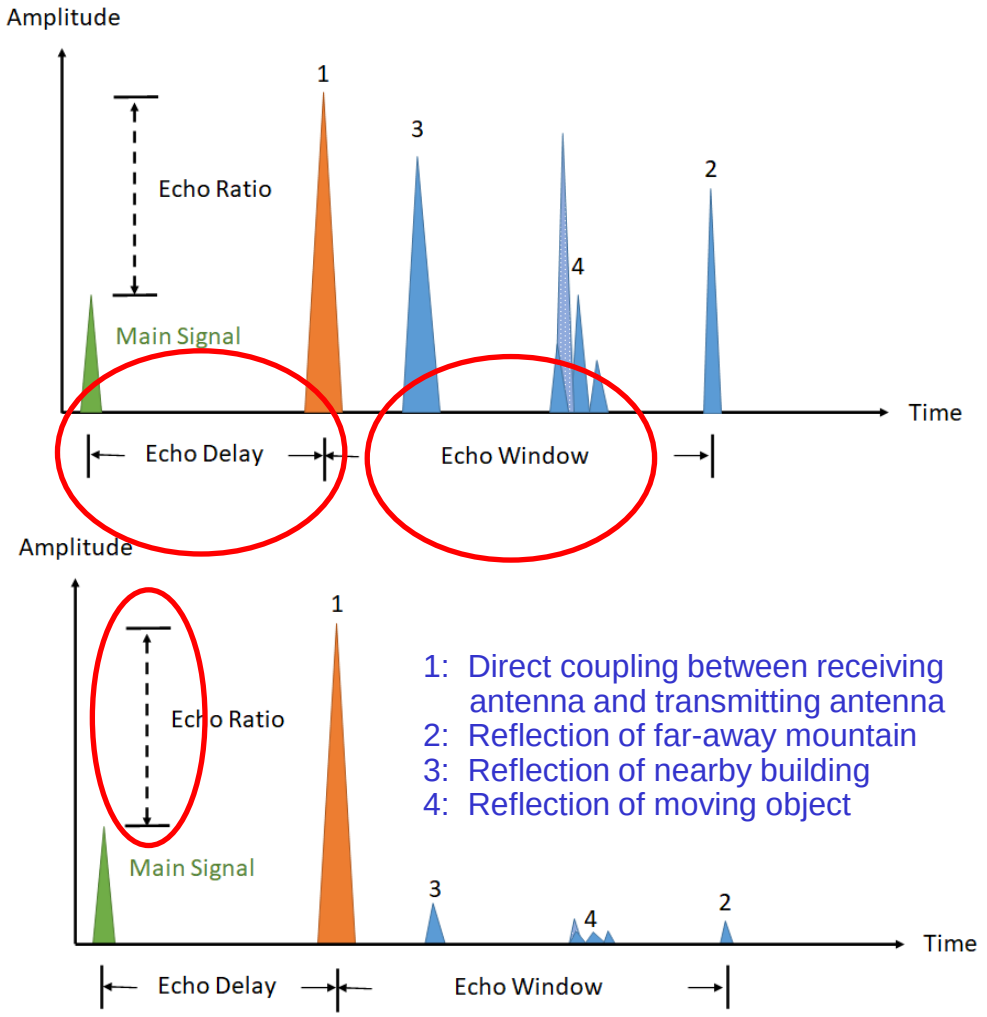
- Disadvantages of OCDR
  - The transmitted power is limited by the “echo”
  - The quality of transmitted signal is easily deteriorated and can be an interference to other channels

- Advantages of OCDR
  - Doesn’t require additional transmit network
  - Easier installation and lower cost
  - Doesn’t require GPS as reference signal

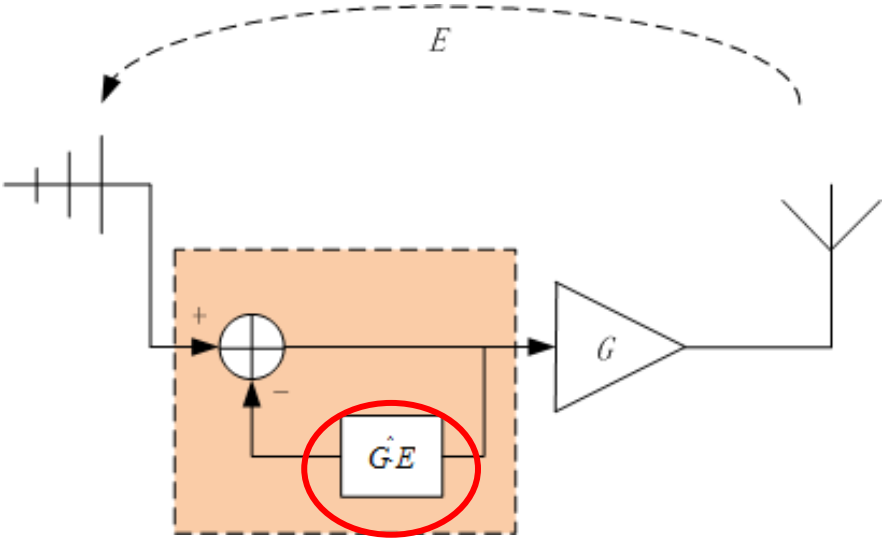
Interference cancellation can overcome the disadvantages of OCDR!

Understanding interference cancellation

- Echo Delay: The delay between echo and received signal
- Echo Window: Length of echo channel impulse response
- Process Delay: The delay of the echo cancellation process
- Echo Ratio: Signal strength RX versus TX



Understanding interference cancellation



$$H_{ICS} = \frac{G}{1 - G \cdot E \cdot Z^{-n} + \hat{G} \cdot E \cdot Z^{-n}}$$

Z: phase relationship between the input and the output

H: system transfer function

G: system gain

E: system isolation

Conclusion: The system gain of OCDR is severely limited by the system isolation. How to increase the isolation is the key to OCDR application!

Understanding interference cancellation

OCDR System Gain Example (w/o ICS)

Assume:

Received signal level = - 50dBm

Antenna isolation = 80dB

Antenna Gain = 10dB

Result:

Max system gain: Antenna isolation (80) – Antenna gain (10dB) = 70dB

Max transmitted power: Received signal power + max system gain = -50 + 70 = 20dBm

This is an output of just 100mW…

Understanding interference cancellation

OCDR System Gain Example (with ICS)

Assume:

Received signal level = - 50dBm

Antenna isolation = 80dB

Antenna Gain = 10dB

Gain due to ICS = 30 dB

Result:

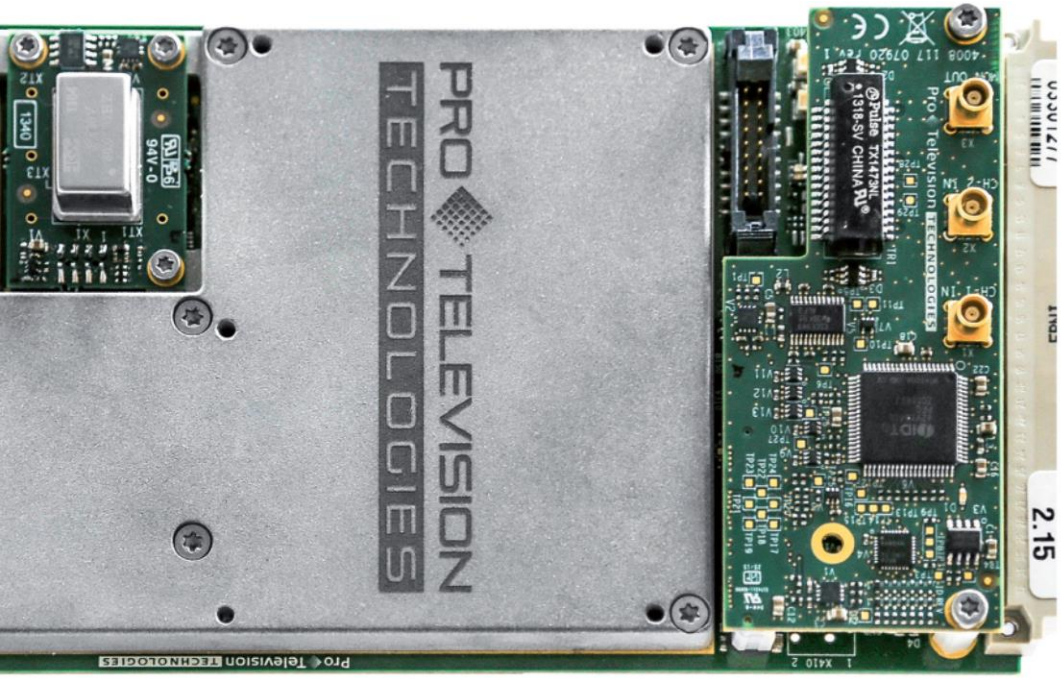
Max system gain: Antenna isolation (80) – Antenna gain (10dB) +30dB = 100dB

Max transmitted power: Received signal power + max system gain= -50 + 100 = 50dBm

This is an output of 100W…

So – if you have gaps, we have solutions

And its all inside one box!



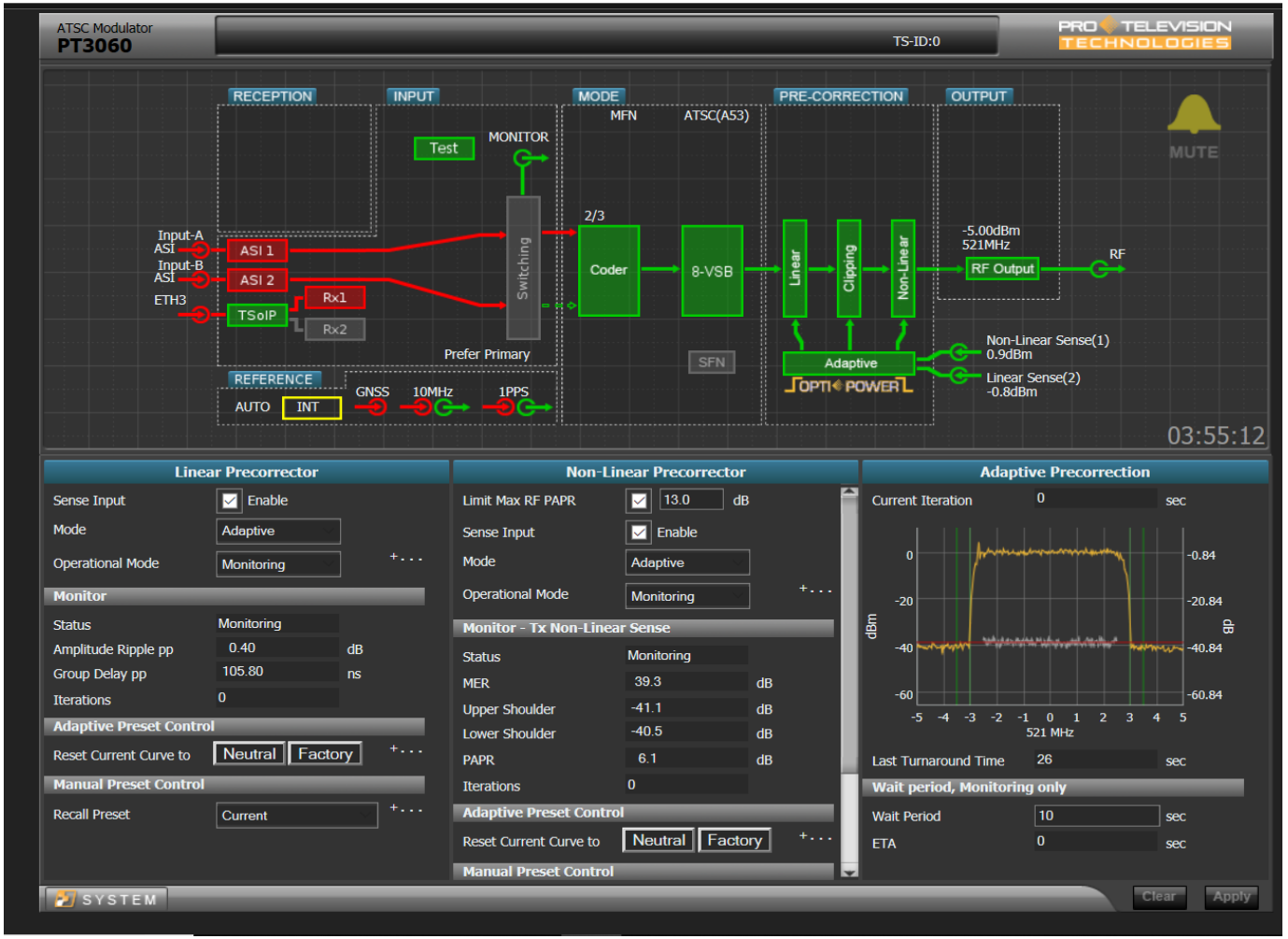
The choice is easy…
You don’t even have to choose

One box does it all!

- Exciter
- Transmitter
- Translator
- Converting translator
- SFN
- OCDR

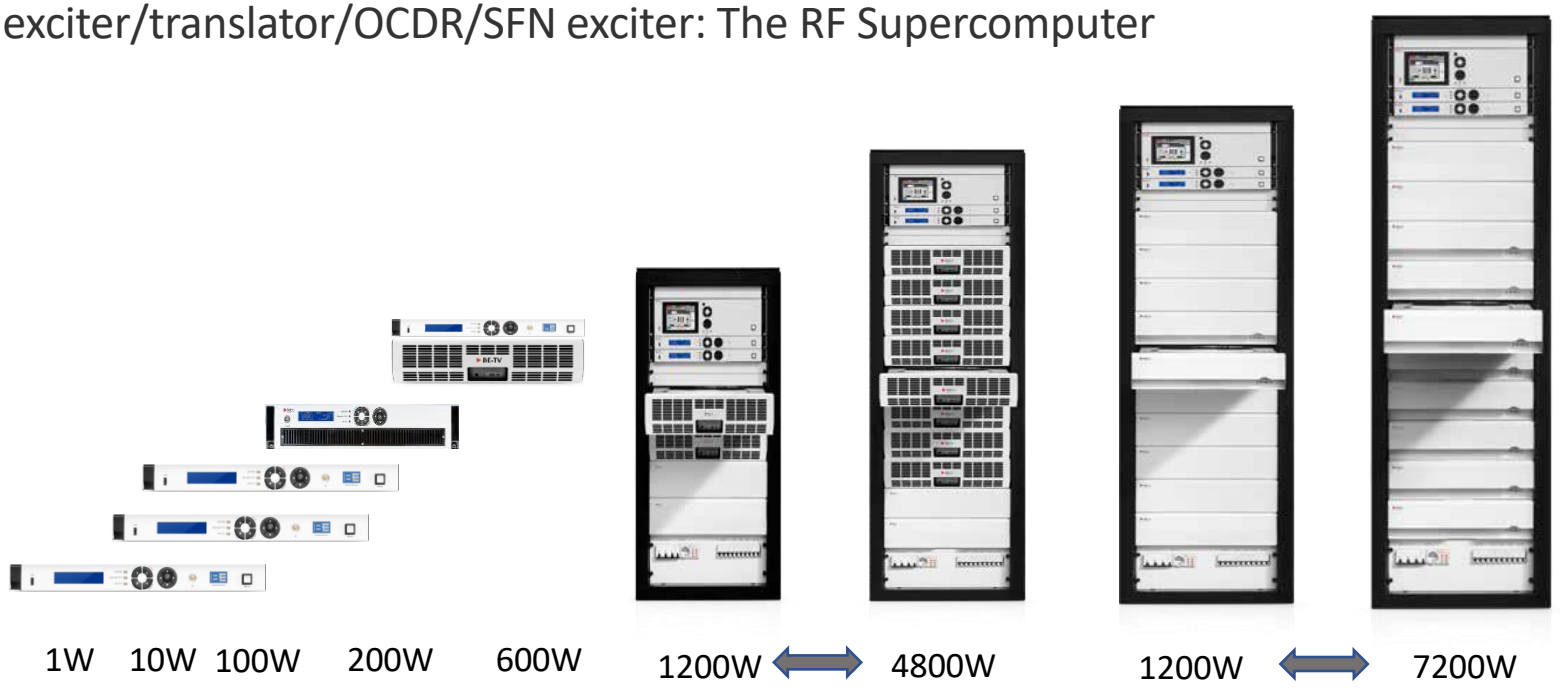
Configuration in the field

- Drag and drop
- OCDR – Any standard
- SFN Translator – Any standard
- ATSC Translator
- ATSC 3.0 Translator



The Elenos Group has the answers you need

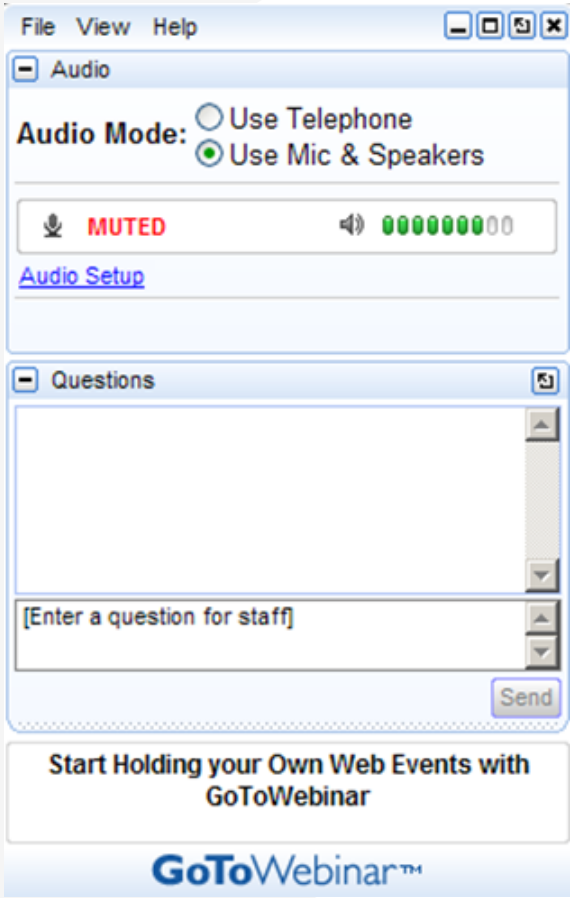
- Optimal performance is obtained by a transmitter on a different frequency i.e. translator
- If that is not available an OCDR provides an excellent low capital cost, easy install, low cost of ownership choice
- Choosing an SFNR option is an excellent choice, for the right conditions
- Any choice is just a “click away” with the Elenos Group digital exciter/translator/OCDR/SFN exciter: The RF Supercomputer



It’s time for your questions

Look for the Questions tab on the GoToWebinar interface

- Enter your question
- We’ll answer live or, if time doesn’t permit, we’ll answer you after the webinar via email
- Thanks for your questions and feedback - they help us keep these webinars relevant.



Thank you

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