TRANSMITTER & RF SYSTEM TIMING & SYNCHRONIZATION

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MULTIPLE CABINET TRANSMITTER TIMING / SYNCHRONIZATION

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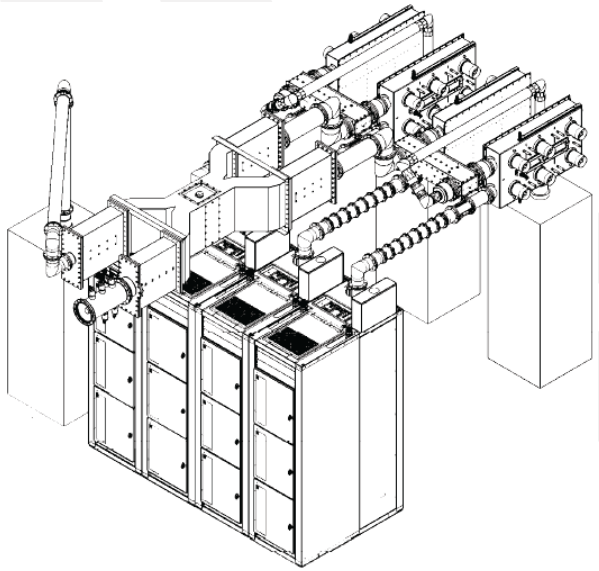
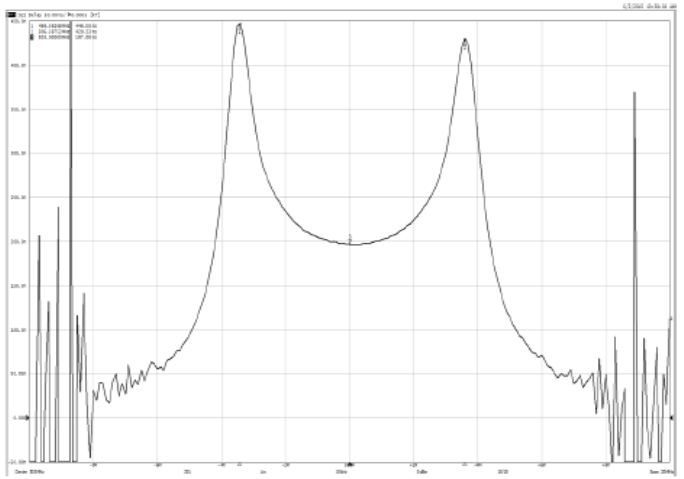
- Combining multiple PA cabinets and multiple mask filter transmitters & RF systems, timing and synchronization becomes important.
  - RF signal passes through each amplifier cabinet in a multiple cabinet transmitter the amplifiers and combiners within each cabinet can have slightly different group delay, this can change the amount of time it take for each RF path through a multiple cabinet transmitter and RF system. Timing influences phase as you could be more that one wavelength out of phase.
  - This is also the case then using multiple RF mask filters as each mask filter can have different group delay thru the mask filters and other RF devises.





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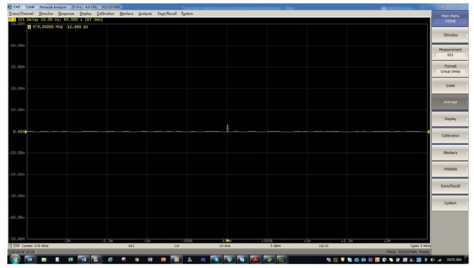
Example: The Transmitter and RF system shown utilizes 2 mask filters.

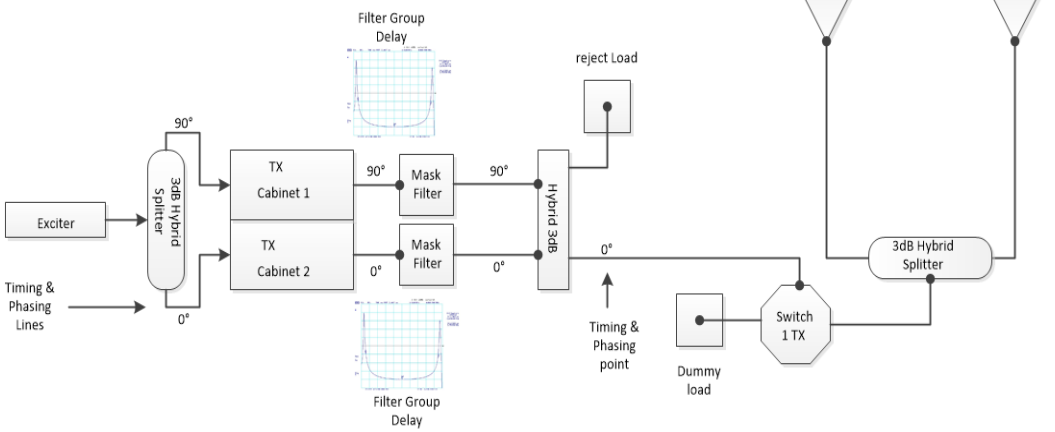
Even if the Phasing is perfect and all the power is minimized at the reject load, it can still be out of sync.

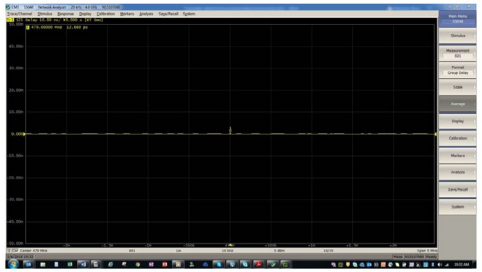
The timing could be a number of wavelengths different between TX cabinet 1 and TX cabinet 2 at the output of the 3dB hybrid combiner especially in complex transmitter and RF installations.

This can be caused by phasing cables length differences, RF transmission line length differences or the mask filters having different group delay values or a combination of Transmitter PA, transmission line and mask filter group delay. Other effects like velocity factor of line can change the electrical length.

- 1 wavelength at 500Mhz using RG223 (Velocity factor .66) line is 15.8” (39.5cm) electrical length this is 1.32nsec of time, if your group delay difference is in the usec range this can cause performance issues with the modulation. Mask filters alone can have group delay numbers as high as 1usec equal to 299m (982ft) of line length.







PA Cabinet & RF System
Time delay

MULTIPLE CABINET TRANSMITTER TIMING / SYNCHRONIZATION

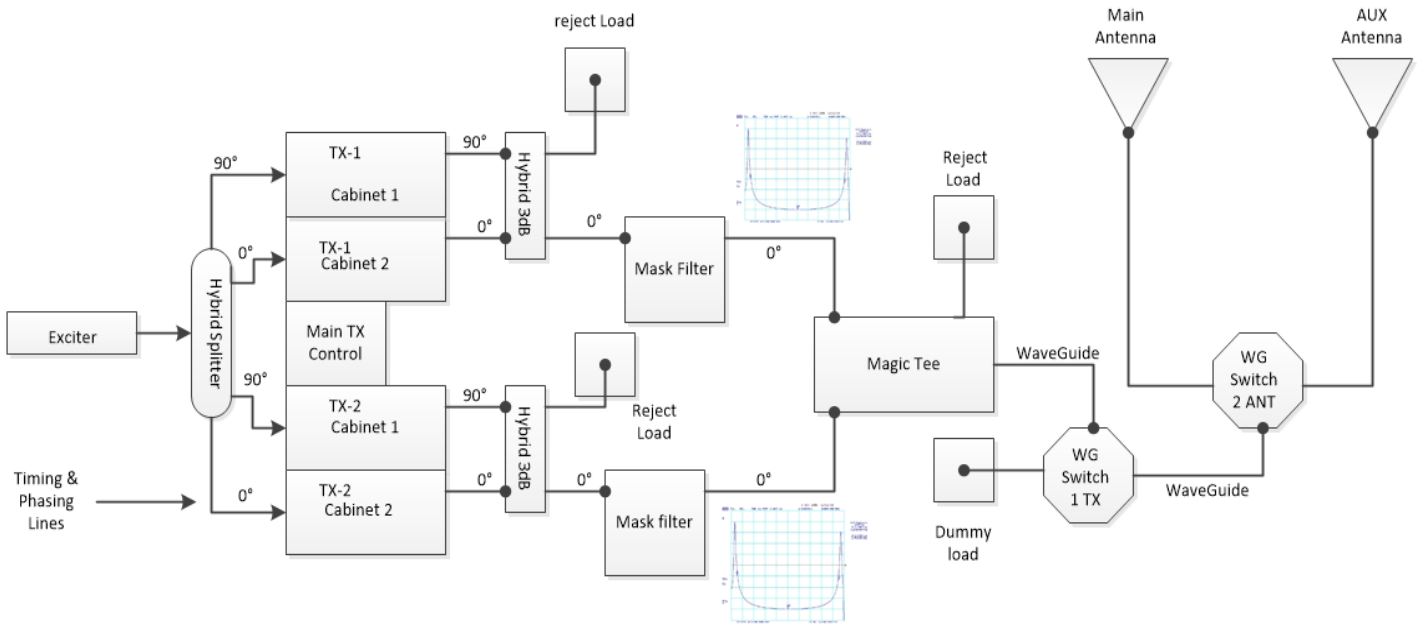
Here is an example where you have two transmitters in a dual transmitter configuration, not only do you need to time each transmitter you will need to time and synchronize both transmitter into the Magic tee combiner (Phase shift combiner).

As you increase the number of cabinets and the number of mask filters and RF components the timing and synchronization becomes more critical.

Phasing and timing are both very important, Phase of the PA modules and cabinets alone does not provide the best performance, Timing / Synchronization and Phasing provide the best performance.

What does the Transmitter and RF system timing affect ?
Performance & Signal quality

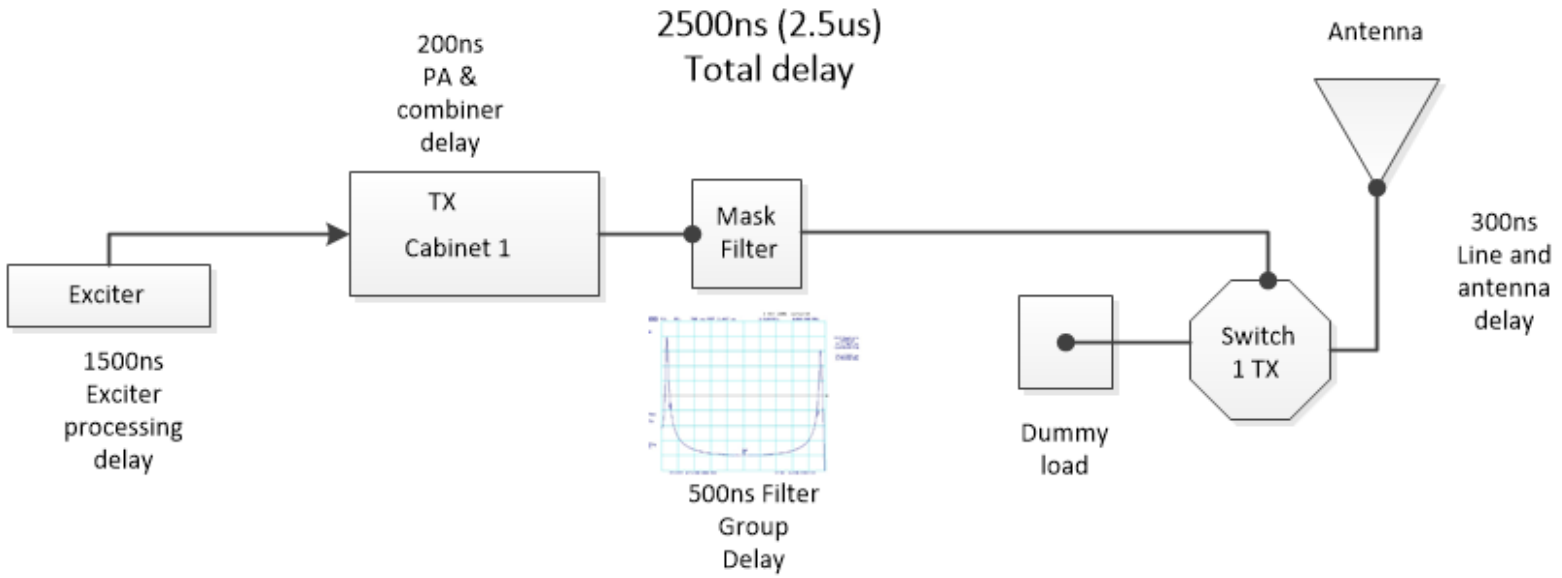
- EVM & MER (8VSB)
- MER & CN (COFDM)
- Timing influences the adaptive precorrection samples pre & post mask filter which effects MER.



Very High-power transmitters with 5 or more cabinets can have 5 or more mask filters

TRANSMITTER TIMING / SYNCHRONIZATION FOR ATSC 3.0

- ATSC 3.0 Bootstrap Reference Emission Time – A time value indicating the instant at which the leading edge of the first symbol of a ATSC 3.0 Bootstrap is to be emitted from the Transmitter **Antenna**.



Transmitter-to-Antenna-Delay (TAD) for ATSC 3.0 is input into the exciter

ATSC 3.0 - Single frequency network timing and synchronization should be calculated for ever site within an SFN as every site will have different transmitters and different RF systems with different delays. Transmitter-to-Antenna-Delay (TAD)

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