
Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [Optional continuous spectrum pulse]

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Abstract: [Discussion on optional continuous spectrum pulse for 15.4a PHY.]

Purpose: [To forward the discussion within 15.4a group]

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Optional Continuous Spectrum Pulse

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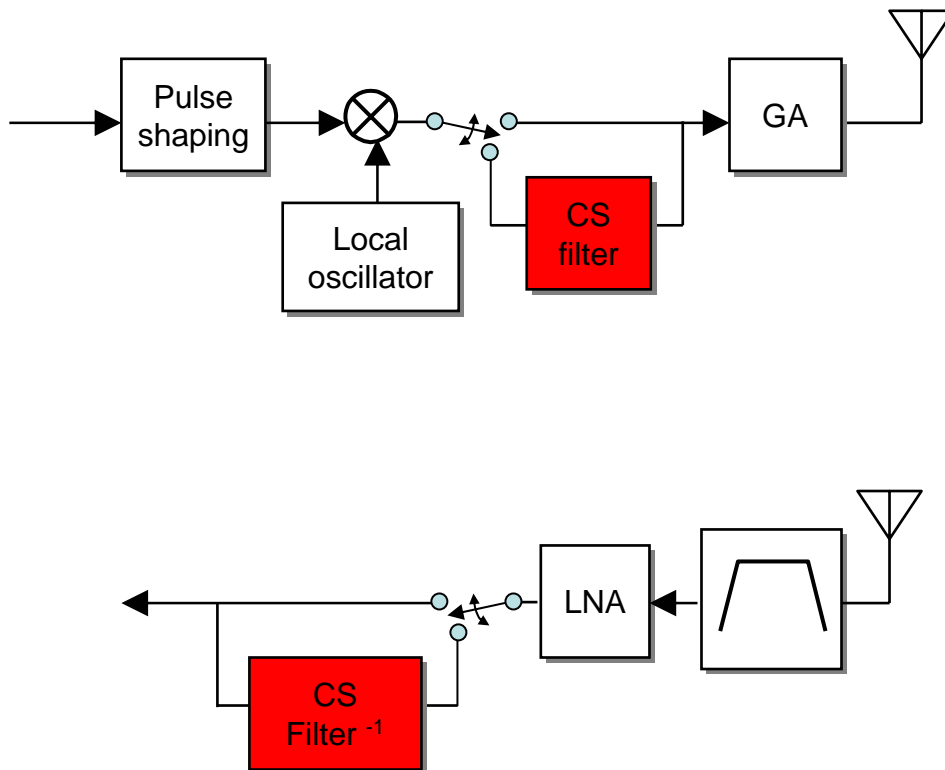
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Concerns on Optional Continuous Spectrum (CS) Pulse

1. What are needed to include the CS pulse?
2. Is CS-UWB compliant with FCC rule?
3. What can the CS pulse help?

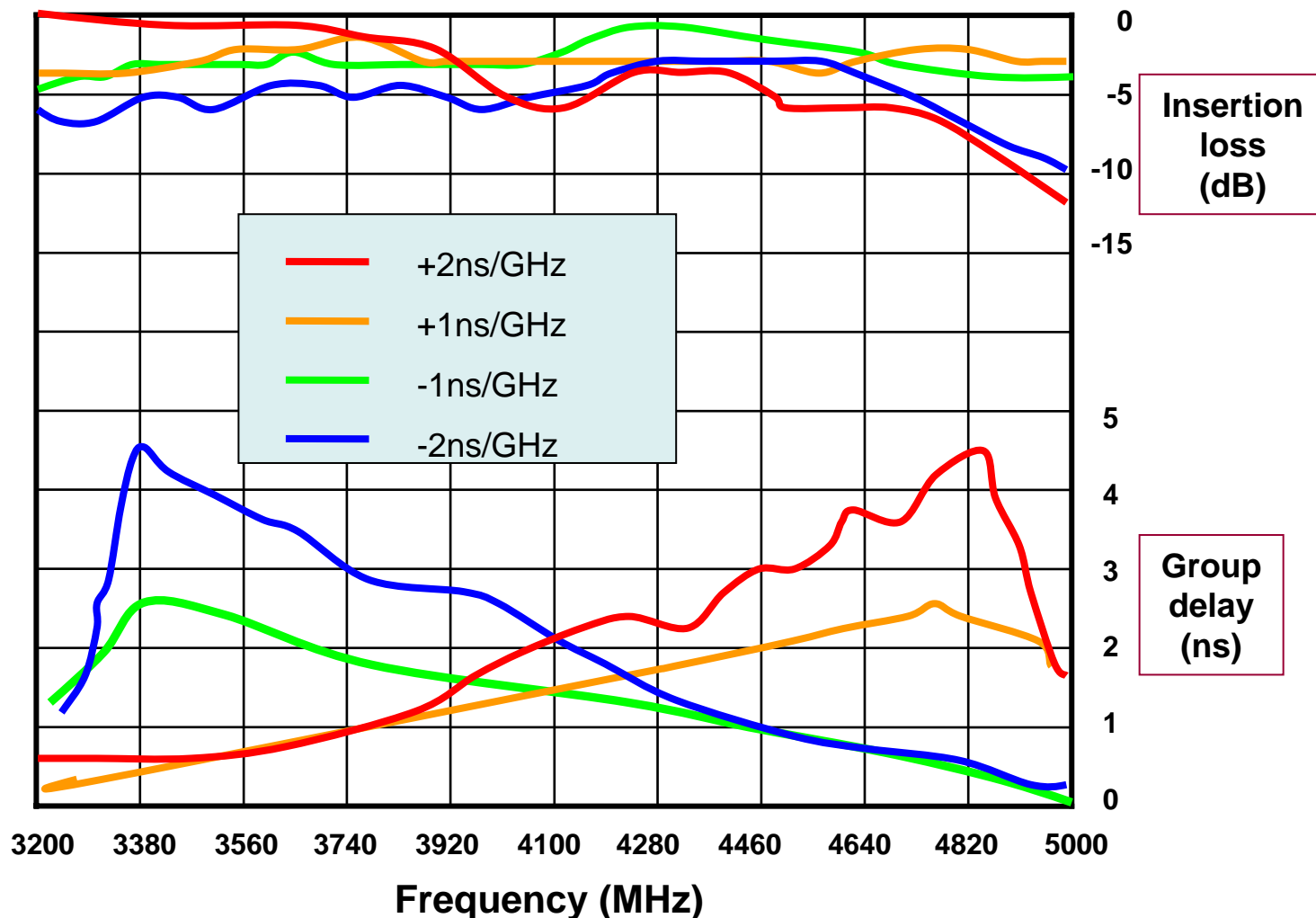
1. What are needed to include the continuous spectrum pulse?

Additional Circuits Needed

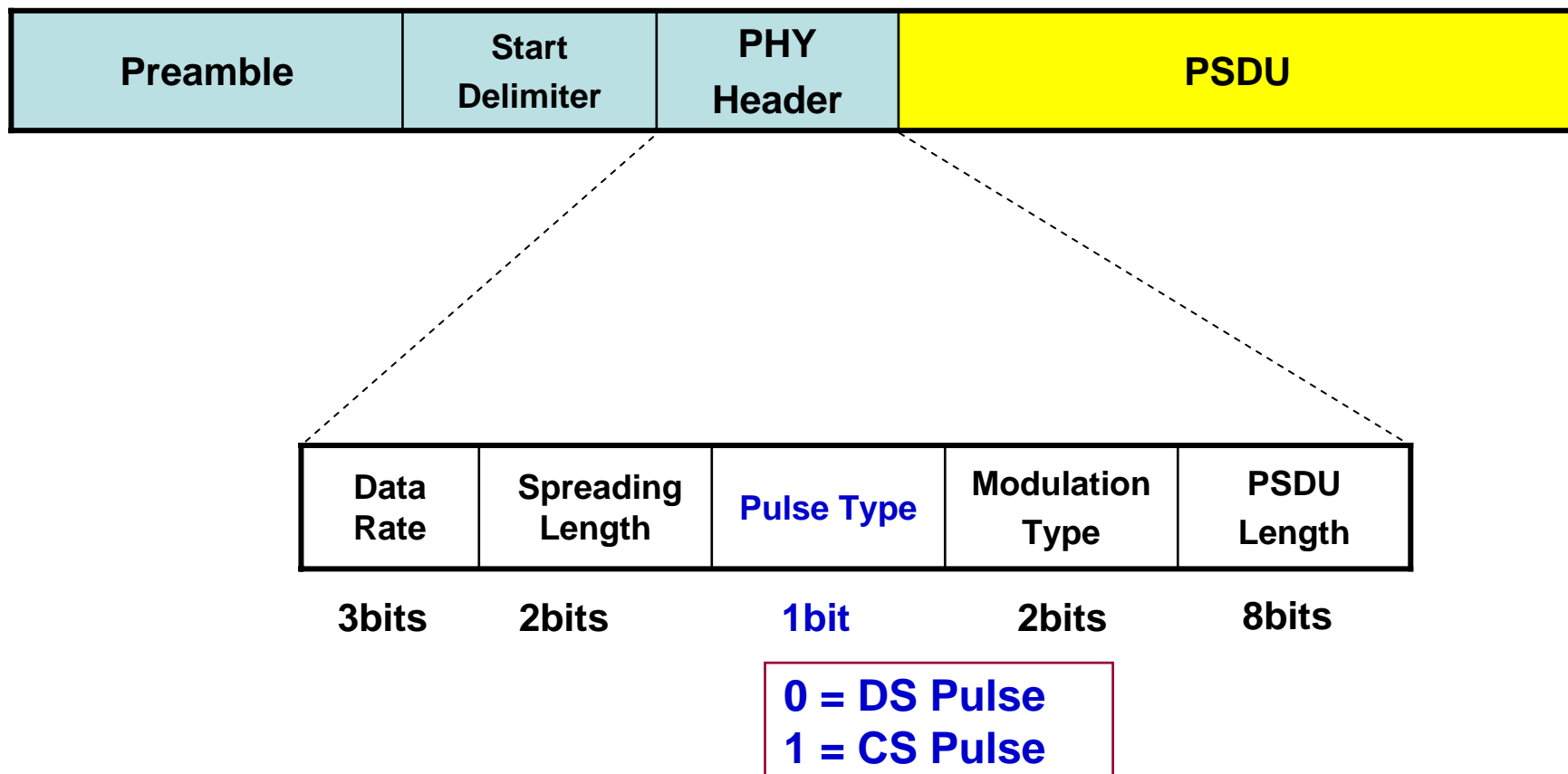


- A pair of CS filter and inverse-CS filter are needed at the transmitter and receiver respectively.

Realization Examples



Additional Definition in PHY Header



2. Is the CS-UWB compliant with FCC rules ?

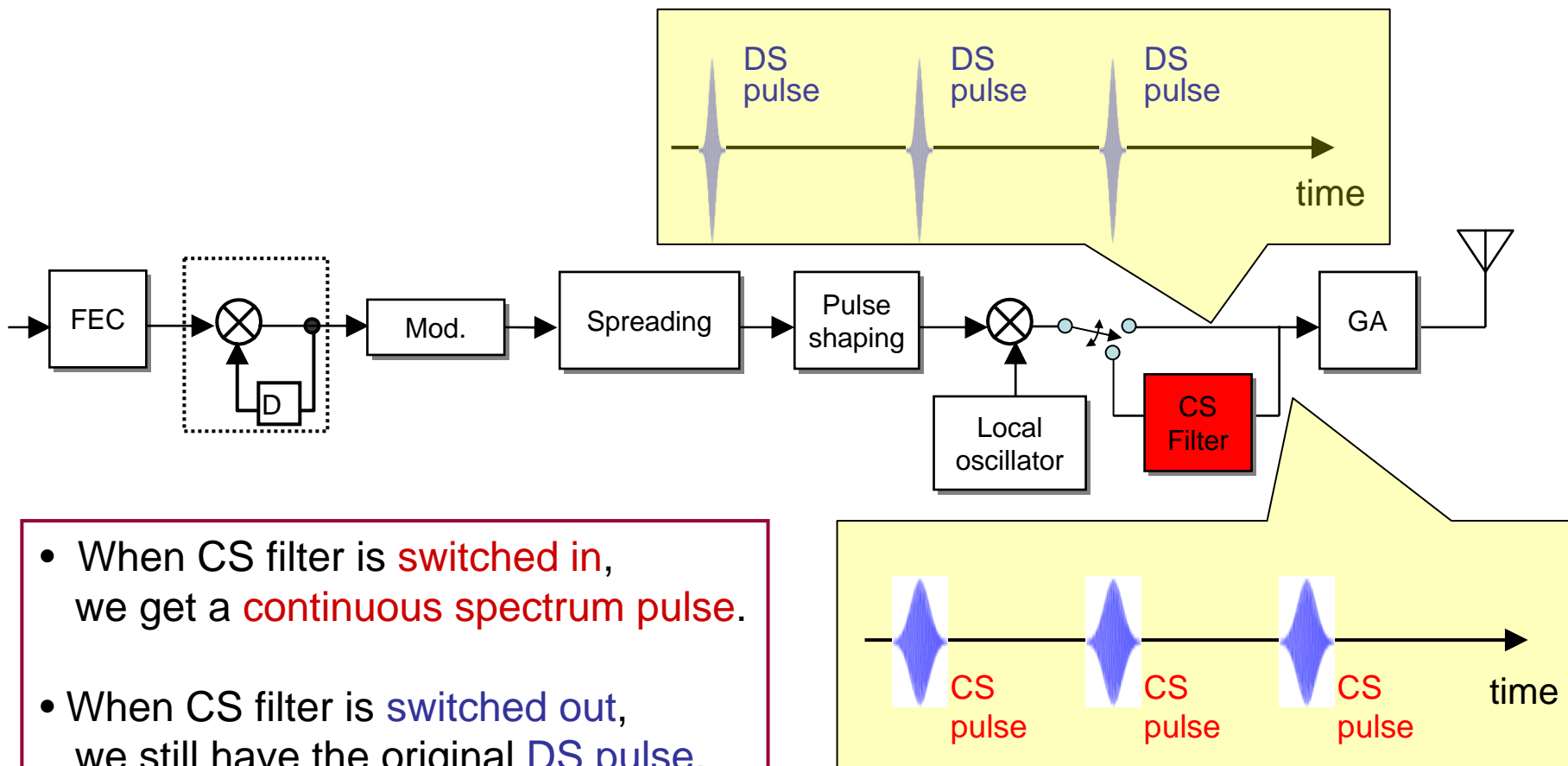
FCC Requirements on UWB

- FCC Regulation on UWB (1st R&O)
 - When measuring the emission power, Frequency sweep, and Frequency hopping must be stopped.
- FCC Waiver for MB-OFDM
 - If it is in ordinary operation, hopping may not be stopped for measurement.
 - For MB-OFDM even hopping is stopped, it still satisfies the UWB definition.

Key Points for Compliance

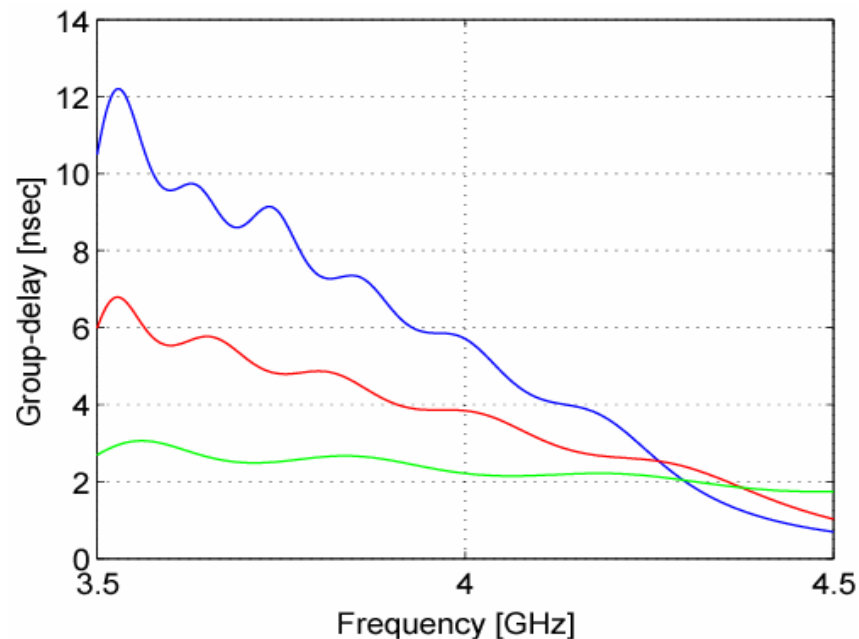
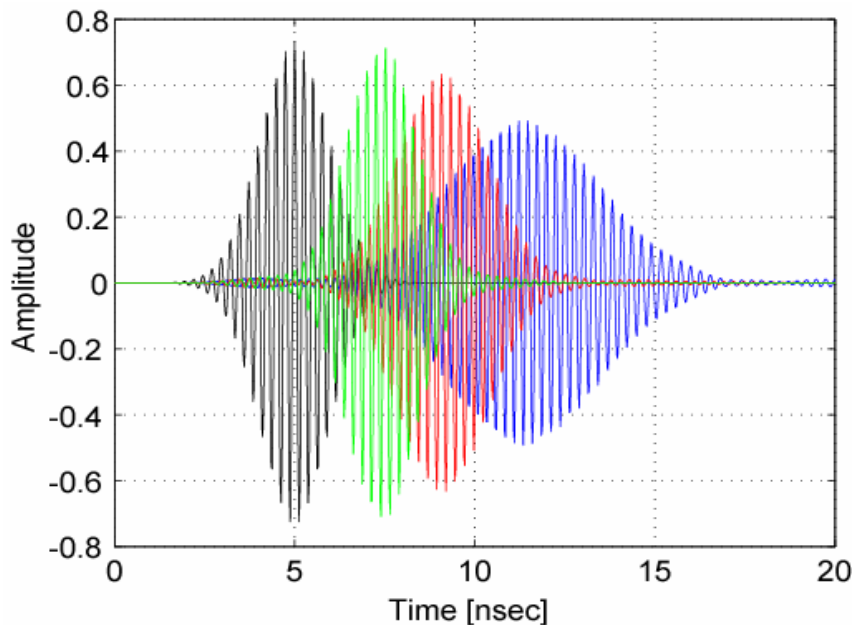
- The spectrum of CS signal must meet the FCC spectrum mask.
- The signal must occupy a minimum bandwidth of 500MHz no matter the CS circuit is on or off operation.

Optional CS Pulse



- When CS filter is **switched in**, we get a **continuous spectrum pulse**.
- When CS filter is **switched out**, we still have the original **DS pulse**.

CS Pulse Examples



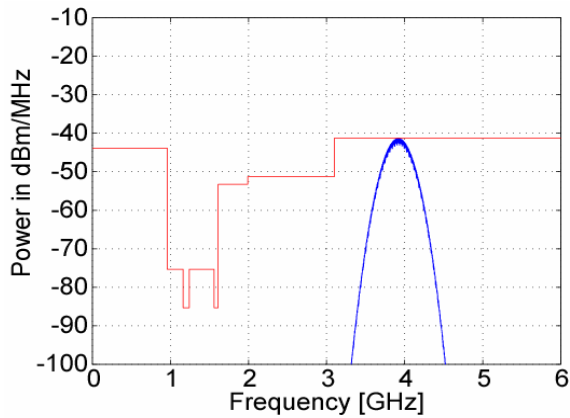
Gaussian without CS

1ns/1GHz CS

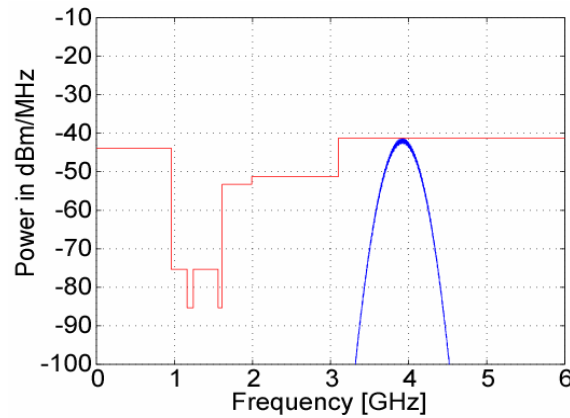
5ns/1GHz CS

10ns/1GHz CS

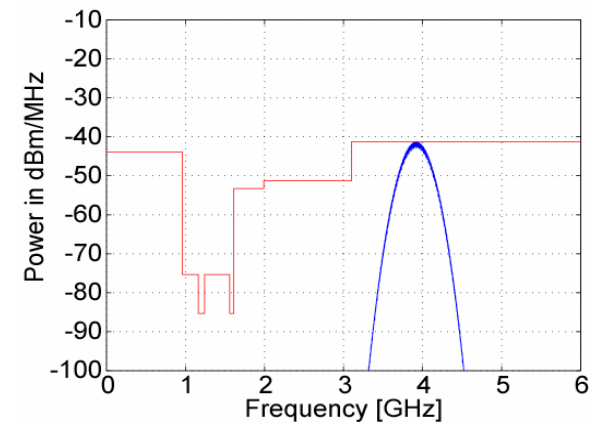
Signal Spectrum Comparison



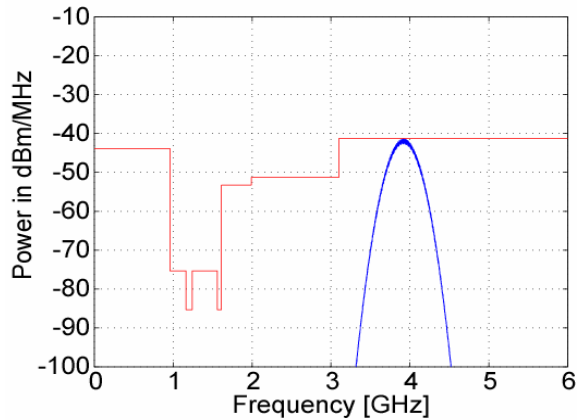
< Gaussian without CS >



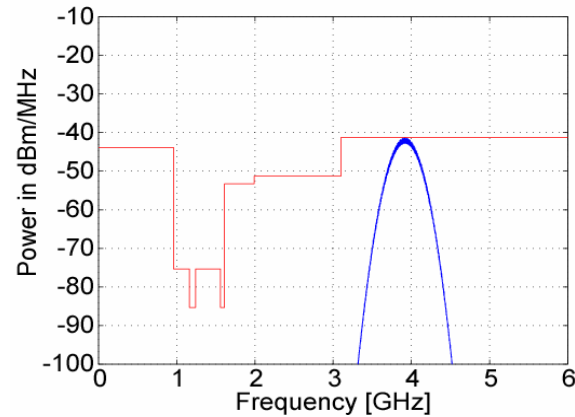
< 1ns/1GHz CS >



< 5ns/1GHz CS >

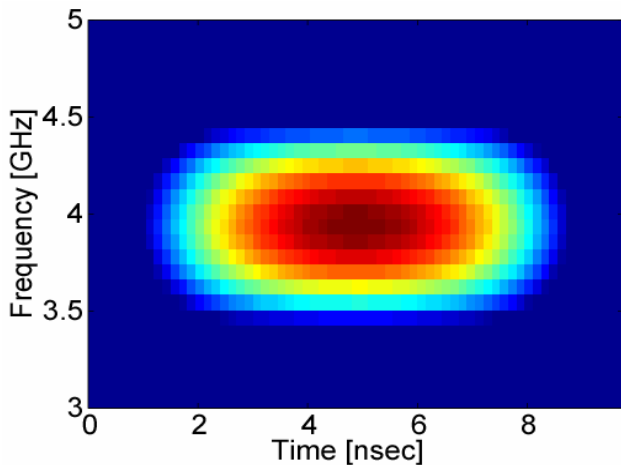


< 10ns/ 1GHz CS >

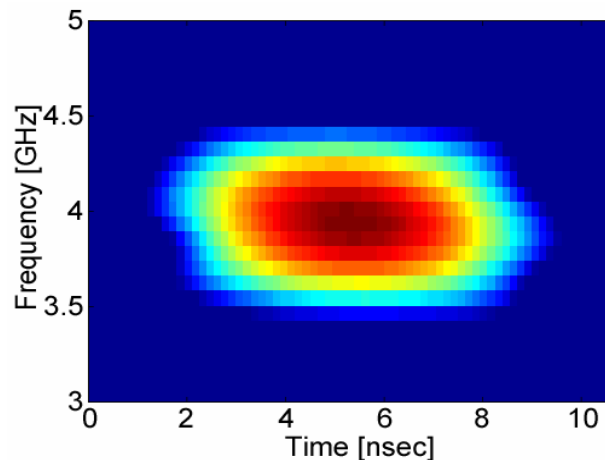


< 1-5 ns/500MHz CS >

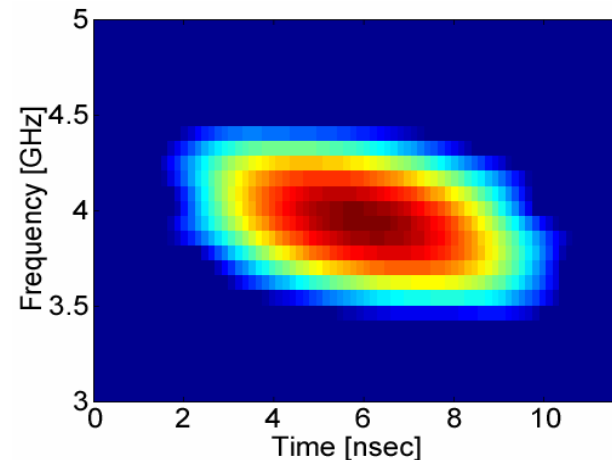
Two-Dimensional View on Spectrum



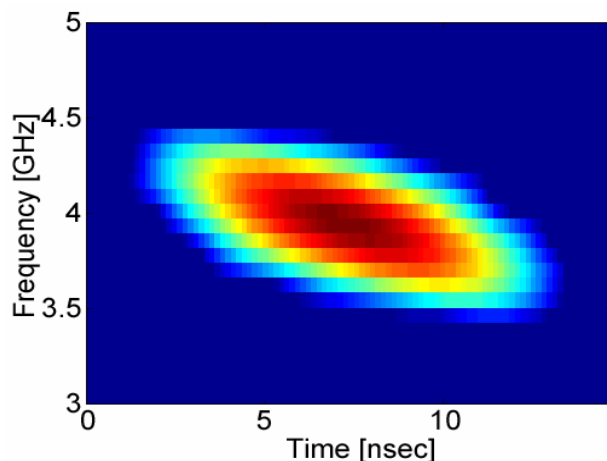
< Gaussian without CS >



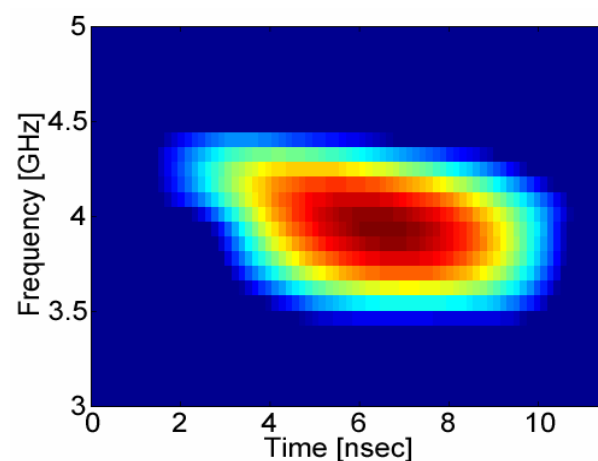
< 1ns/1GHz CS >



< 5ns/1GHz CS >



< 10ns/ 1GHz CS >



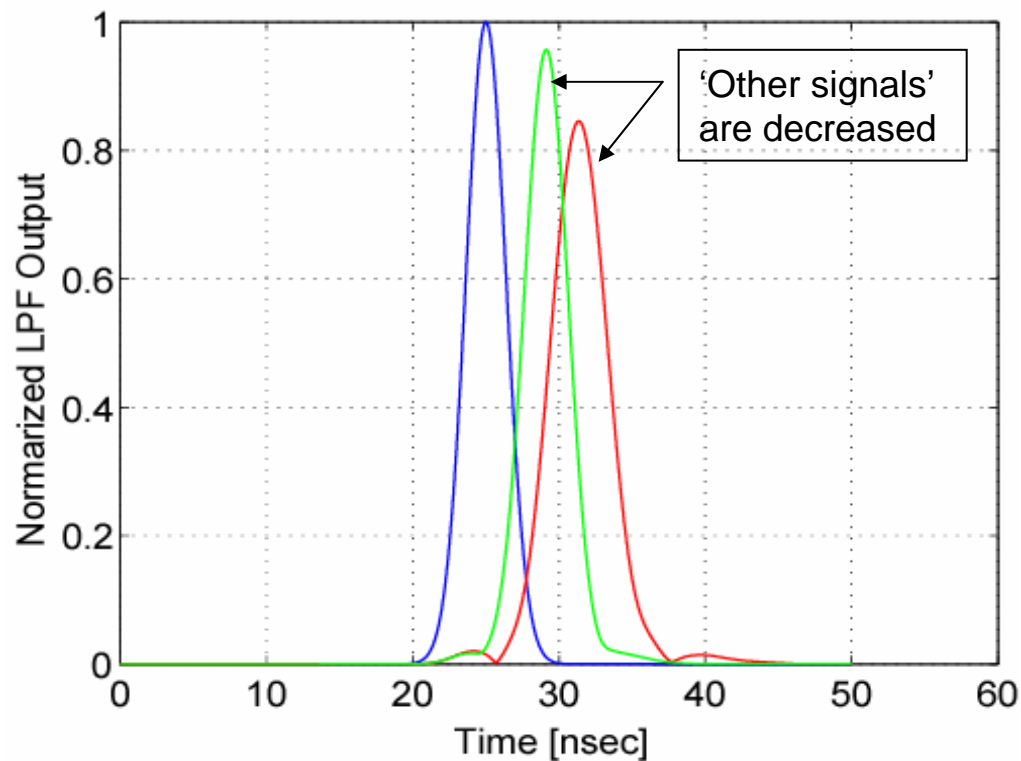
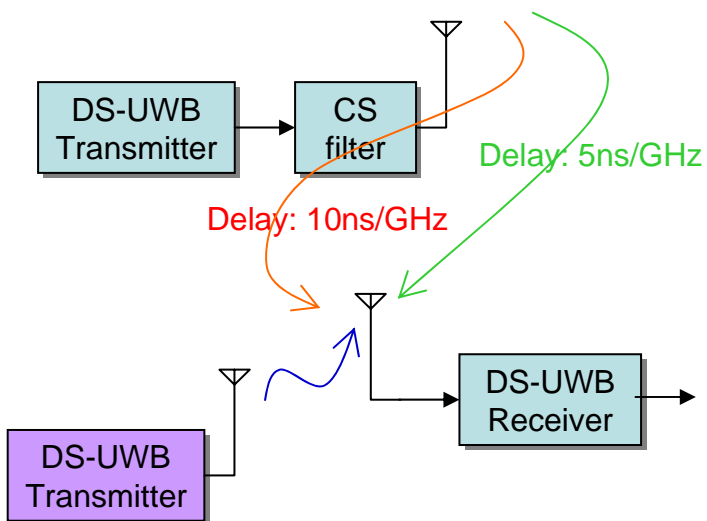
< 1-5 ns/500MHz CS >

Approach for Compliance

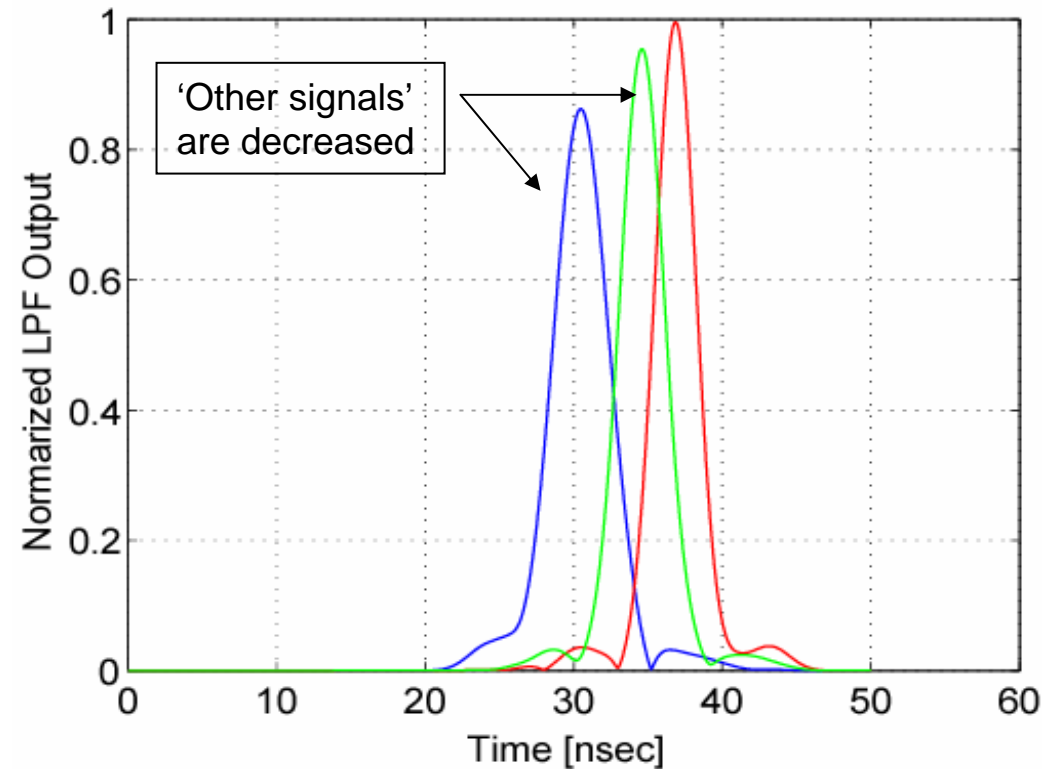
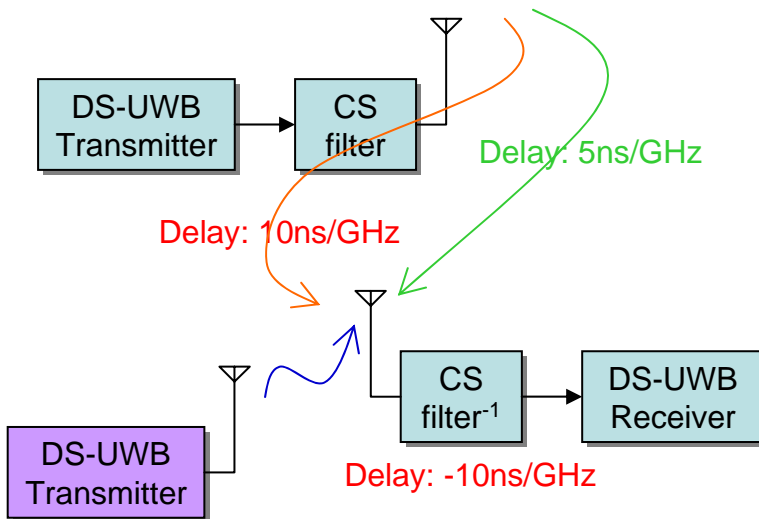
- CS pulse meets all requirements of UWB.
 - Satisfy 500MHz bandwidth no matter if the CS filter is switched in/out.
 - Satisfy the FCC spectrum mask.
- This option leaves a way for those who want take advantages of CS pulse to get better performance.

3. What can the CS pulse help?

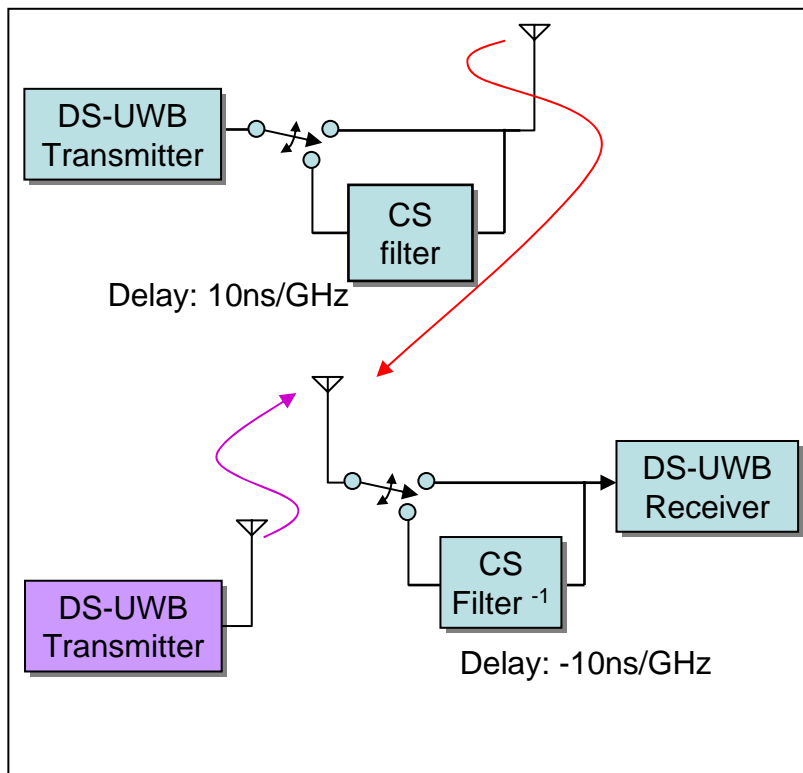
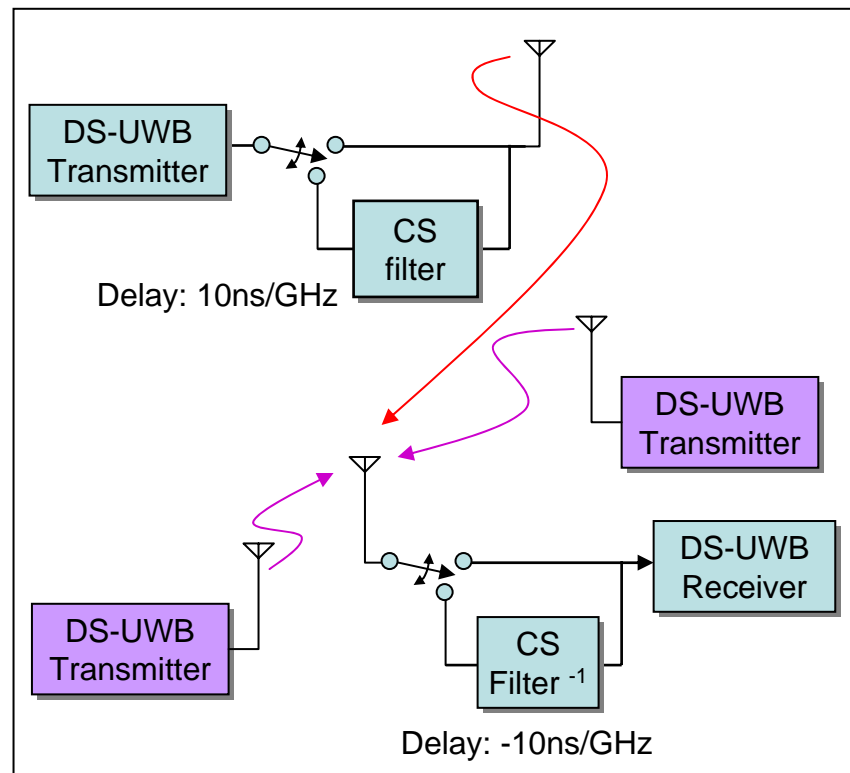
Output Signal Of DS-UWB Receiver



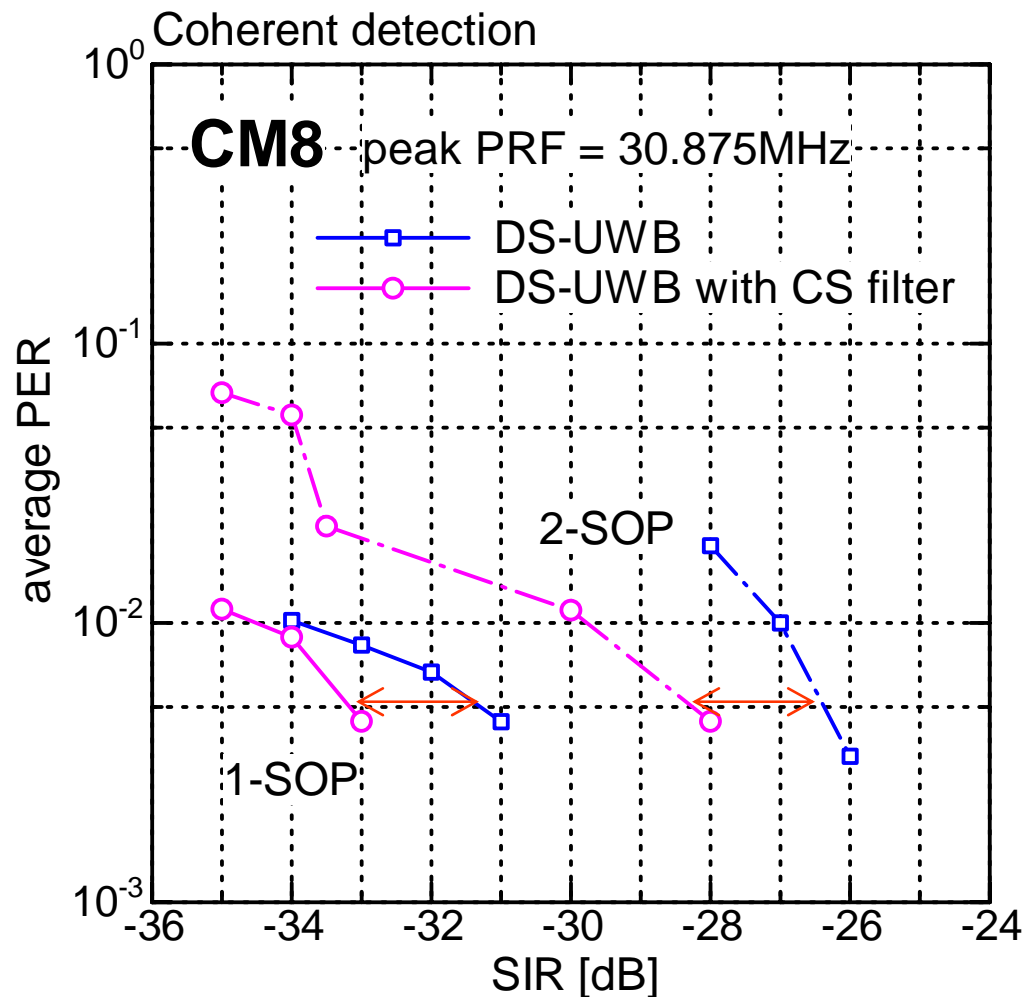
Output Signal Of CS-UWB Receiver



Block Diagram For SOP Simulation

**1-SOP****2-SOP**

Enhanced SOP With CS Filtering



Concluding Remarks

- Optional CS-UWB is fully compliant with FCC rule.
 - meet the spectrum mask.
 - occupy a minimum bandwidth of 500MHz.
- Optional CS-UWB benefits both CS players as well as non-players.
 - reduce the interference from other transmitters.
 - present smaller interference than DS-only transmitters.
 - enhance SOP performance for both.