

# Prototyping with OAI

## C-RAN CoMP use-case

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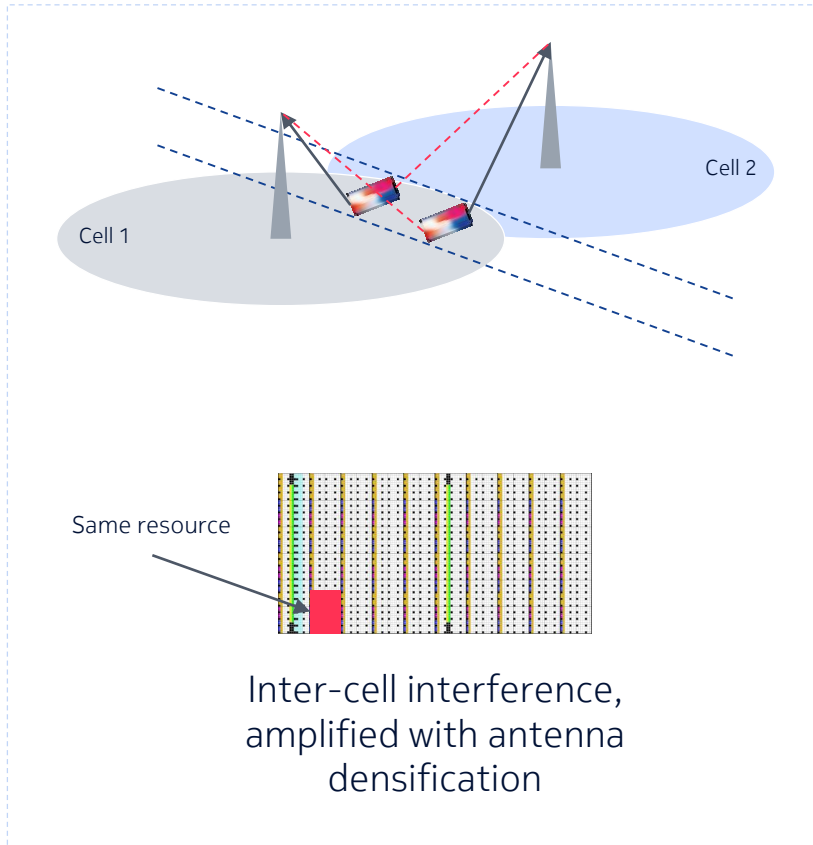
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# Objectives

- Demonstrate Coordinated Multi-Point capabilities (CoMP) using open source tools and commodity hardware.
- Provide a high level CoMP control.
- Integrate RAN in an end-to-end validation system.

# Use-case scenario (1/2)

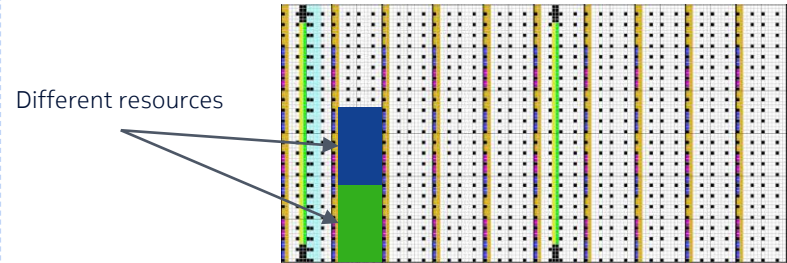


- Significant throughput loss
- Increased block error rate
- Poor transmission quality

A possible solution



Use a low complexity schedulers coordinator



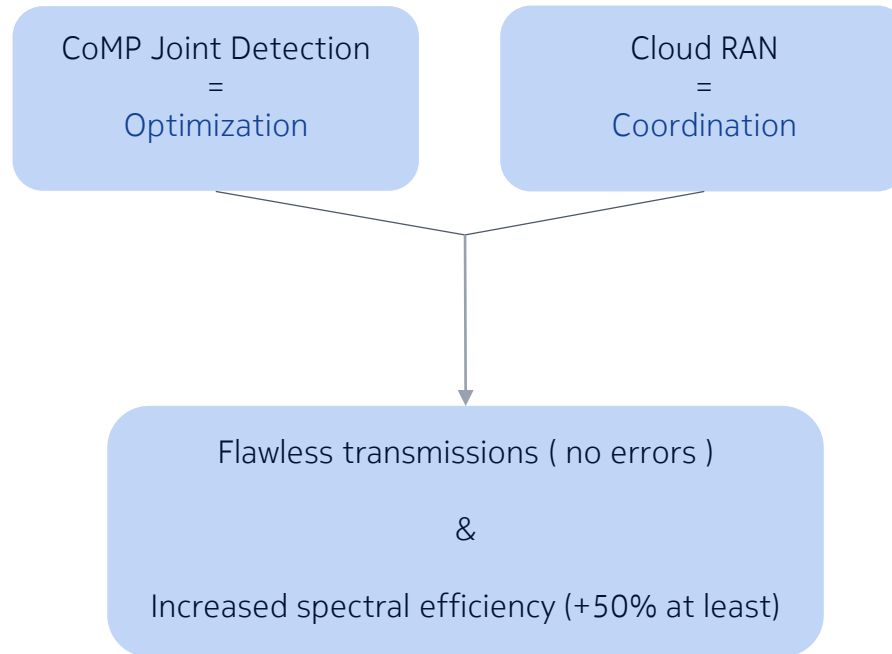
Avoids Interference

**But**

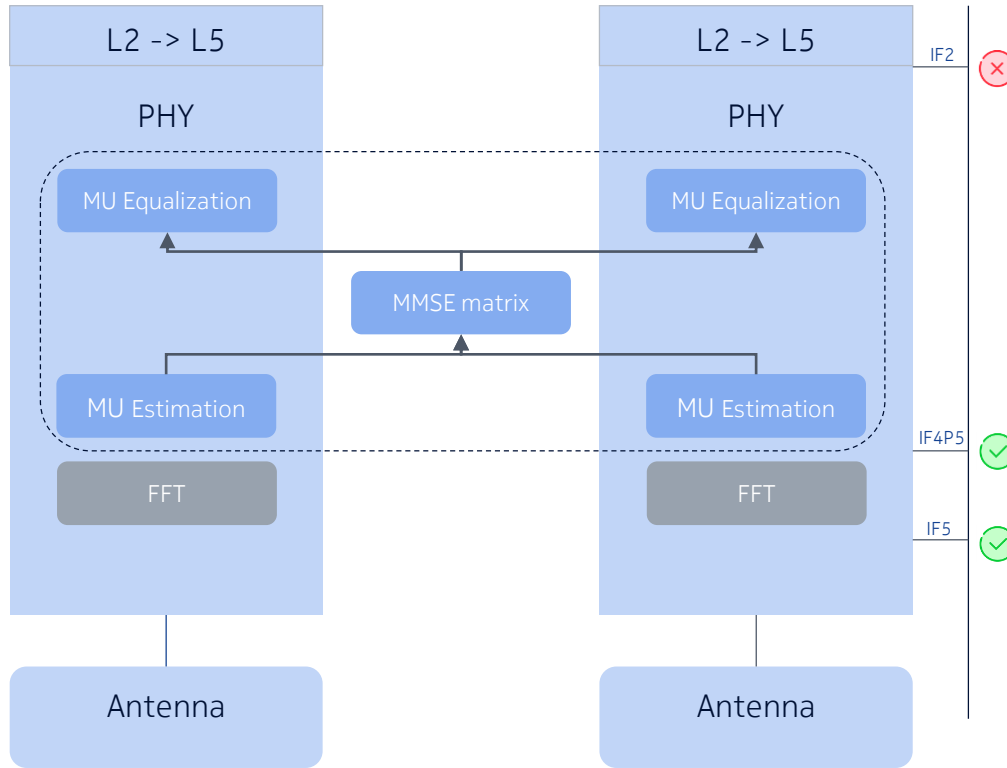
lowers spectral efficiency

## Use-case scenario (2/2)

Instead of avoiding a physical reality, we take advantage of it !



# Functional specification (1/2)



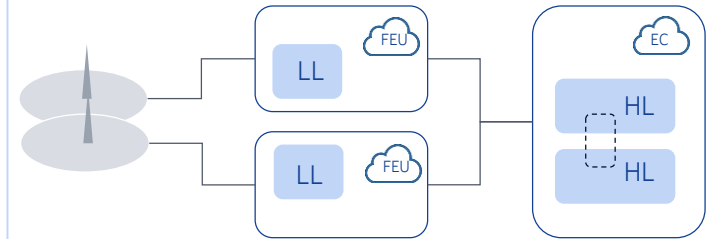
Multi-user MMSE equalization

- Suboptimal & low complexity

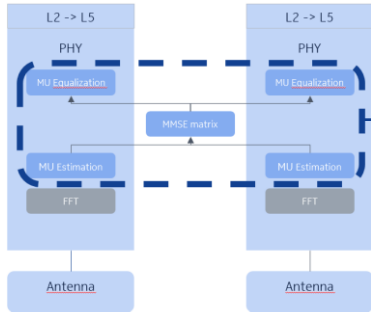
Timing constraint : few 100s of  $\mu$ s for the whole process

- Reducing computation cost
- More challenging for  $n > 2$  users

## Functional split choice



# Functional specification (2/2)



Assumption 1 (As1) :  $SNR \gg 1$

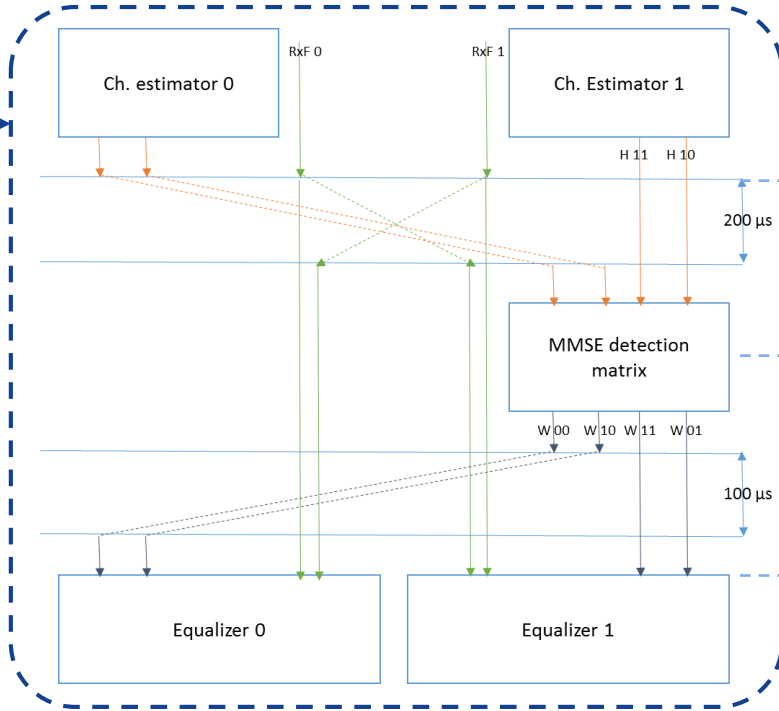
$$y = h x + z$$

Using (As1) :  $y = h x$

Multi-user ( $n = 2$ ) model :

$$y_i = h_{i1} x_1 + h_{i2} x_2, i = 1, 2$$

With vectors :  $\mathbf{Y} = \mathbf{H} \mathbf{X}^T$



$$\text{Output : } \mathbf{H} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix}$$

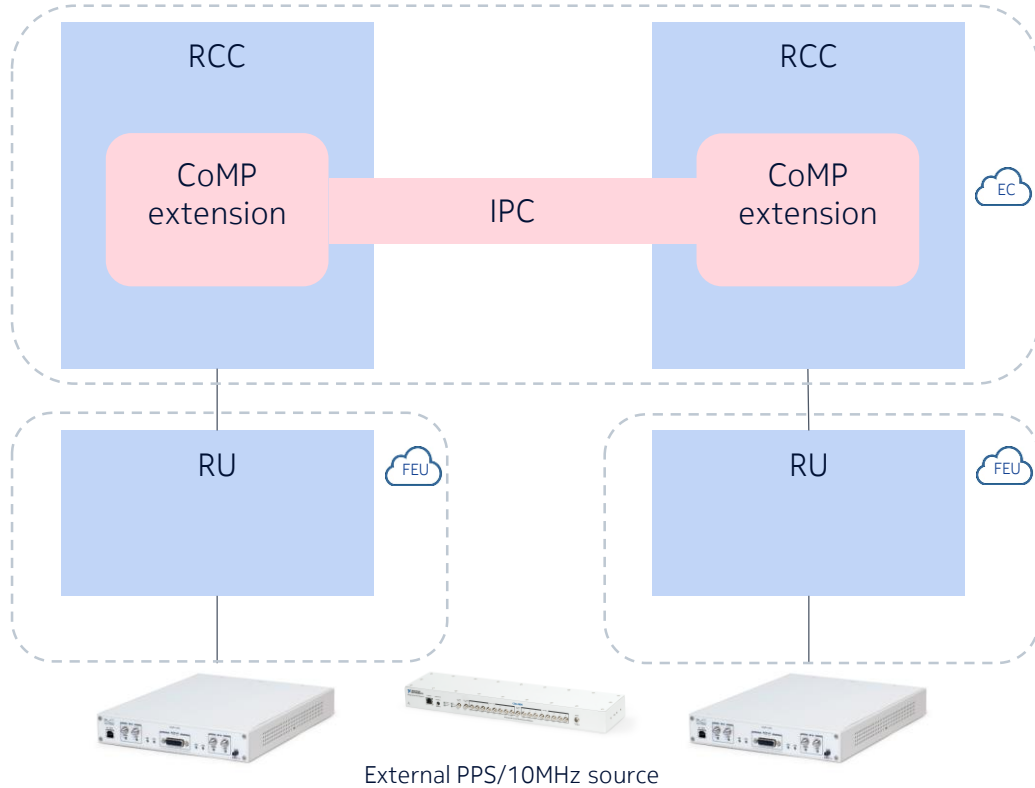
$$\mathbf{W} = (\mathbf{H}\mathbf{H}^* + \sigma^2 \mathbf{I}_d)^{-1} \mathbf{H}$$

With (As1)

$$\mathbf{W} = (\mathbf{H}\mathbf{H}^*)^{-1} \mathbf{H}$$

$$\begin{aligned} \mathbf{W}^* \mathbf{Y} &= [(\mathbf{H}\mathbf{H}^*)^{-1} \mathbf{H}]^* \mathbf{Y} \\ &= [(\mathbf{H}\mathbf{H}^*)^{-1}]^* \mathbf{H}^* \mathbf{H} \mathbf{X}^T \\ &= [(\mathbf{H}\mathbf{H}^*)^{-1} (\mathbf{H}\mathbf{H}^*)]^* \mathbf{X}^T \\ &= \mathbf{I}_d \mathbf{X} = \mathbf{X}^T \end{aligned}$$

# Technical specification

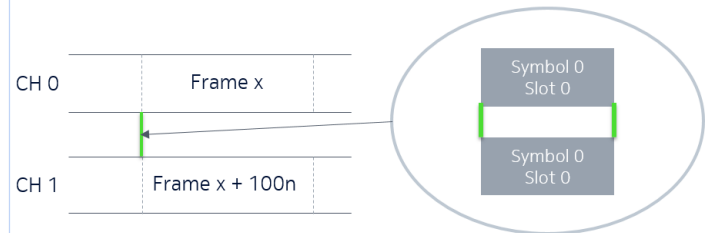


NGFI split in use IF4P5

IPC in use : Shared memory (ns latency)

RCC & RU are OAI lte-softmodem instances with specific configurations

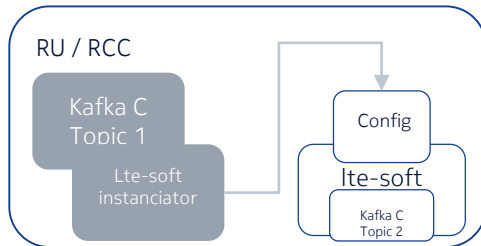
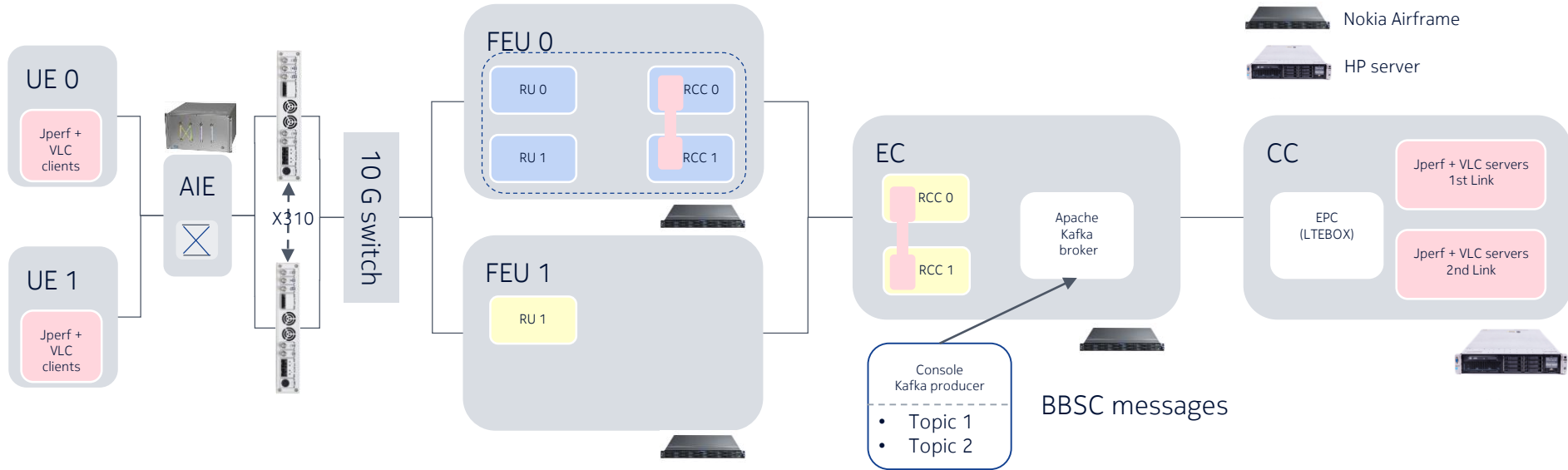
Pilot symbol positions in the frame require subframe alignment



Advantageous compared to GPS



# End to end system overview



Lte-softmodem instanciador intercepts messages of a specific topic 1 and instanciates in the form of a container an lte softmodem (RU / RCC) pinned on 2 cores according to received configuration

# Perspectives

CoMP related short-term perspectives :

- Upscale to more than two users.
- Enhance interference detection mechanism.

Overall system perspectives :

- CoMP as part of a SON toolbox.
- Enhance deployment automation.

**NOKIA**