



# New waveform and advanced receiver for new launchers telemetry

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## OVERVIEW

**Goal :** Transmit telemetry data from rocket to ground  
**Stakes :** Reliability and Efficiency of telemetry data transmission  
 Guarantee data acquisition  
 Improve Data rate for video stream (~ 5Mb/s)  
**Former System :** Analog modulation PCM/FM  
**Advantages :** Support non-linear amplification  
 Enable non-coherente demodulation

**Issues :** Limited coding gain  
 Channel strongly disturbed  
**Proposed Solution:** Non-coherent soft receiver

## Non-coherent Soft Receiver

### System Model

**Modulation :** Continuous phase modulation (CPFSK type)

$$s(t, \alpha) = e^{j\phi(t, \alpha)}$$

Information-carrying phase

$$\phi(t, \alpha) = 2\pi h \sum_{i=0}^{N-1} \alpha_i q(t - iT)$$

**Channel model :** Non-coherent Type

$$r(t, \alpha) = s(t, \alpha) \cdot e^{j\theta} + n(t)$$

$n(t)$  is an AWGN with spectral density  $N_0$

- $\theta$  - assumed to be unknown
- constant over the whole transmission
- uniformly distributed between  $[0, 2\pi[$

### Receiver

**Algorithm:** Trellis Based Receiver (BCJR type)

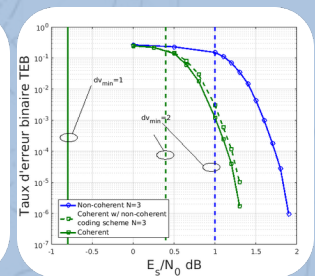
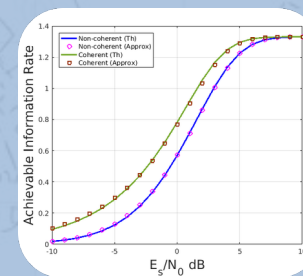
**States :** Block of symbols

**Metric :** Average over  $\theta$  to remove its dependency

### Performances

**Simulation :** Quaternary CPFSK ( $h = 5/7$ )

Coding Rate 1/2



## Upcoming

**Channel Estimation :** Draw from CNES IQ flight phase recording  
**Modulation :** Select the most suitable CPM modulation regarding channel estimation  
**Coding :** Protograph and/or convolutional code regarding the modulation  
**Performance enhancement :** Use frequency and/or polarisation diversity

## Conclusion

Non-coherent Soft Receiver gives performances close to the coherent one

Non-coherent coding scheme can be used in coherent regime