Transmitting in wideband: practice and learnings

HFIA meeting, Portsmouth, Sept. 11th, 2014

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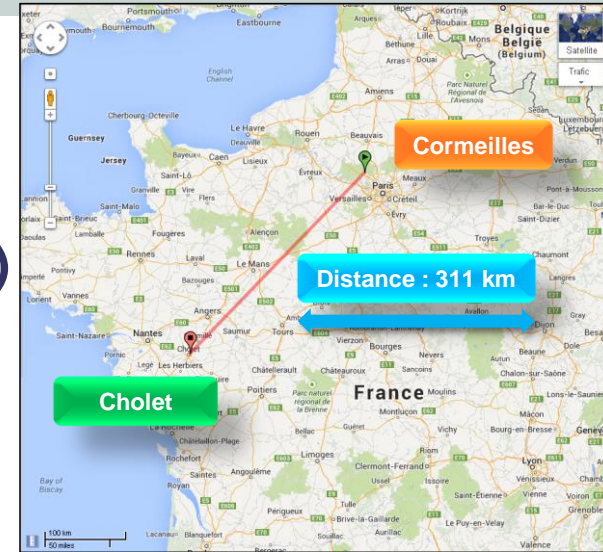THALES Communications & Security

SALAMANDRE project for French MoD

- ◆ **Launched Dec. 2013**
- ◆ **Purpose : study and demonstrate HF XL multi-channel non contiguous wideband waveform**

First milestone for the project : March 2014

- ◆ **Live demonstration to French MoD representatives**
- ◆ **Analysis on collected data for this transmission on:**
  - ○ HF Channel
  - ○ Possible wideband use

➔ **"Practice" and "Learnings" considerations hereafter**

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March 27th, 2014

◆ **21 participants (MoD + military forces)**

◆ **live demonstration (image, text, random data)**

Sep 11th, 2014 / TH/TCS/RCP/DT/cl,14/0030/PRE

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Issue of frequency allocation

◆ **As already mentioned in BLOS meetings, availability of frequencies for wideband transmissions is necessary**

- ○ It is confirmed again that being allocated 24kHz contiguous is problematic in France

- ○ Obviously this cannot be solved by using frequencies above 12MHz when in NVIS configurations (see below illustration of LUF-MUFfor Cholet<->Cormeilles link)

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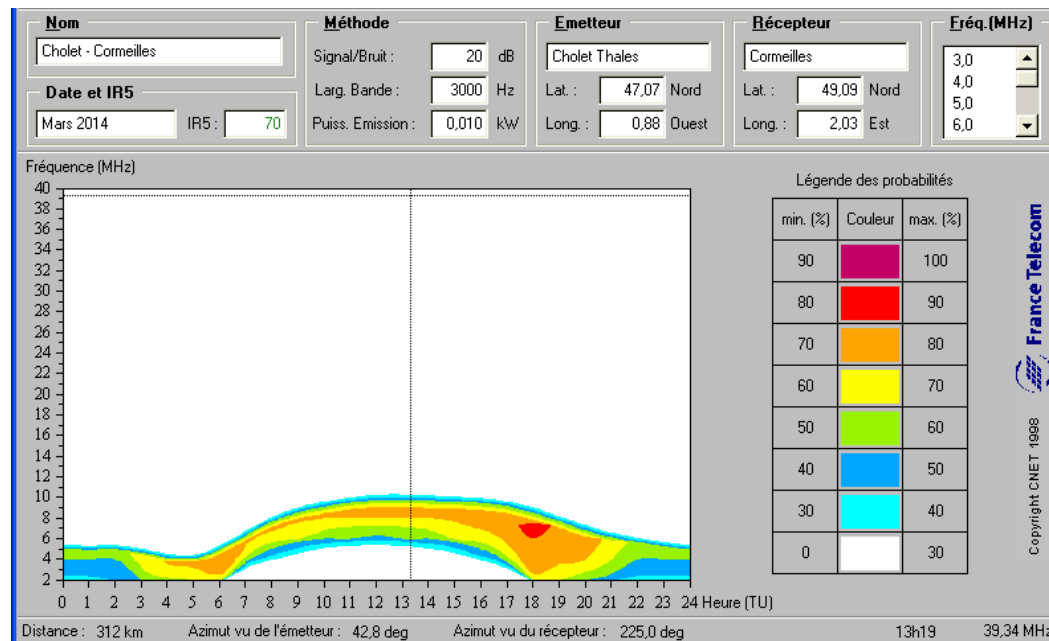
Questions raised and results sought

◆ **On the interest of wideband non-contiguous approach to take advantage of frequency diversity**

  ○ No real diversity is expected in 12 kHz (possibly 24kHz ?), but diversity exist when expanding to 200kHz

◆ **Measuring availability: selecting a correct noise floor reference**

  ● Known issue of noise impulsive nature

  ● Stationarity considerations

◆ **Comparing availability: defining a metric**

  ○ Remaining issues

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## HF channel diversity in frequency

◆ **Field measures have been carried out that confirm the existence of frequency diversity between the HF XL channels.**

  ○ This diversity will help improving reliability, both for high and low data rate

  ○ This will also allow consider possibly shorter interleaver length

◆ **Illustration (March 2014): comparison of equivalent SNR measured for 4 consecutive frames for each of their 16 channels (spread over 200kHz)**
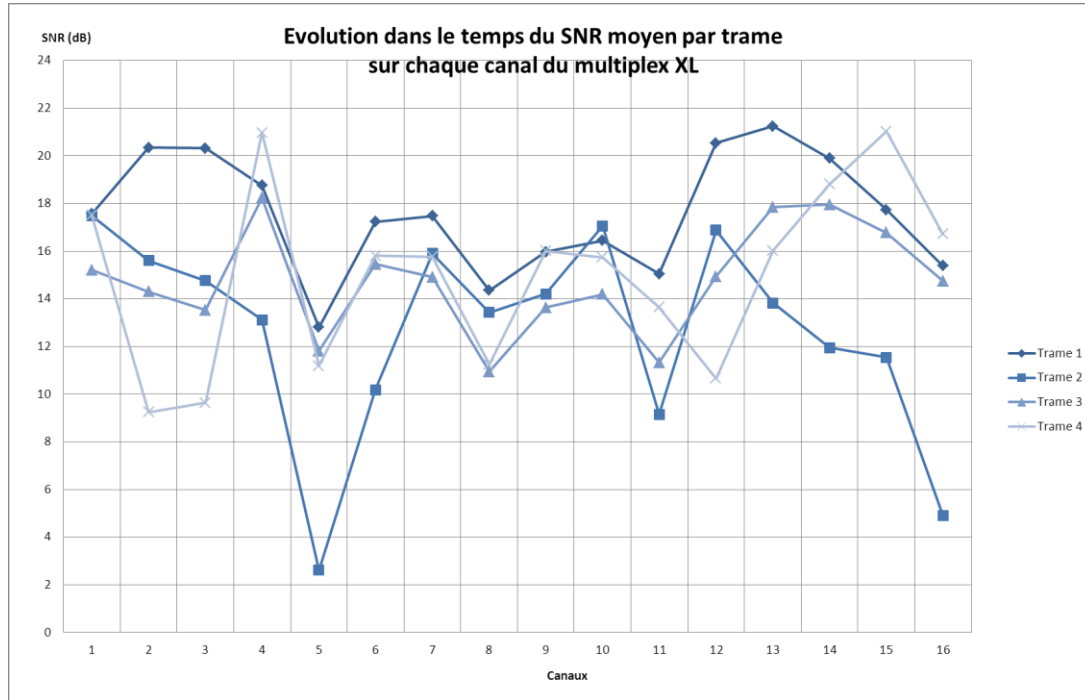
HF noise estimation

◆ **Noise level may vary inside a 1 MHz bandwidth of several dB**

  ○ Measuring the noise floor on Bw=250kHz is recommended rather than 1MHz
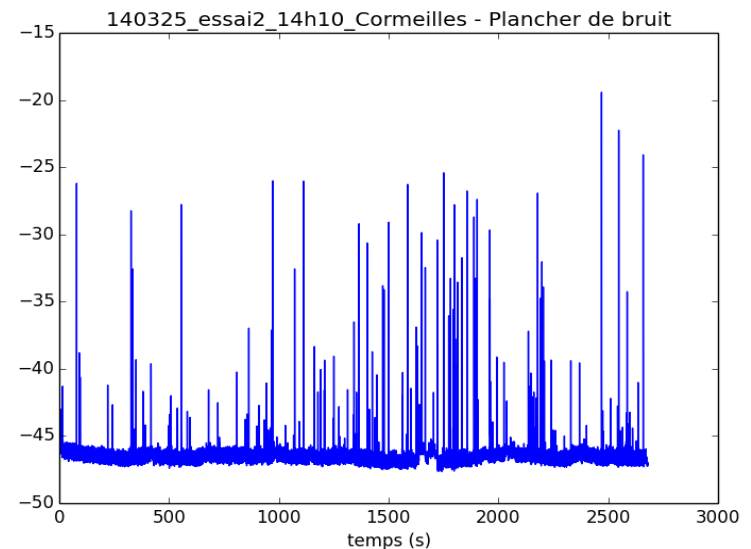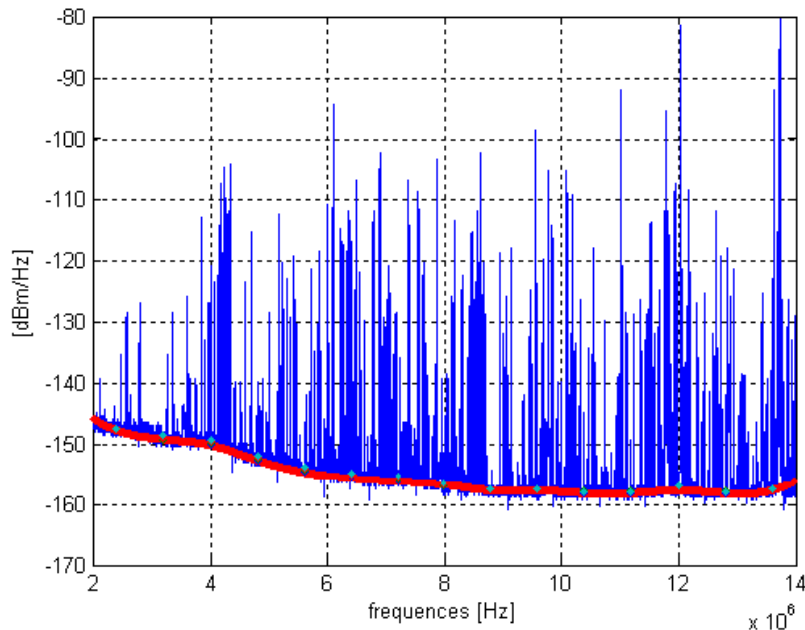
◆ **Impulsive nature of noise must be taken into account**

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Establishing a comparison metric for spectrum occupancy

◆ **Independent for now of actual spectrum allocations (first stage)**

◆ **Taking into account the capability of HF waveforms (coding, interleaving, even ARQ) to overcome some perturbations**

◆ **Channel occupancy : for a given channel, the percentage of time that the measured signal power exceeds a specified threshold $(SNR)_T$ above the noise floor**

◆ **Channel availability ratio : the percentage of channels which occupancy is less than a given occupancy threshold O_T, in a given frequency band**

Known limitations (deemed acceptable for now, may necessitate further refinement later)

◆ **Not taking into account differences between both sites**

◆ **Measuring only "quantity", not "quality"**

Metric and analysis proposed to the *ad hoc* WB on channel availability currently working on wideband spectrum issues within NATO BLOS CaT
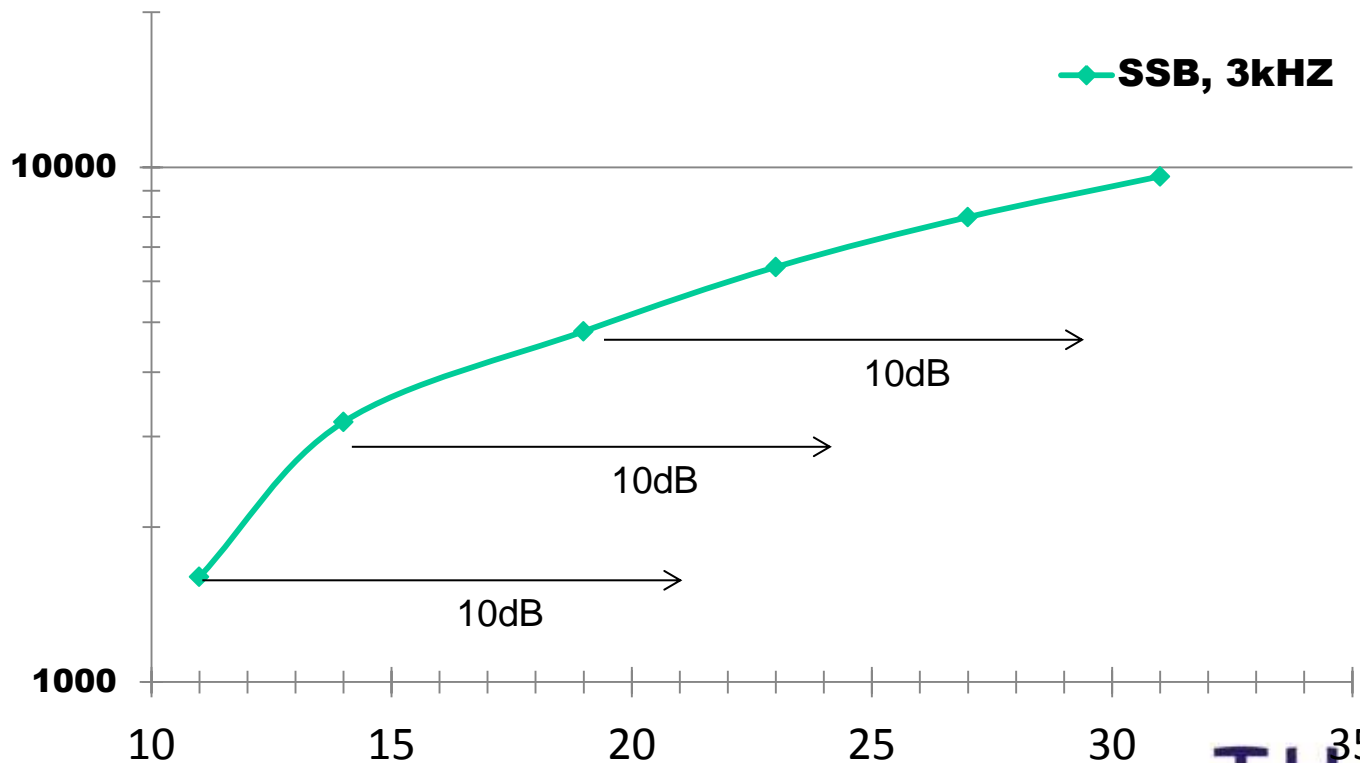
Illustration of limitation 1 : measures in Cholet / Cormeilles (March 2014)
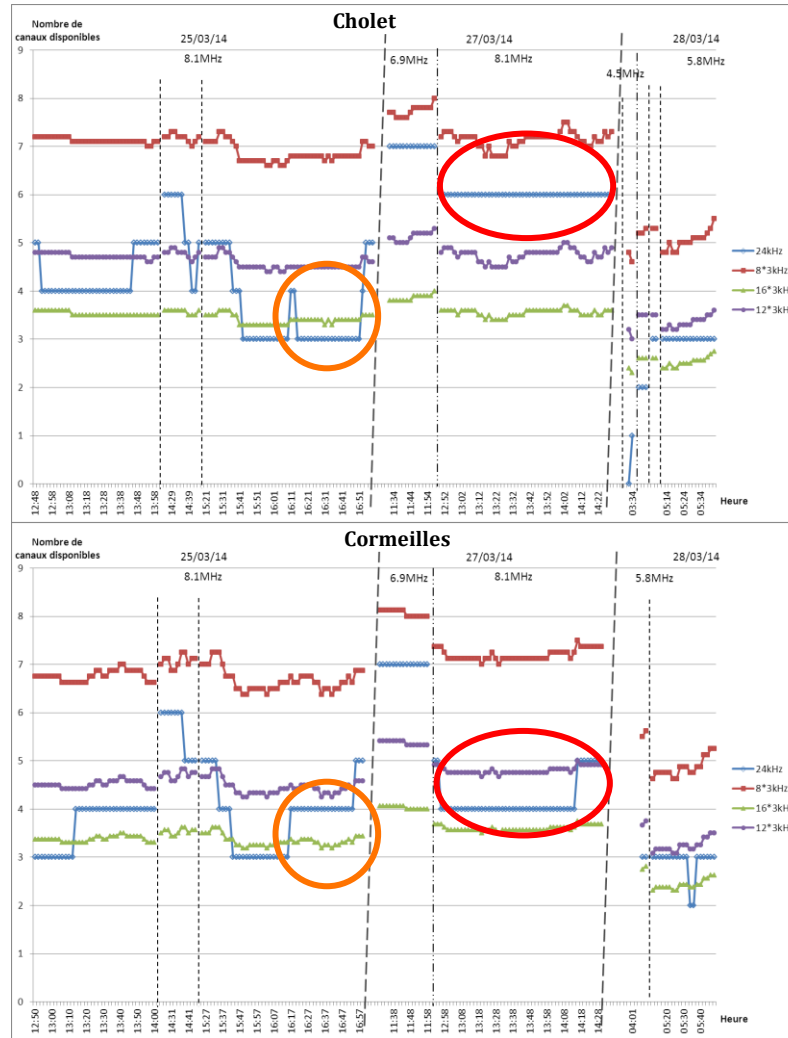
Illustration of limitation 2 : "quantity" vs. "quality"

◆ **Availability is achieved if measured noise in a channel remains below a given threshold a large percentage of time**

◆ **Classical threshold in HF is 10dB**

    ○ Depending on modulation considered, this can result in a factor 2 or 3 in throughput !!

Wideband transmissions are the new frontier:

◆ **More resilient, more adaptable, providing further services**

To be successful and feasible in practice, wideband transmissions implies to

◆ **Consider carefully the spectrum issue (allocations are mandatory)**

◆ **Make the best of HF channel**

　　○ Cope with its impulsive and non stationary properties

　　○ Take advantage of diversity (temporal & frequency) offered

　　○ Select good channels through ALE/ALM wideband in coherence with both sites qualities

And in that case, they will meet the expected goals !

THALES welcomes comments and questions on this presentation as well as realised trials.

Thanks for your attention

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**with grateful thanks to our colleagues
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