Demonstration: Voice transmission over NATO Narrow Band Waveform Physical Layer with Low-Cost Software Defined Radio Platforms

Dr. Ir. Vincent Le Nir, Prof. Dr. Ir. Bart Scheers

Royal Military Academy – Department CISS

BELGIUM

vincent.lenir@rma.ac.be, bart.scheers@rma.ac.be

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Introduction

- There is currently no narrowband Combat Net Radio (CNR) STANAG waveform for international and combined missions providing interoperability in Network Centric Operations (NCO)
- The principal objective of the Narrow Band Waveform (NBWF) is to achieve coalition interoperability within lower tactical levels
- Military Software Defined Radio (SDR) equipment provides the flexibility to incorporate new waveforms and functionalities without having to upgrade or to replace hardware components.
- Therefore, the SDR technology provides an efficient and inexpensive way to implement the NBWF

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Review of the NBWF Physical Layer (STANAG 5631)

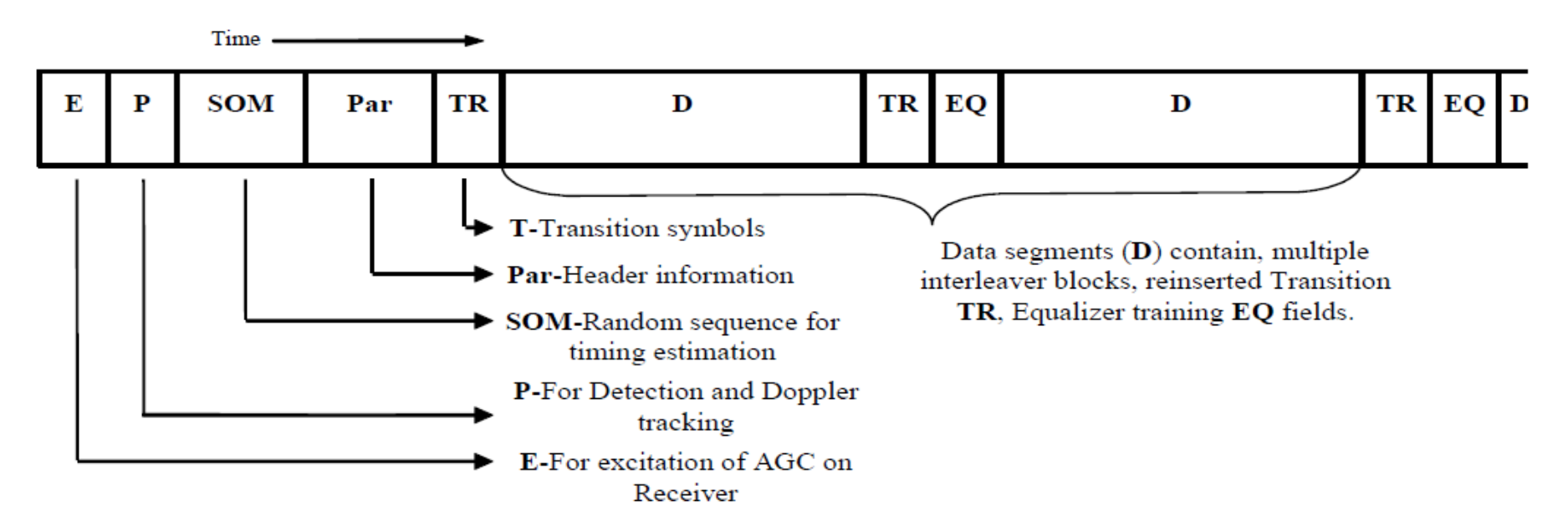
- The NBWF uses bandwidths of 25 KHz up to 50 kHz with on-air bit rates up to 82 kbps in the VHF or lower UHF bands with continuous phase modulation (CPM)

Waveform Modes	User Data Rates (kbps)	L	Mc	h	Pulse Shape	Code Rate	Symbol Rate(ksps)	Nominal 99% BW (kHz)
N1	20	2	2	1/2	REC	2/3	30	25
N2	31.5	2	2	1/4	REC	3/4	42	25
N3	64	3	2	1/6	REC	4/5	80	25
N4	82	3	2	1/9	REC	6/7	96	25
N5	40	2	2	1/2	REC	2/3	60	50
N6	63	2	2	1/4	REC	3/4	84	50
NR	10	2	2	1/2	REC	1/3	30	25

- L is the number of symbol intervals
- Mc is the alphabet size
- h is the modulation index

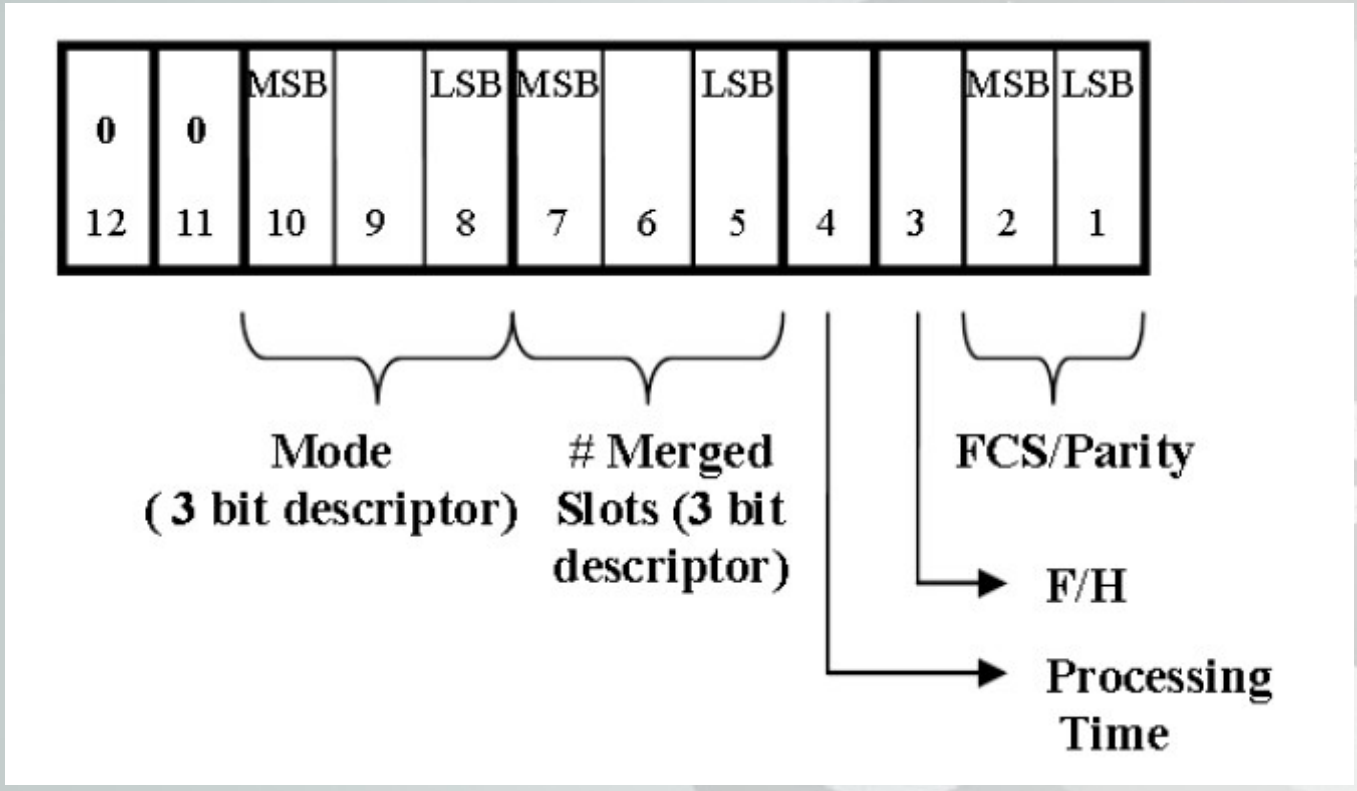
Review of the NBWF Physical Layer (STANAG 5631)

- The slot size of the NBWF is 22.5 ms (to be in accordance with MELP frame length). There can be single slots or merged slots with or without processing time applied to the final slot. P=45 symbols, SOM= 63 symbols, Par=48 symbols, TR=2 symbols, EQ=16 symbols



Review of the NBWF Physical Layer (STANAG 5631)

- The contents of the “Par” register contains 12 information bits. These 12 bits are block coded using the extended Golay (24,12) code.



Real-time Qt Application for NBWF

- Physical Layer (L1): select NBWF modes N1, N2, N3, N4, N5, N6, NR
- Parameters to control Tx and Rx rate, frequency, gains
- Link Layer (L2): select Point-to-Point TDD, Point-to-Point FDD, TDMA, NBWF TDMA
- Several applications (Video (M-JPEG), Audio (MP3 or MELPe, BER, Text message, IP traffic)
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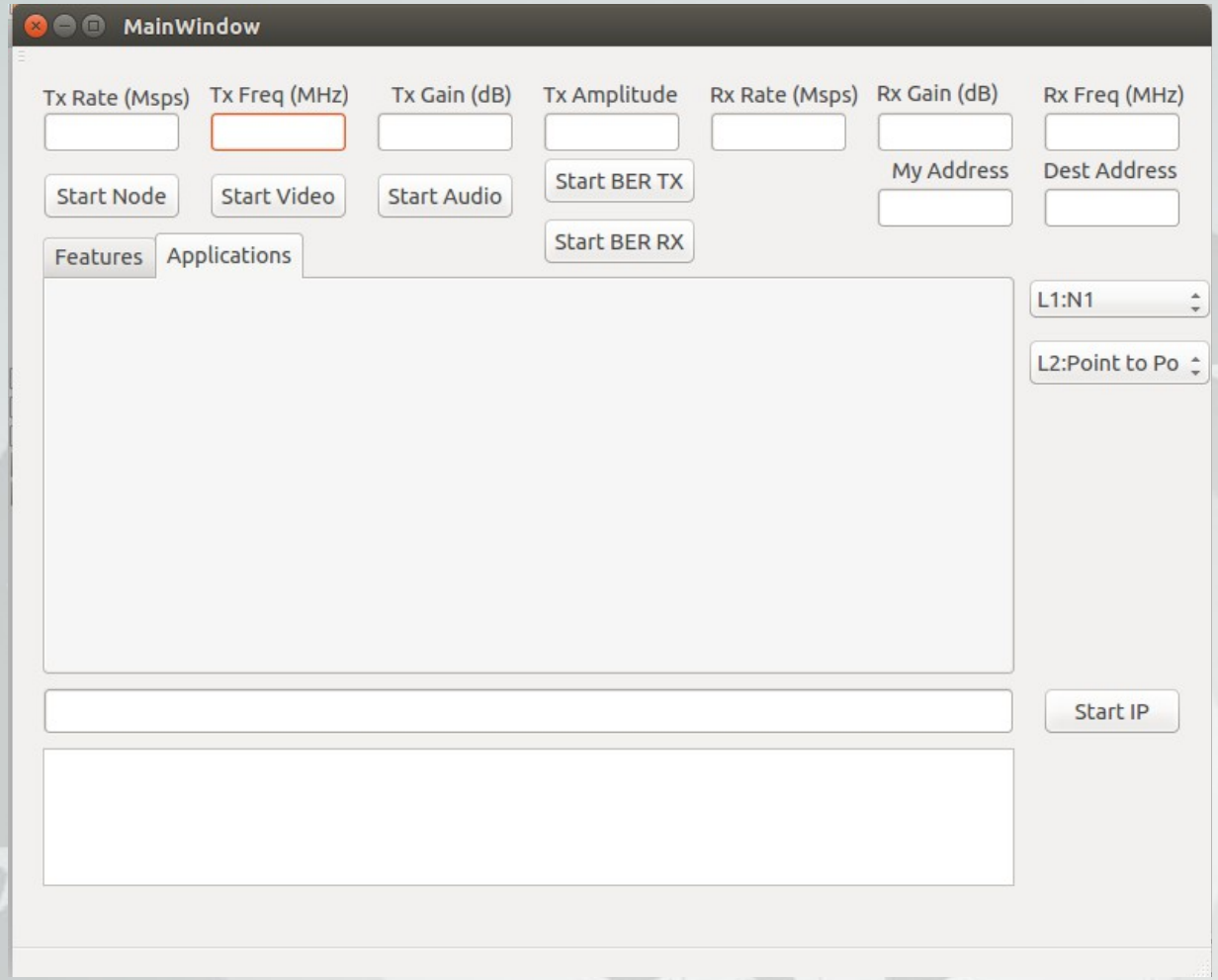
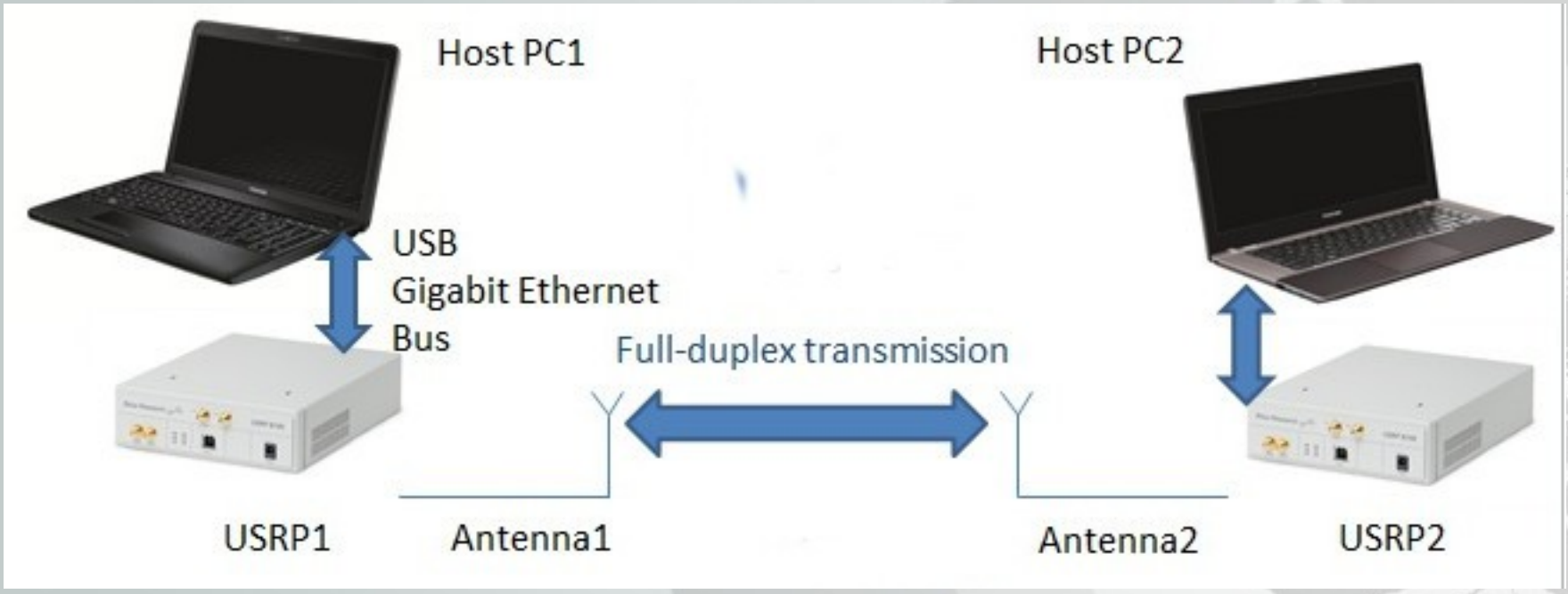
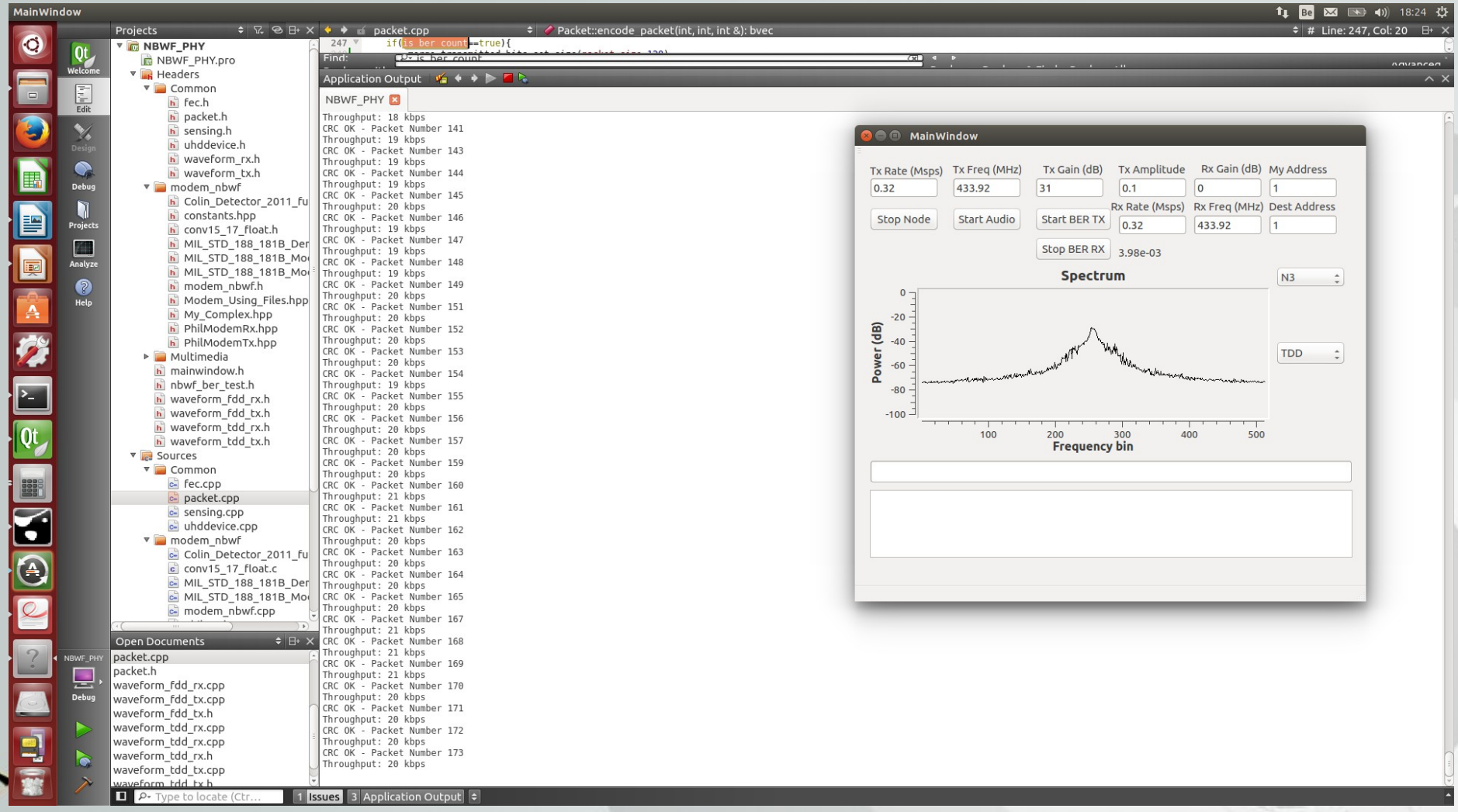


Real-time Qt Application for NBWF

- Demonstration of the Qt NBWF application using laptops or single board computers, USRPs, MioT or other SDR hardware.



Real-time Qt Application for NBWF



Conclusions and future work

- Conclusions
  - Implementation of NBWF Physical Layer
  - Implementation of some parts of the NBWF Link Layer
- Future work
  - Continue on the implementation of the NBWF Link Layer (STANAG 5632)
  - Implementation of the NBWF Network Layer (STANAG 5633)
  - Use the NBWF as a basic waveform in the EDA Cat B MAENA project for the VHF link
  - Use this work for a NATO reference implementation

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