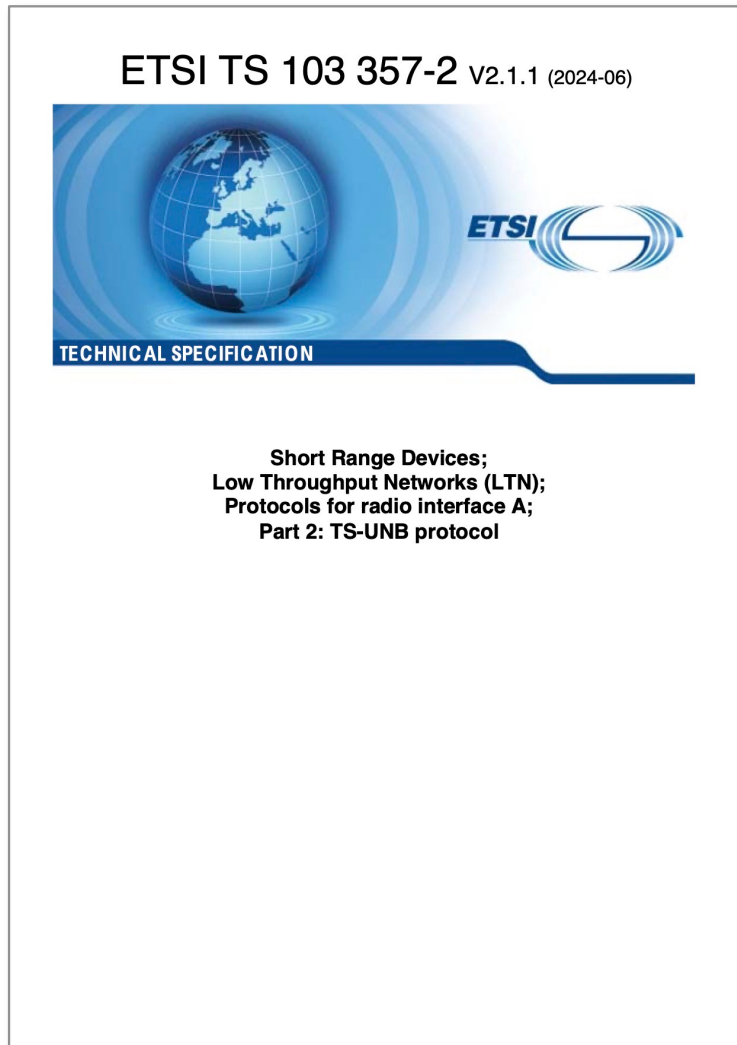


New functionalities in TS-UNB specifications v2

Journées LPWAN - Rennes 03-04 July 2025

author: Benoît Ponsard

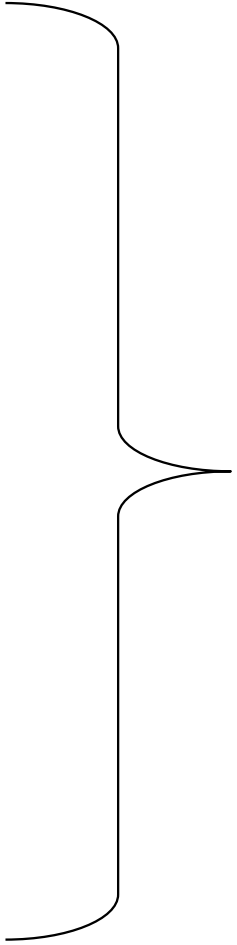
Foreword



- publicly available at etsi.org
- LINK
- MAC
- **PHY**
- radio characteristics
 - format
 - function
 - procedures
 - UL
 - DL

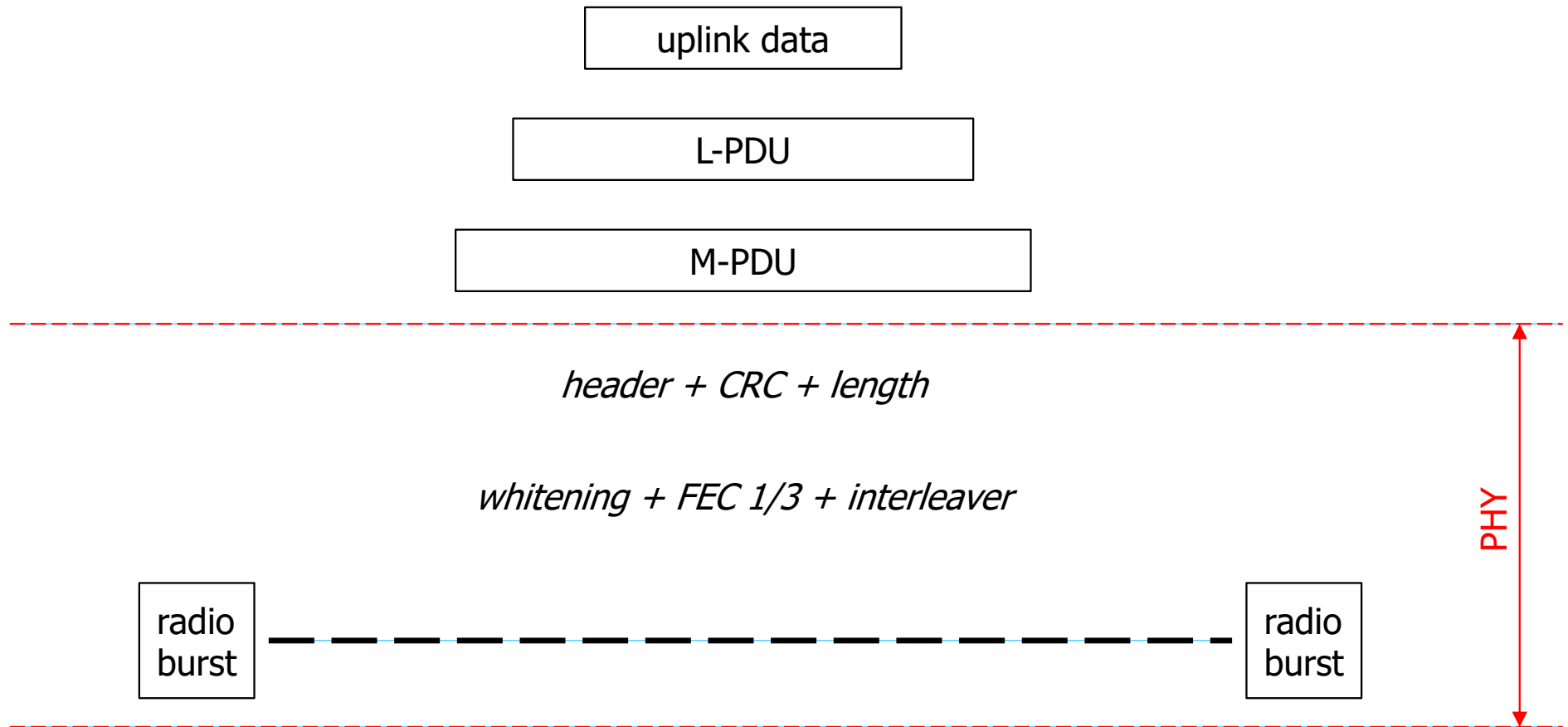
Remainder of TS-UNB principles

- invented in Fraunhofer IIS
- frequency hopping for interference resistance
- shall work with uplink-only sensors
 - → no synchronisation of hopping sequence

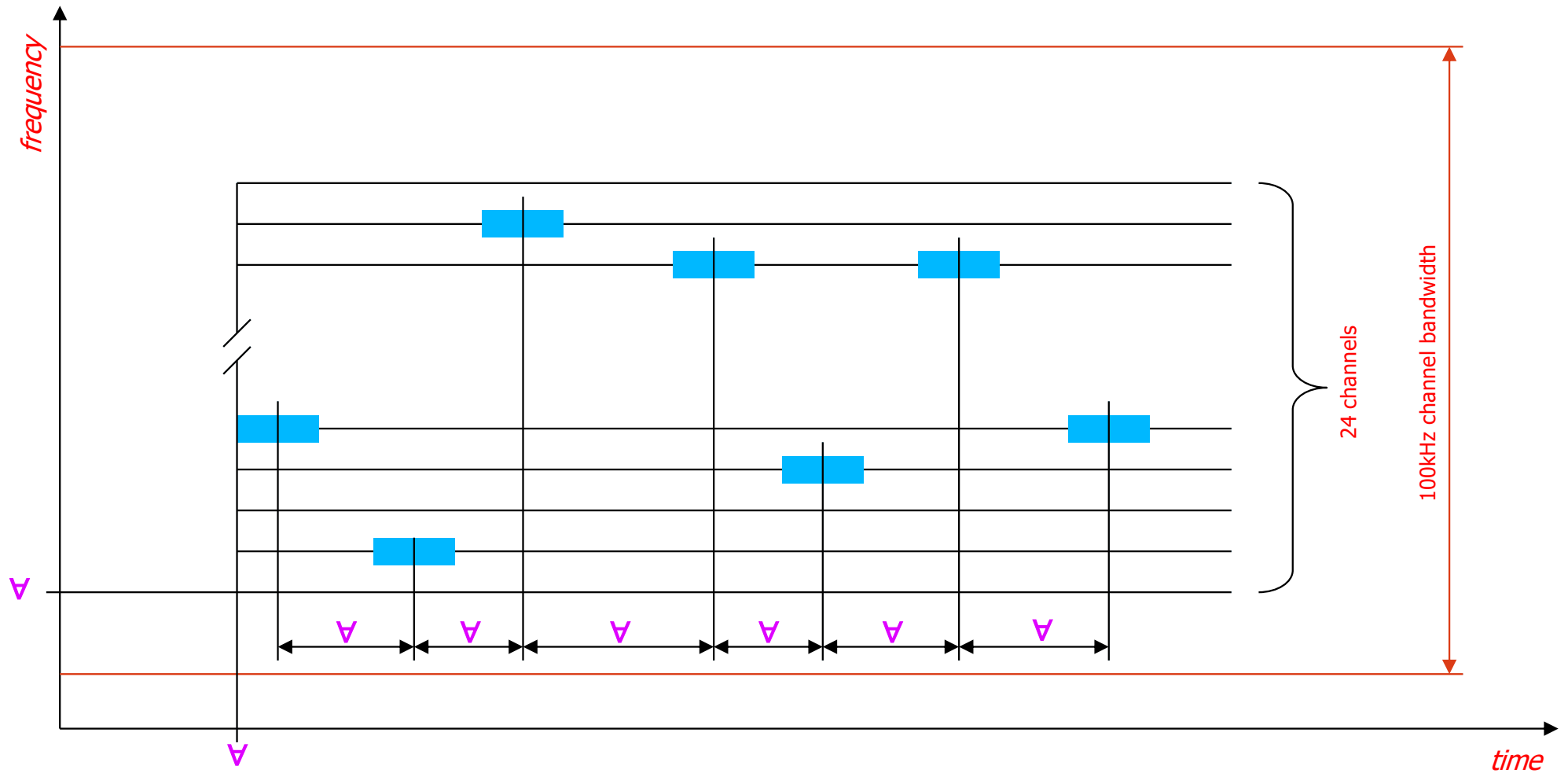


pre-defined
hopping sequences
with
pseudo random
time & frequency patterns

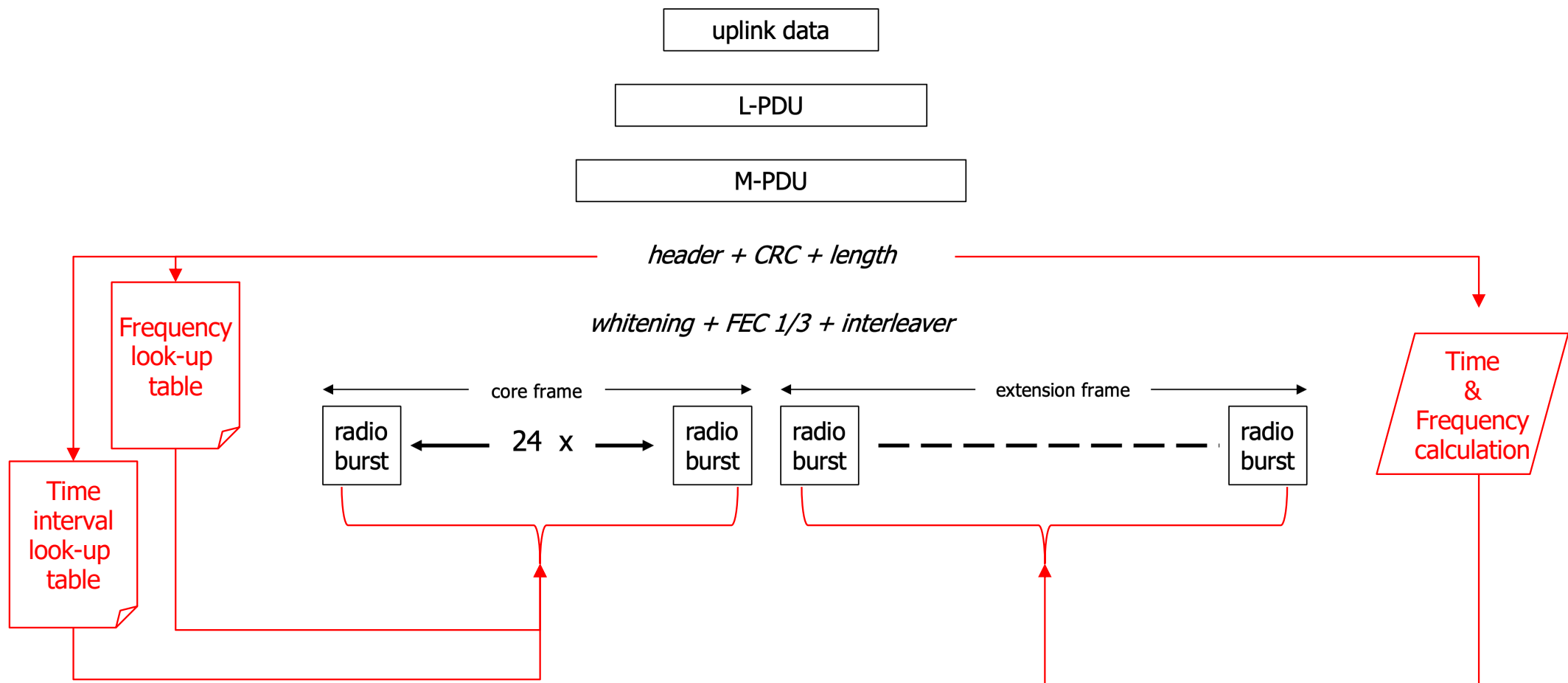
PHY level robustness: behind the scenes



Random time-intervals and carriers

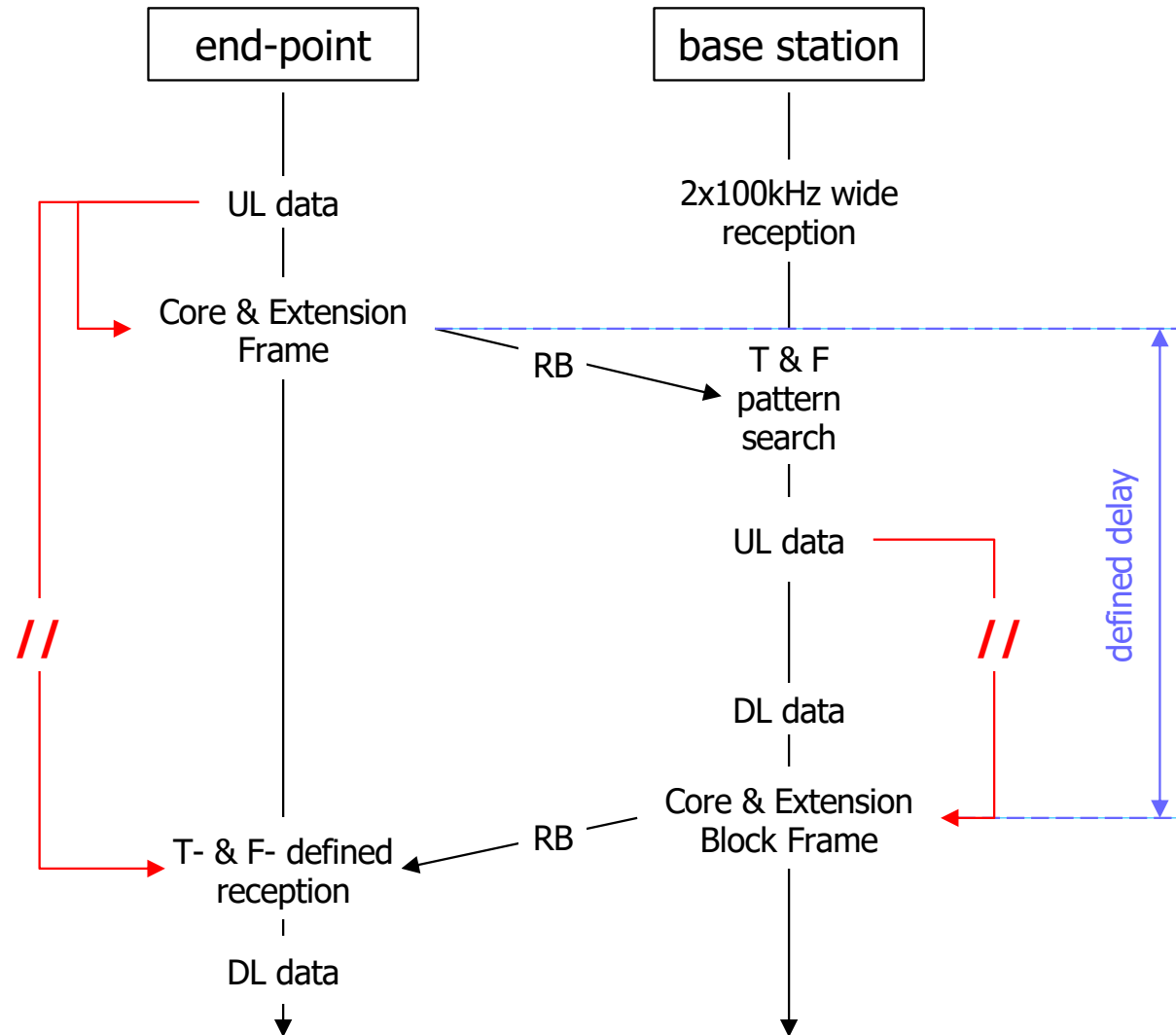


T & F patterns selection in uplink



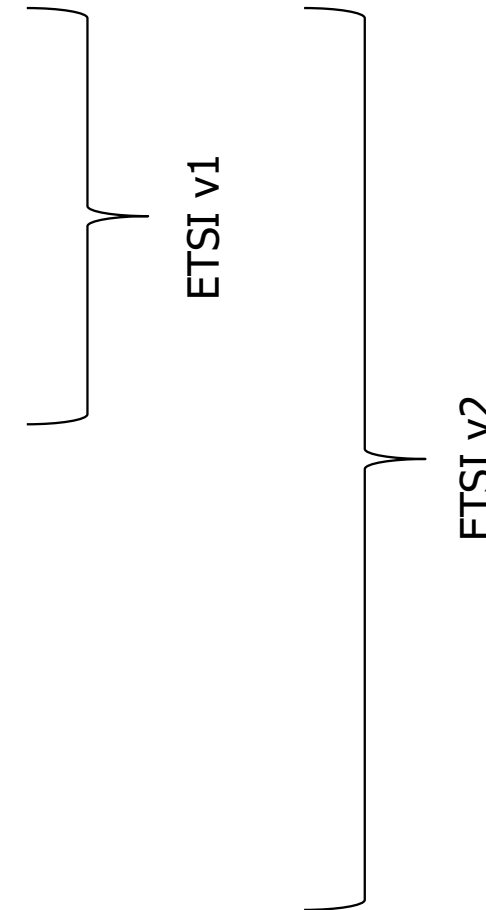
T & F patterns selection in downlink

- constraints in EP
 - limited power
 - limited proc. cap.
- DL T&F pattern derived from uplink message

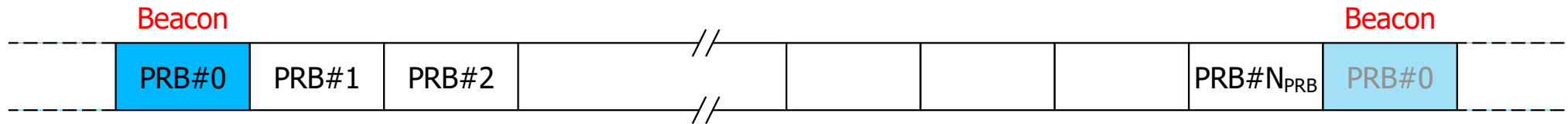


Classes of end-points

- class Z
 - uplink only
- class A
 - UL + EP-triggered downlink transmission
- class B
 - A + scheduled downlink transmission
- class C
 - B + event-triggered downlink transmission



DLB frame for scheduled downlink transmission

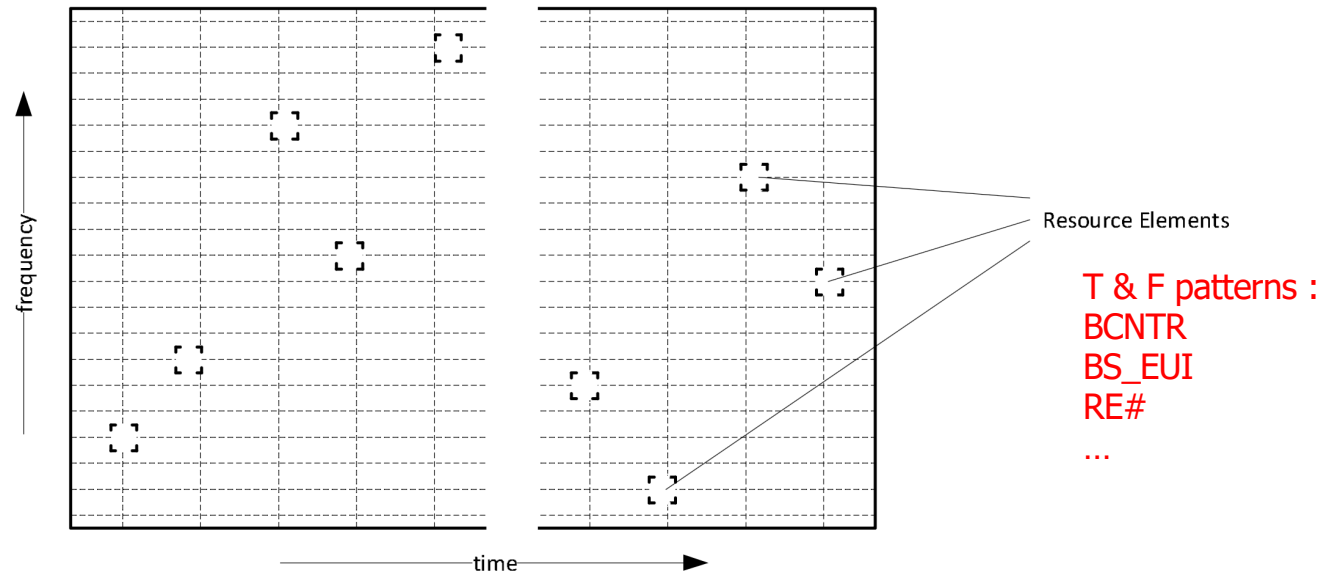


beacon period

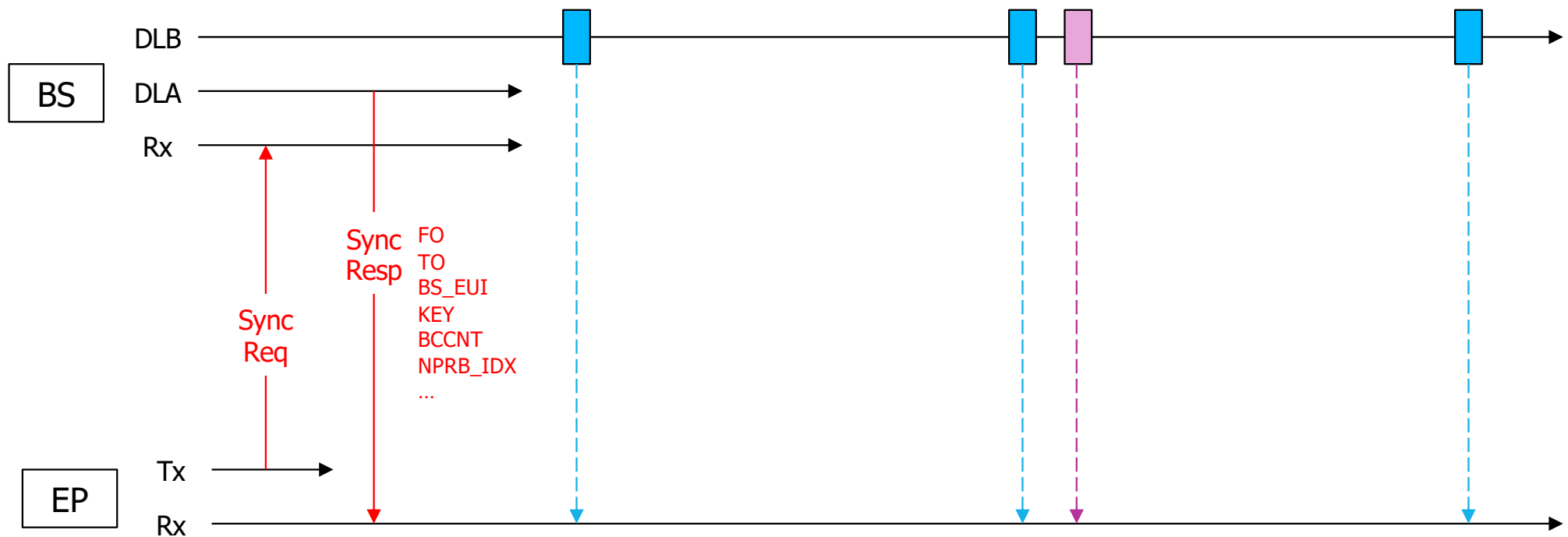
NPRB_IDX	Number of PRBs	DLB frame duration [s] (rouded to 0,1 s)
0	3	11,8
1	4	15,7
2	5	19,7
3	7	27,5
4	9	35,4
5	11	43,3
6	13	51,1
7	17	66,8
8	25	98,3
9	31	121,9
10	37	145,5
11	49	192,7
12	73	287,0
13	121	475,8
14	169	664,5
15	217	853,3

14mn22s

Physical Resource Block



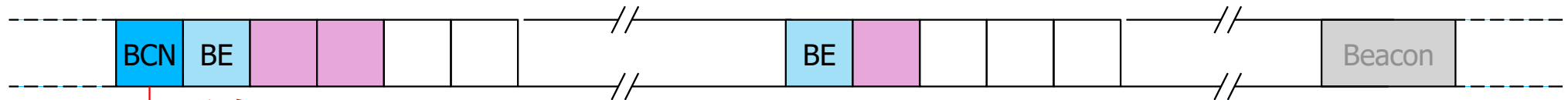
How to know T & F patterns of REs ?



Addressing scheme in DLB transmission

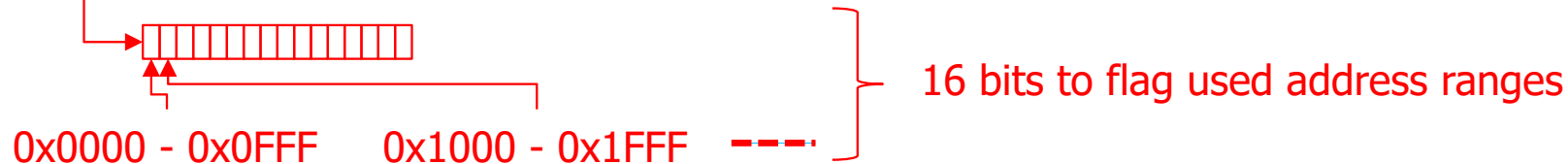


Pre-addressing of destination @



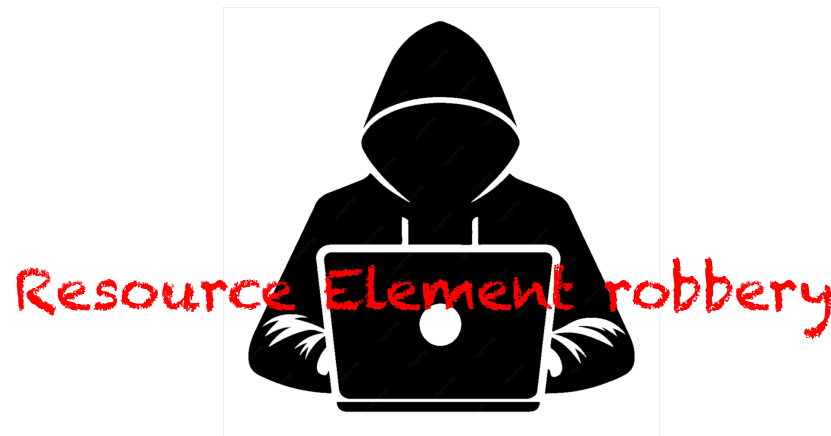
Pre-addressing of destination @

Pre-addressing of de@stination @



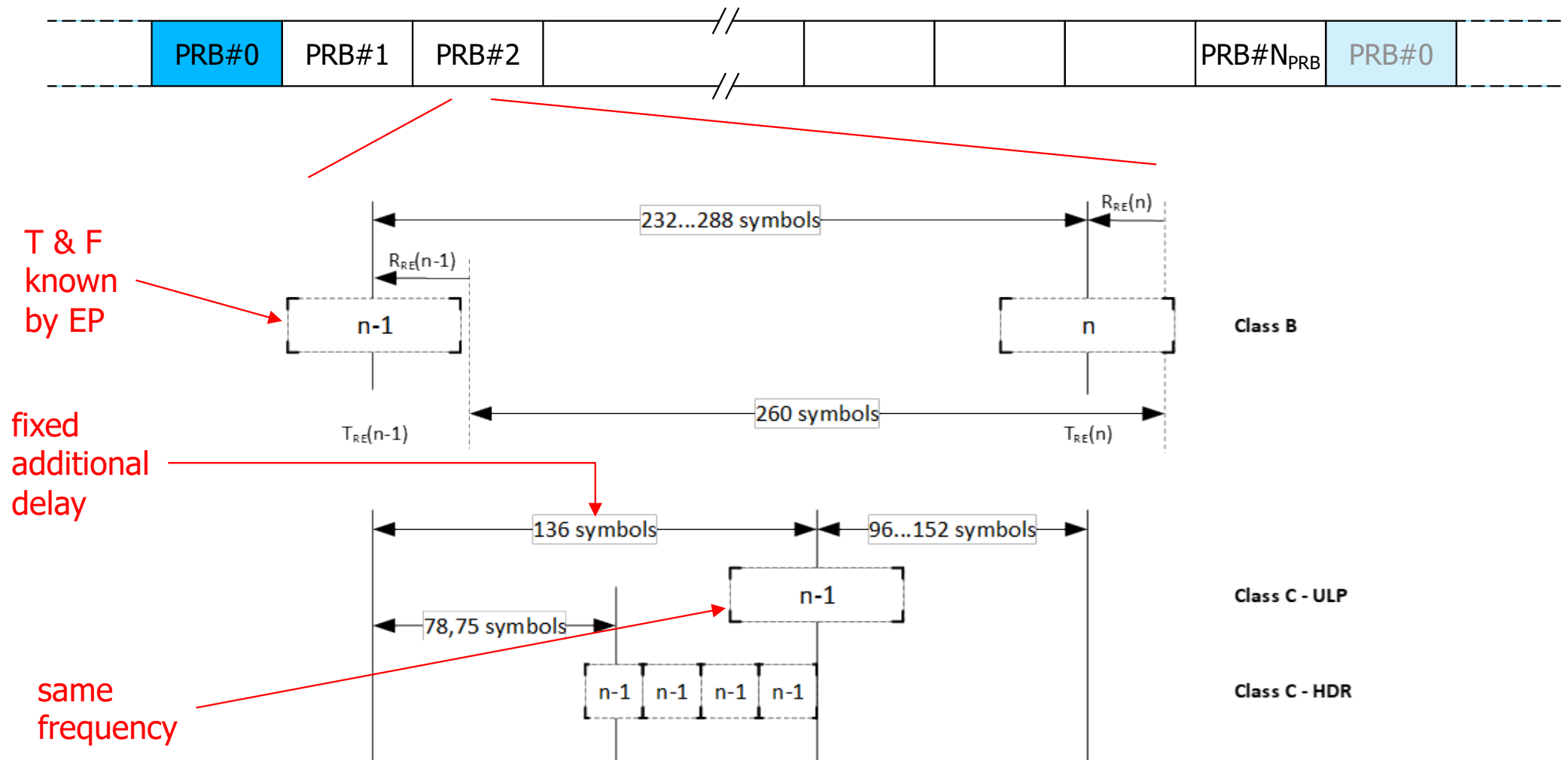
DLC frames for event-triggered downlink transmission

- DL event at random
- DLB frame up to 14mn22s → can't wait
- limited-resource EP -> full scan not possible



© Freepick icon

Piggybacking DLC frames on to DLB frames



High data rate (1/)

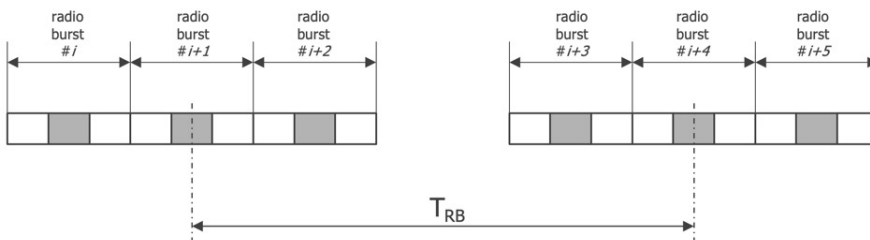
- objective:
 - less power in UL
 - overcome DC limit in DL

Symbol rate acronym	ER	ULP	ULP2	ULP8
Symbol rate full name	Extended Reach	Ultra Low Power	Ultra Low Power 2	Ultra Low Power 8
Formal value (in baud)	$\frac{26 \cdot 10^6}{2^{16}}$	$\frac{26 \cdot 10^6 \times 3}{2^{15}}$	$\frac{26 \cdot 10^6 \times 3}{2^{14}}$	$\frac{26 \cdot 10^6 \times 3}{2^{12}}$
Approx. value (in baud)	396,7	2380,3	4 760,7	19 043

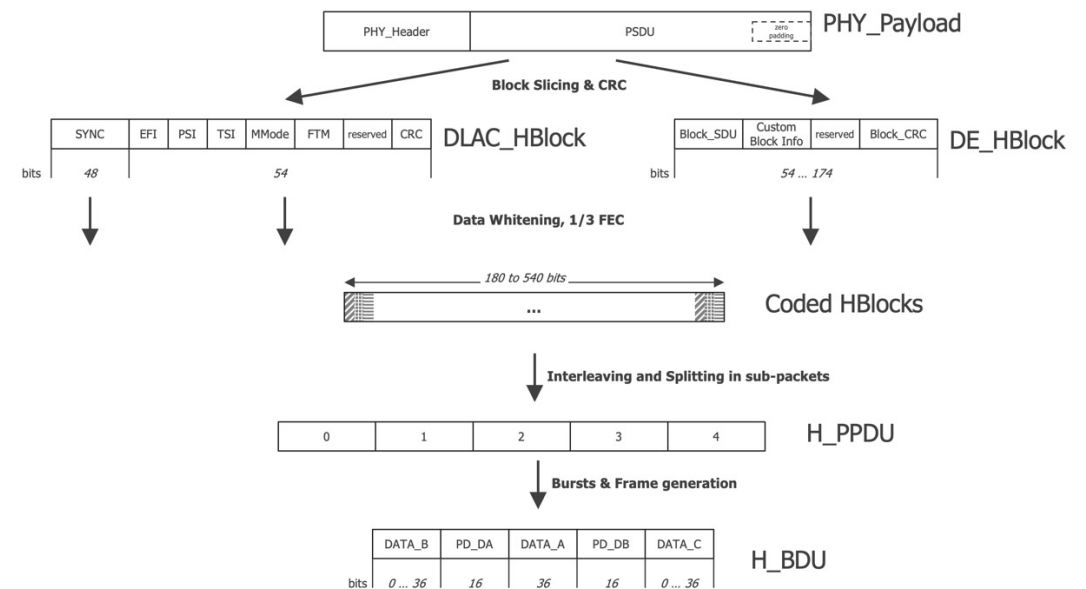
High data rate (2/)

- problem
 - more time in setting PLL and Tx than in actual transmission

burst concatenation



new radio bursts format



High Data Rate (3)

Table 4-152: Examples of radio transmission times

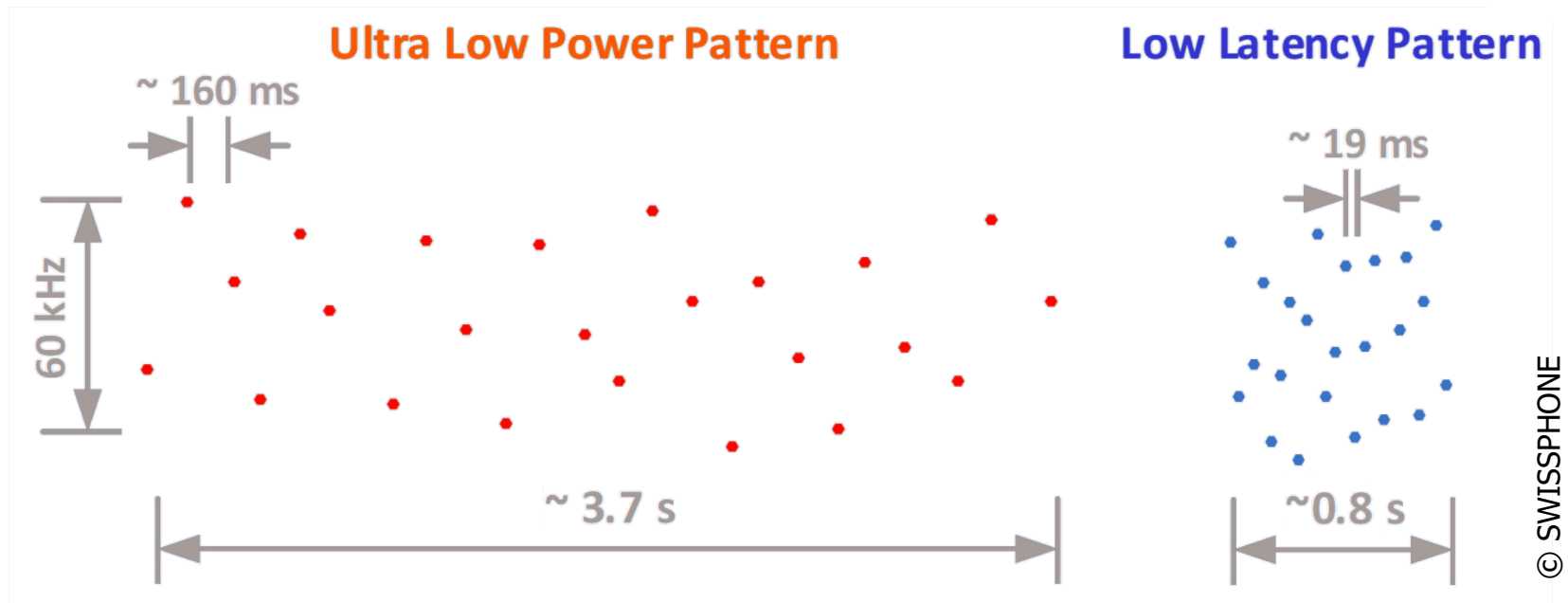
Transmission mode	Symbol rate	Radio-burst structure	Radio-burst duration	Core Frame on-air time	Extension Frame on-air time
ULZ	ER	Standard	90,74 ms	2 177,81 ms	90,74 ms per add. Byte in MPDU
ULZ	ULP	Standard	15,14 ms	362,97 ms	15,14 ms per add. Byte in MPDU
ULZ	ULP8	Concatenated	1,89 ms	45,37 ms	1,89 ms per add. Byte in MPDU
DLA	ULP	Standard	11,76...21,43 ms	105,87 ms	211,73...383,13 ms per add. Extension frame block
DLA	ULP2	Standard	5,88...10,71 ms	52,93 ms	105,87...191,57 ms per add. Extension frame block
DLA	ULP8	Concatenated	1,47...2,68 ms	13,23 ms	26,47...47,89 ms per add. Extension frame block
DLA	ULP8	HDR	3,57...7,35 ms	32,14 ms	64,28...133,33 ms per add. Extension frame block
DLB	ULP	Standard	11,76...21,43 ms	105,87 ms	383,13 ms per add. Beacon Extension frame 211,73...383,13 ms per add. data frame block
DLC	ULP	Standard	11,76...21,43 ms	211,73...383,13 ms	211,73...383,13 ms per add. data frame block
DLC	ULP8	HDR	3,57...7,35 ms	64,28...133,33 ms	64,28...133,33 ms per add. Extension frame block

NOTE: The elements in this table are for information only.

© from ETSI v2

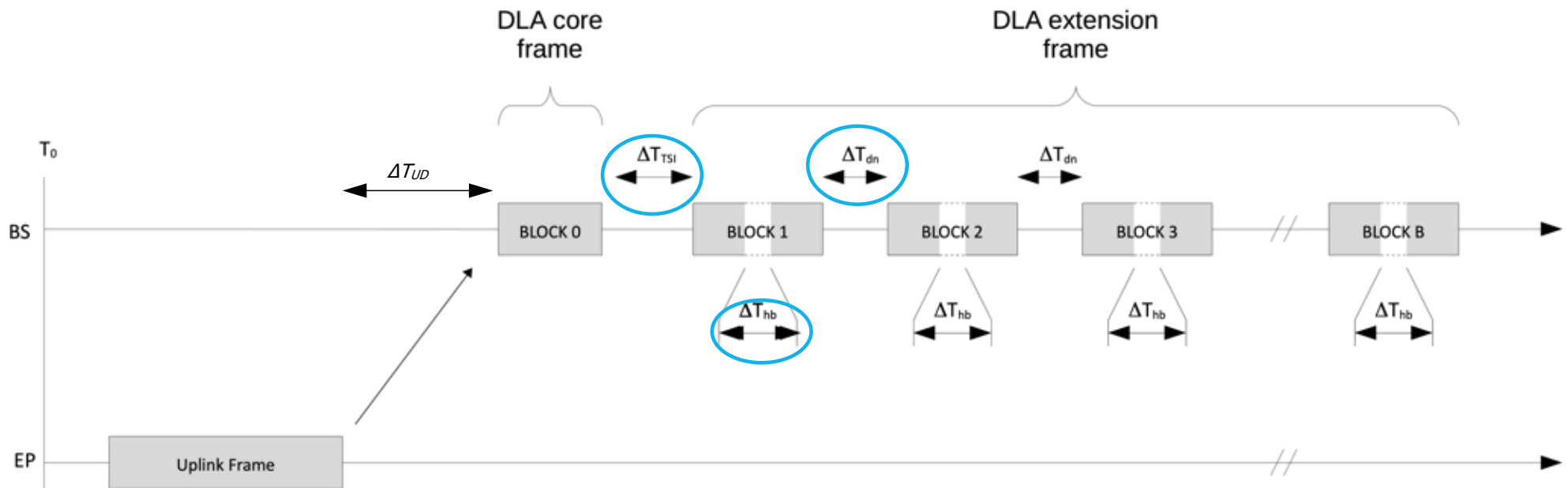
Other PHY level functionalities in ETSI v2 (1/)

→ low latency T & F patterns



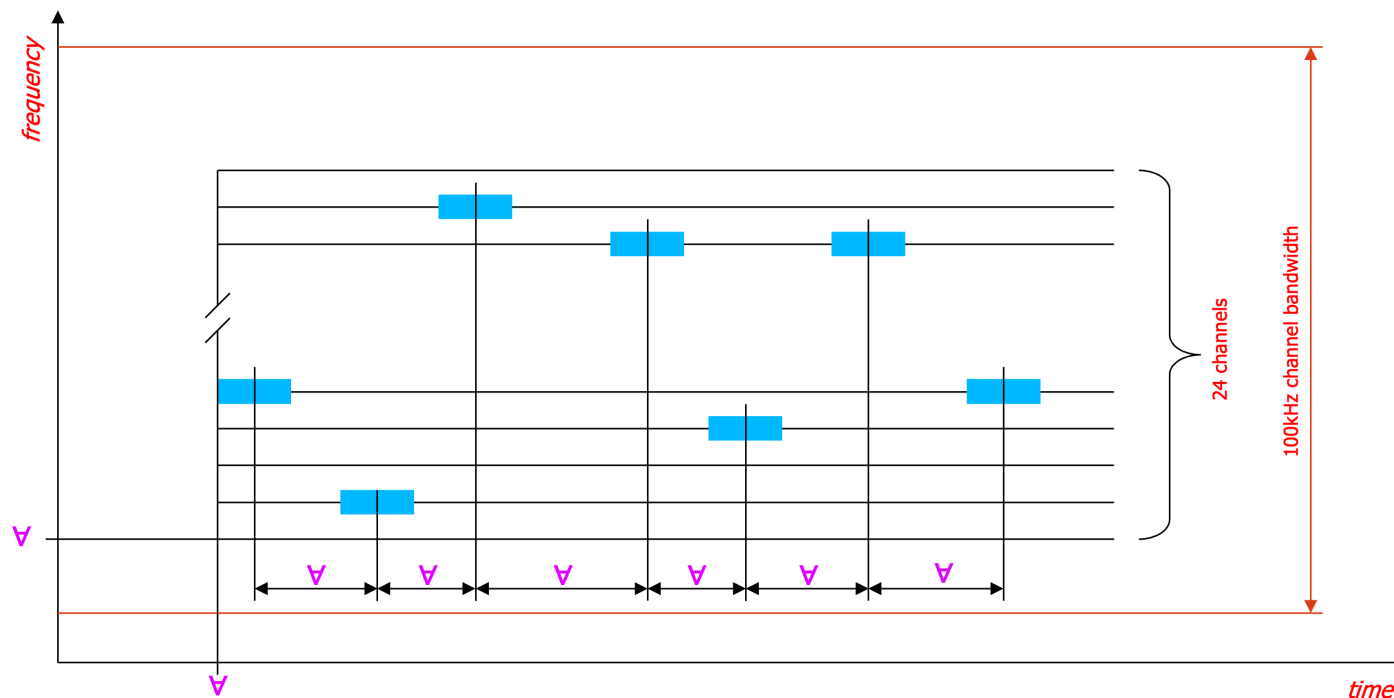
Other PHY level functionalities in ETSI v2 (2/)

➔ flexible timing in DL blocks



Other PHY level functionalities in ETSI v2 (3/)

➔ extra-long UL intervals for low power-drain EPs



mean interval from 158,93ms (UPG1 & UPG2) to 660ms (UPG6)

Conclusion

- new functionalities in ETSI v2
 - PHY-level
- based on play with T & F patterns
- but always
 - pseudo-random time intervals
 - pseudo-random frequency hops
 - orthogonality kept



thank you !

contact: benoit.ponsard@kimeggi.com

+33 (0)6 84 74 7071

<https://www.kimeggi.com>