

# Implementing Flexible Small Cell Open RAN

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# SCF251 FR1 Reference Design paper



Some of the themes discussed in these slides are informed by the work done by the SCF251 “FR1 Reference Design”

Contributors:



May 2022 cover feature



## Anatomy of the 5G Small Cell

May 13, 2022 Patrick Hindle, Microwave Journal No Comments



The industry has been talking about the small cell market for many years as being on the verge of huge growth, but while it is a sizable market and there has been some growth, it has not taken off as quickly as many expected. Though with the emergence of 5G, it is poised to do so; meeting the goals of increased capacity in dense areas and the large number of connections needed for IoT applications. In 2020, the 5G small cell market was \$741 million and is expected to grow to about \$18 billion by 2028, according to Forbes Business Insights, exhibiting a compound average growth rate of 54 percent.

The Small Cell Forum recently published “5G NR FR1 Reference Design, the case for a common, modular architecture” that outlines the design of small cells in detail (Document 251.10.01). This article is based on sections 3.2-3.4, outlining the architectures for the RF section of small cells.

<https://www.microwavejournal.com/articles/38108-anatomy-of-the-5g-small-cell>

May 19, 2022

### The Case for a Common, Modular 5G FR1 Small Cell Architecture

Microwave Journal Media Director, Pat Hindle, talks with some of the authors of the Small Cell Forum report, “The Case for a Common, Modular architecture for 5G NR FR1 Small Cell Distributed Radio Units” including Victor Torres from iCana, Martin Lyseiko from Picocom, Ahmed Abdelrahman from Analog Devices and Michael Milnes from Senko about how they developed the report and came up with the standard architectures. The RF Front End portion of the report is summarized in the [May issue cover story](#) of the Microwave Journal.

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<https://podcasts.microwavejournal.com/e/the-case-for-a-common-modular-5g-fr1-small-cell-architecture/>

5G NR FR1 Reference Design

The case for a common, modular architecture for 5G NR FR1 small cell distributed radio units

DECEMBER 2021

DOCUMENT 251.10.01

[www.smallcellforum.org](https://www.smallcellforum.org)

<https://www.smallcellforum.org/press-releases/small-cell-forum-proposes-reference-design-for-5g-nr-fr1-small-cells/>

# Agenda

- ❖ 5G Small Cell Drivers
- ❖ 5G Small Cell Architecture
- ❖ Dimensions of flexibility
  - ❖ Spectrum
  - ❖ Performance
  - ❖ Functional split
- ❖ Summary



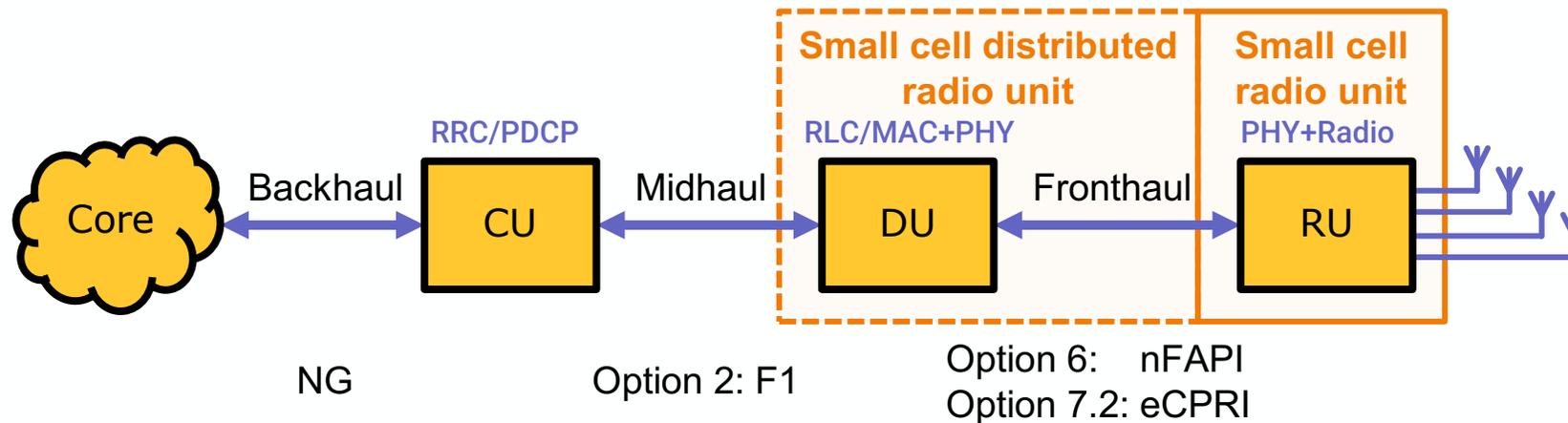
# 5G Small Cell Drivers

- ◆ Deployment
  - ◆ Network densification
  - ◆ Private networks / edge computing
  - ◆ Neutral host <- *interesting use case*
- ◆ Open, multi-vendor ecosystem



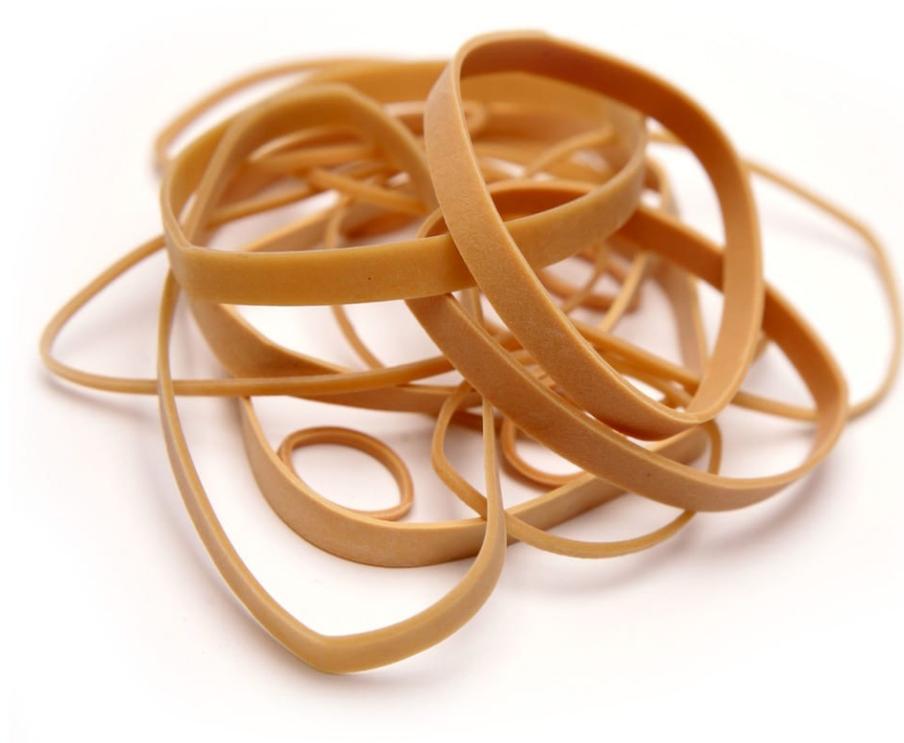
# 5G Small Cell Architecture

- ◆ Disaggregated RAN functions
  - ◆ Central Unit – RRC/PDCP (ciphering)
  - ◆ Distributed Unit – RLC/MAC + (PHY)
  - ◆ Radio Unit – PHY + Radio
- ◆ Fronthaul / Midhaul
  - ◆ Ethernet, coupled with precision time protocol for network synchronisation

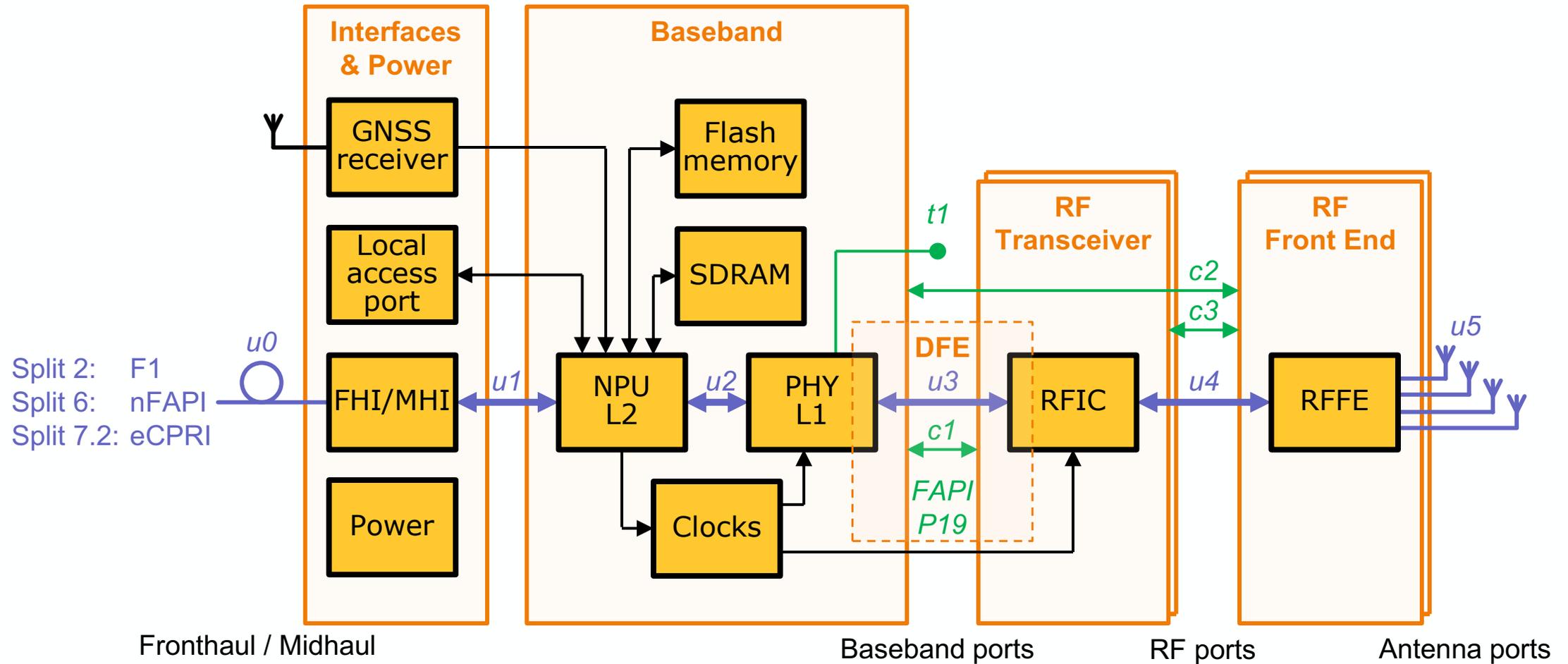


# Dimensions of flexibility

- ◆ Spectrum
  - ◆ Bands, total bandwidth
  - ◆ 4G/5G
  - ◆ Duplexing
- ◆ Performance
  - ◆ Throughput
  - ◆ Transmission power
- ◆ Functional split
  - ◆ Split 2, 6, 7.2
  - ◆ Software defined split

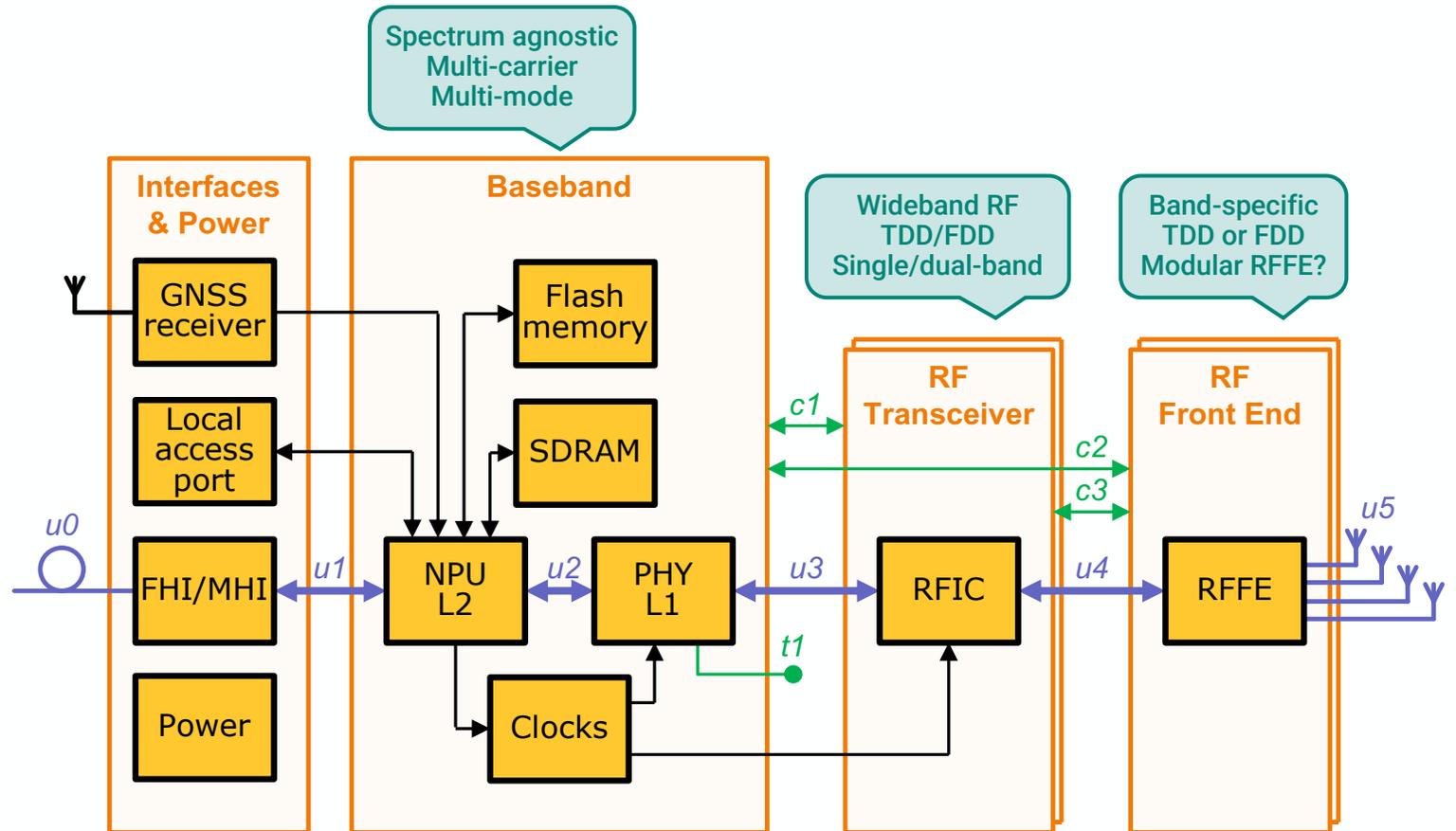


# Reference Small Cell (SCF251, with DFE)



# Spectrum Flexibility

- ◆ Typified by Neutral Host use case
  - ◆ Multi-carrier
  - ◆ Multi-band
  - ◆ Mixed TDD / FDD
  - ◆ Mixed mode 4G/5G
- ◆ Baseband fully flexible
- ◆ RFIC wideband, modulation agnostic
- ◆ RFFE is main point of pain...



# UK MNO Spectrum

Mobile and Wireless Broadband below 5 GHz				Ofcom			
Jan-22							
Frequency Band	Uplink	Downlink	Bandwidth MHz	EE	Telefónica	Three	Vodafone
<b>700 MHz</b>							
	703.0 - 713.0	758.0 - 768.0	2 x 10		Telefónica		
	713.0 - 723.0	768.0 - 778.0	2 x 10			Three	
	723.0 - 733.0	738.0 - 758.0 778.0 - 788.0	20 2 x 10	EE			
<b>800 MHz</b>							
	832.0 - 837.0	791.0 - 796.0	2 x 5			Three	
	837.0 - 842.0	796.0 - 801.0	2 x 5	EE			
	842.0 - 852.0	801.0 - 811.0	2 x 10				Vodafone
	852.0 - 862.0	811.0 - 821.0	2 x 10		Telefónica		
<b>900 MHz</b>							
	880.1 - 885.1	925.1 - 930.1	2 x 5				Vodafone
	885.1 - 890.1	930.1 - 935.1	2 x 5		Telefónica		
	890.1 - 902.5	935.1 - 947.5	2 x 12.4				Vodafone
	902.5 - 914.9	947.5 - 959.9	2 x 12.4		Telefónica		
<b>1400 MHz</b>							
		1452.0 - 1472.0	20				Vodafone
		1472.0 - 1492.0	20			Three	
<b>1800 MHz</b>							
	1710.1 - 1715.9	1805.1 - 1810.9	2 x 5.8		Telefónica		
	1715.9 - 1721.7	1810.9 - 1816.7	2 x 5.8				Vodafone
	1721.7 - 1736.7	1816.7 - 1831.7	2 x 15			Three	
	1736.7 - 1781.7	1831.7 - 1876.7	2 x 45	EE			
	1781.7 - 1785	1876.7 - 1880.0	2 x 3.3	Shared Access			
	1880.0 - 1900.0		20	DECT cordless telephony			
<b>1900 MHz</b>							
	1899.9 - 1909.9		10	EE			
	1909.9 - 1914.9		5		Telefónica		
	1914.9 - 1920.0		5.1			Three	
<b>1900 / 2100 MHz</b>							
	1920.0 - 1920.3	2110.3 - 2124.9	0.3			Three	
	1920.3 - 1934.9		2 x 14.6				
	1934.9 - 1944.9	2124.9 - 2134.9	2 x 10		Telefónica		
	1944.9 - 1959.7	2134.9 - 2149.7	2 x 14.8				Vodafone
	1959.7 - 1979.7	2149.7 - 2169.7	2 x 20	EE			

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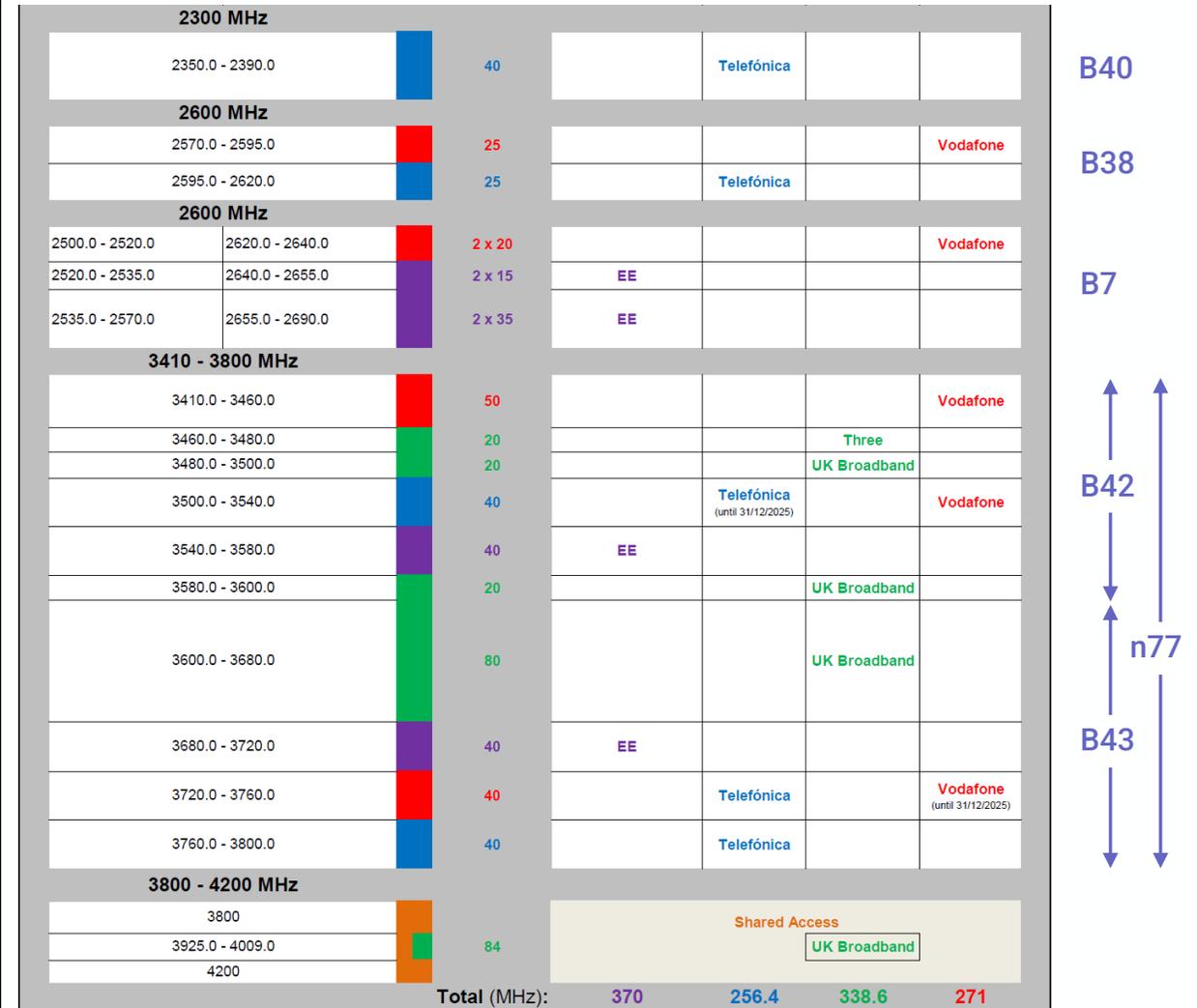
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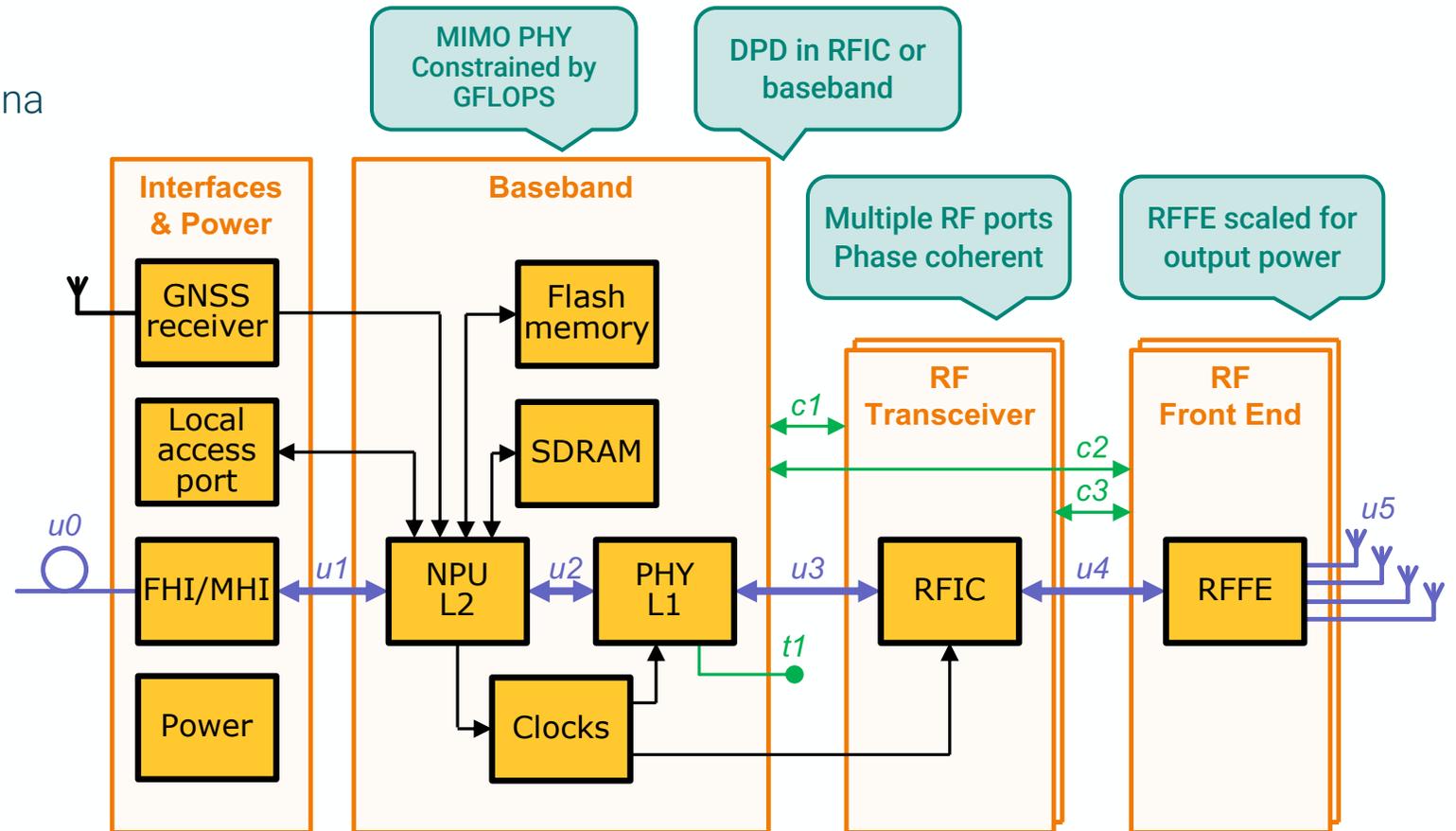
[https://www.ofcom.org.uk/\\_data/assets/pdf\\_file/0016/232108/frequency-allocations-mobile-broadband-below-5ghz.pdf](https://www.ofcom.org.uk/_data/assets/pdf_file/0016/232108/frequency-allocations-mobile-broadband-below-5ghz.pdf)



# Performance flexibility

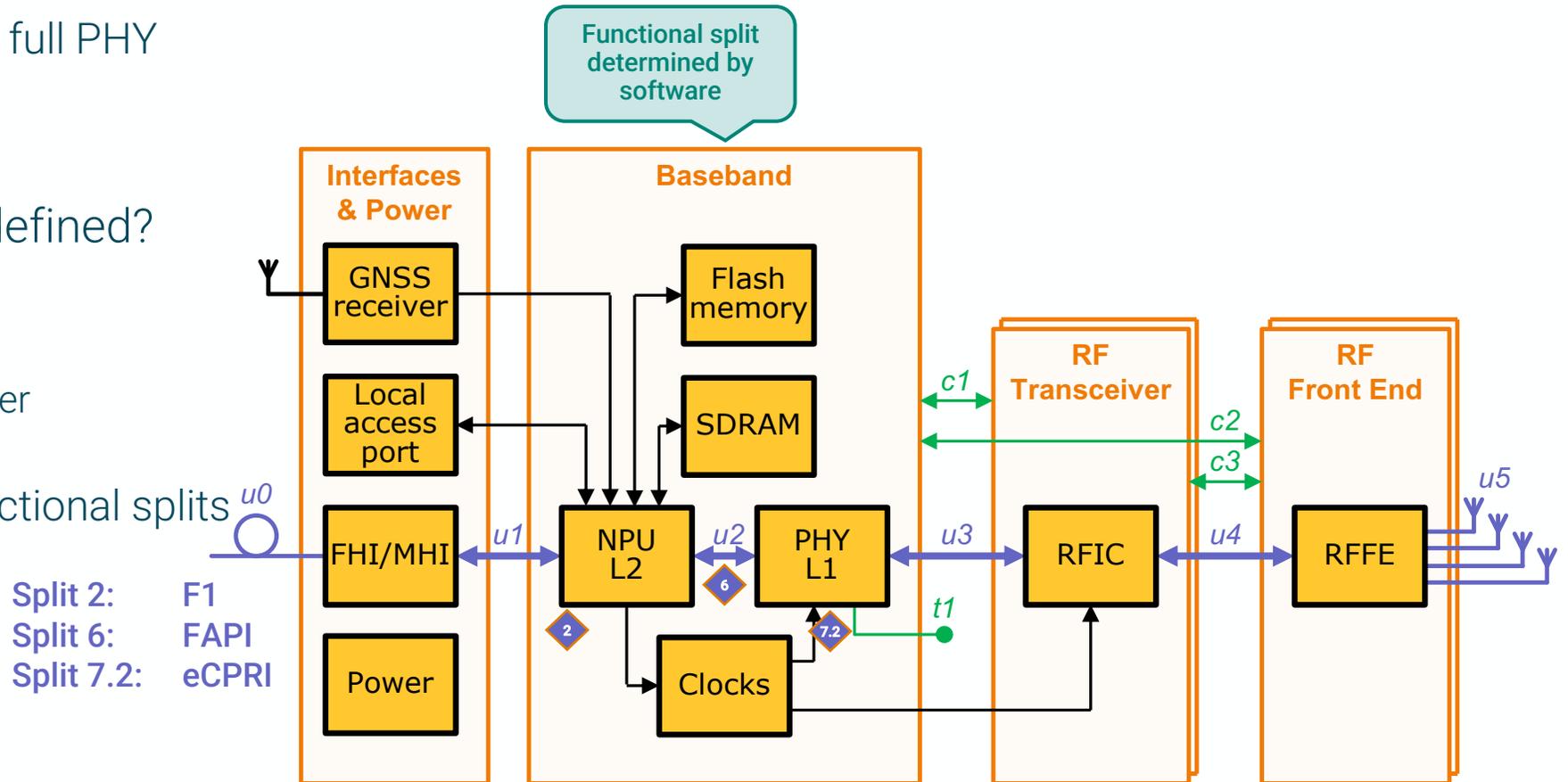
## Throughput

- ◆ Total bandwidth
  - ◆ #Antennas x bandwidth per antenna
- ◆ Dimensioned across design
- ◆ Traded off against
  - ◆ Bandwidth
  - ◆ Multi-band operation
- ◆ e.g.
  - ◆ Single band 8T8R
  - ◆ Single band 4T4R, dual CA
  - ◆ Dual band 4T4R
  - ◆ Quad band 2T2R
  - ◆ or combinations of..
- ◆ Transmission power
  - ◆ Largely affects RFFE
  - ◆ DPD standard on small cells



# Functional splits

- ◆ Contained within baseband
  - ◆ Split 2 - full L2 stack + full PHY
  - ◆ Split 6 - full PHY
  - ◆ Split 7.2 - low-PHY
- ◆ Can this be software defined?
  - ◆ Yes, but..
  - ◆ Constrained by
    - ◆ Total processing power
    - ◆ Micro-architecture
  - ◆ Not optimal for all functional splits



# Summary

- ❖ 5G small cell architectures able to meet sub-6GHz needs
  - ❖ High-performance Baseband and RFIC can address all solutions
  - ❖ RF front-end main area of customisation
    - ❖ Trend to broadband / multi-band RFFE
- ❖ Any uncertainty around functional splits is manageable



<https://picocom.com/products/socs/pc802/>

<https://www.picocom.com/>



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Thank you