



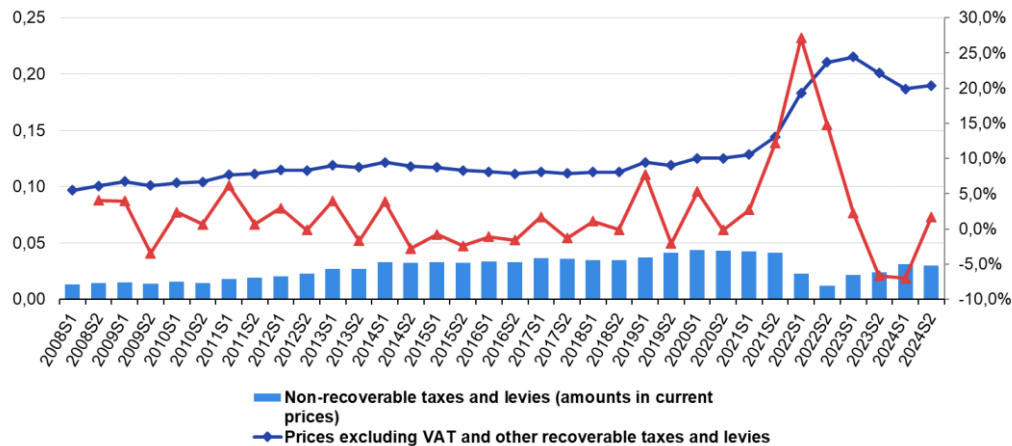
STRATEGIC ADVANCES IN III-V RF TECHNOLOGIES FOR ENERGY-EFFICIENT 5G INFRASTRUCTURE

Gregory U'Ren

The ongoing imperative

- Energy
 - Pricing step increase e/2021
 - Price volatility
- Geo-political uncertainty
 - Access to materials, technology
 - Supply chain resilience

Development of electricity prices for non-household consumers, EU, 2008-2024 (€ per kWh and q/q %)



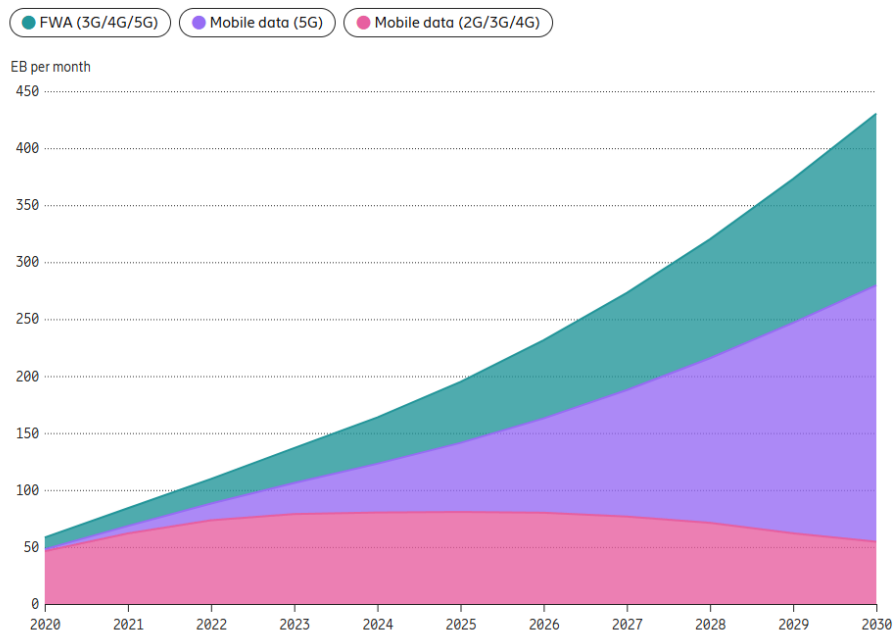
Source: Eurostat (online data codes: nrg_pc_205)

[link](#)

Mobile data traffic

- 17% CAGR
- Network traffic expected to grow by factor 2.6x to reach 430EB/month in 2030
- 6G evolution to address future needs – commercial deployment expectations 2029+

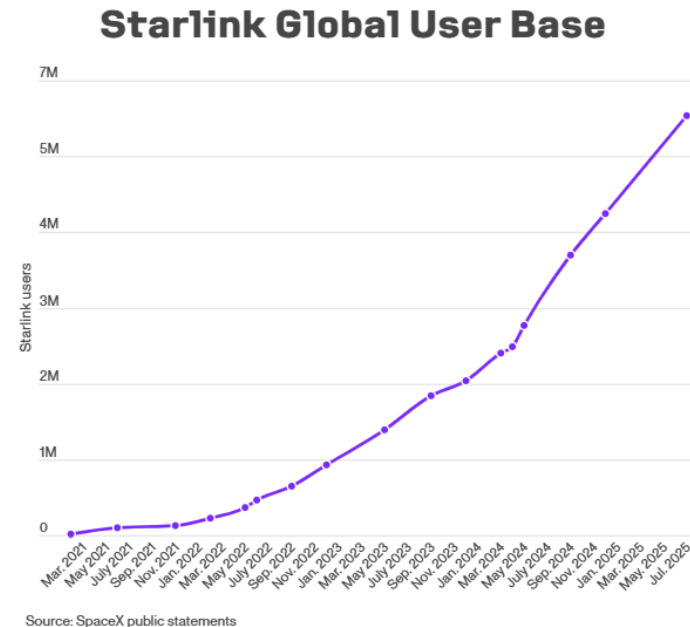
Figure 5: Global mobile network data traffic



<https://www.ericsson.com/en/reports-and-papers/mobility-report/dataforecasts/mobile-traffic-forecast>

■ Non-terrestrial networks (NTN)

- Extension of terrestrial networks
- Ubiquitous Coverage – a 6G priority
- Disruptive : rapid adoption with 6M Starlink subscribers (July'25)
- Today is a relatively small fraction of network traffic



Share

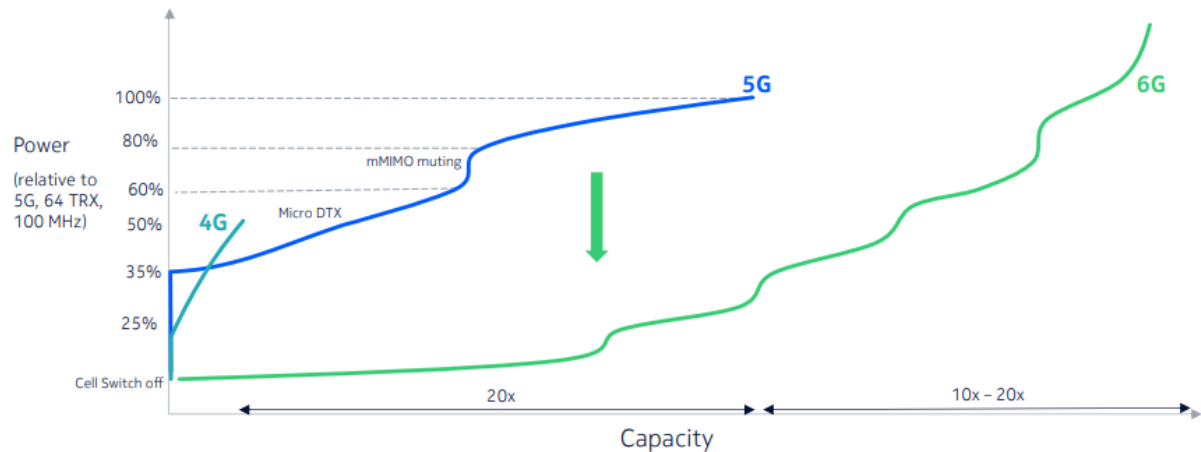
CNET

<https://www.cnet.com/home/internet/starlink-just-passed-2-million-us-subscribers-but-can-it-keep-up-with-users-needs/>



6G challenge

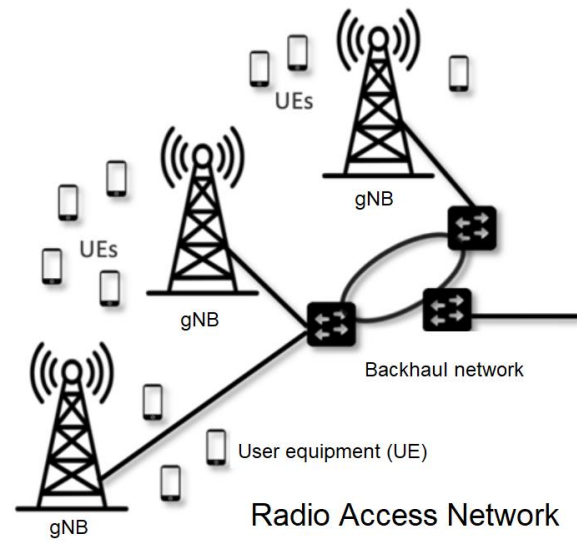
Figure 3. 6G power consumption goal versus 4G and 5G



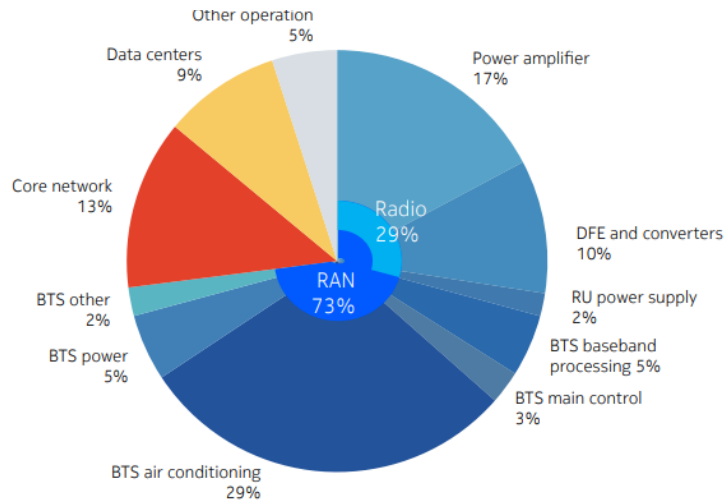
- Expand capacity – build upon existing 5G but with a significantly lower energy footprint

Nokia White Paper "Energy efficiency in next-generation mobile networks", 2023

Energy breakdown



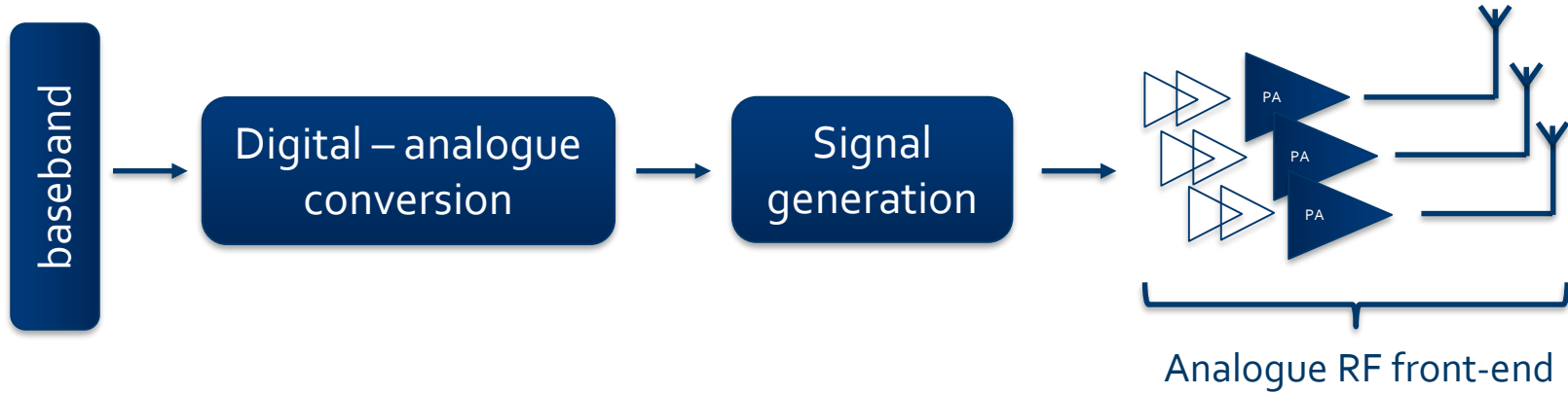
Network operator energy mix (3G/4G/5G)



- The radio unit is a significant contributor to network operations
- Power amplifier efficiency is a key contributor at all load conditions

Nokia White Paper "Energy efficiency in next-generation mobile networks", 2023

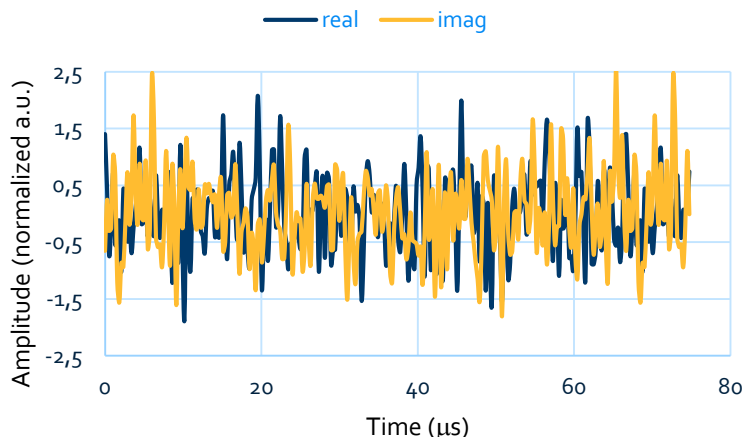
Transmitter



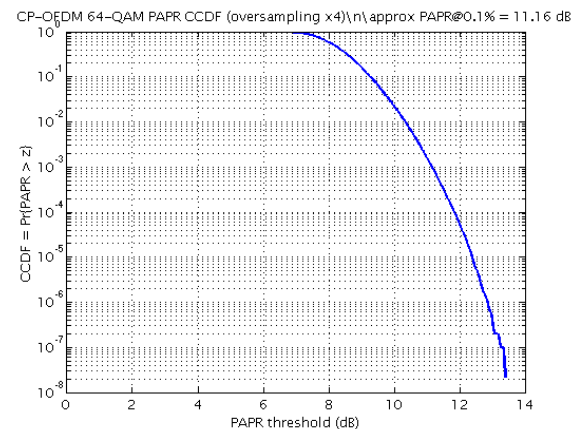
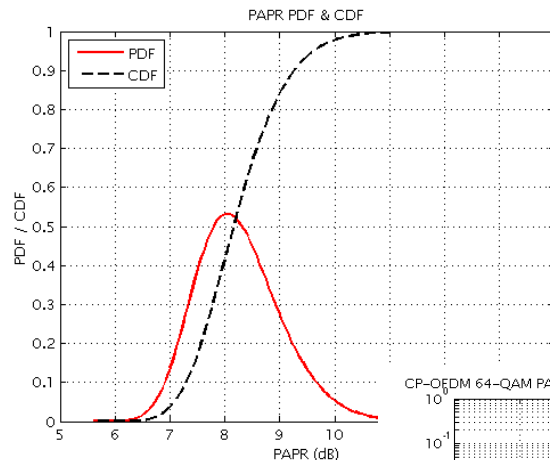
- Soluioning the needs : output power, efficiency, linearity, bandwidth, and cost
- Unused energy is converted to heat

Complex Modulations

OFDM (64 QAM) example temporal waveform

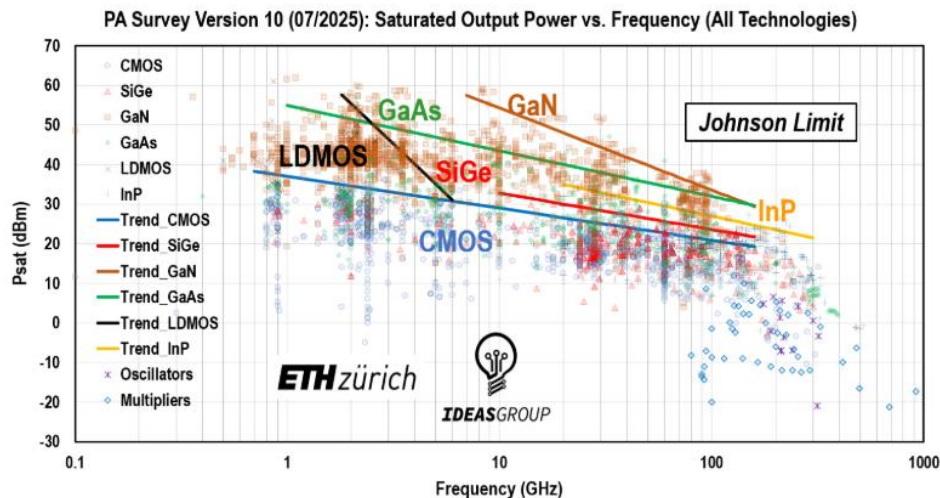


- Spectrally efficiency modulation schemes for Gb/s data rates
- High peak-to-average power ratio (PAPR)
- Amplifiers operate below their maximum capability → Need for highly efficient amplifiers under “back-off” conditions



Pathways to improve amplifier efficiency

- Semiconductor technology
- Design topologies
- Introduce “Intelligence” - adaptive ML based algorithms

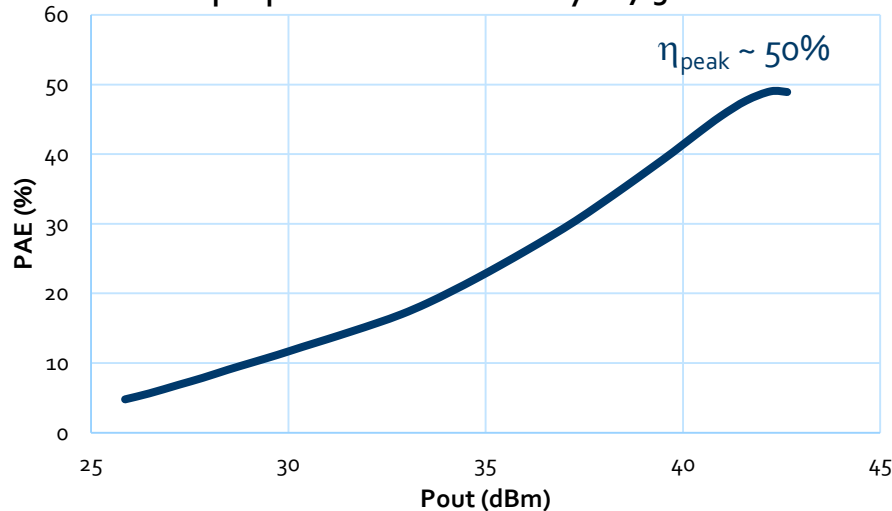


PA Survey Version 10: Saturated Output Power vs. Frequency (All Technologies). Hua Wang

<https://ideas.ethz.ch/Surveys/pa-survey.html>

■ GaN : power & power efficiency

CHA8154 - 2 stage GaN HPA (class A/B)
Input power versus efficiency at 7.5GHz



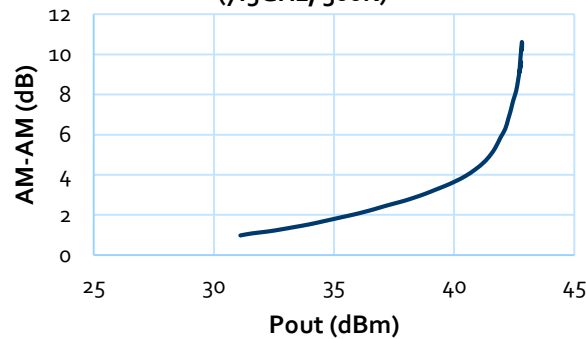
*Fred van Rijs, "New semiconductor technologies for improved power efficiency", 6G Forum EuMW 2025

- GaN/SiC is replacing LDMOS in sub6*



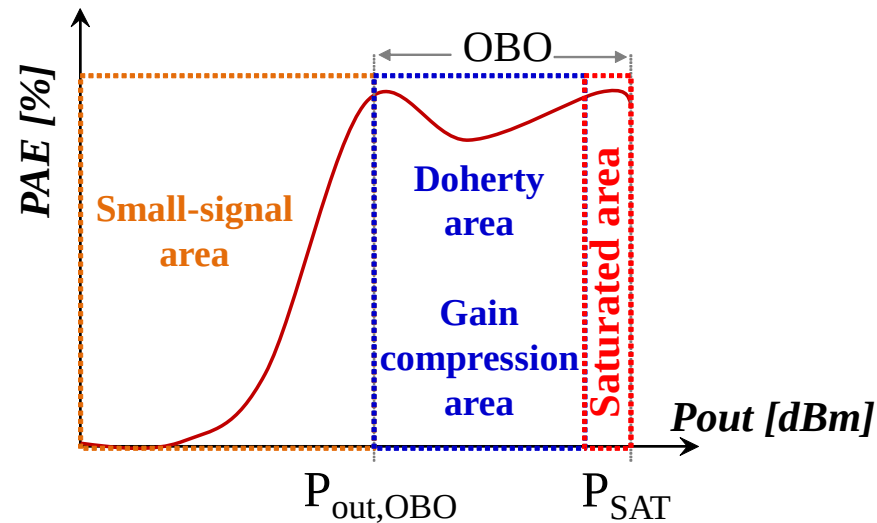
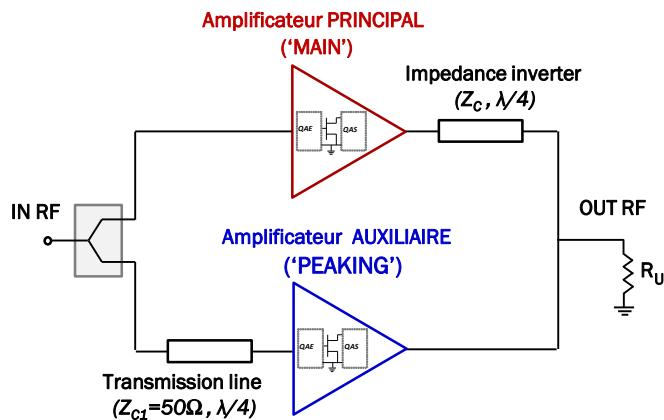
- GaN is also the best candidate for FR₃

CHA8154 : output power versus AM-AM
(7.5GHz, 300K)



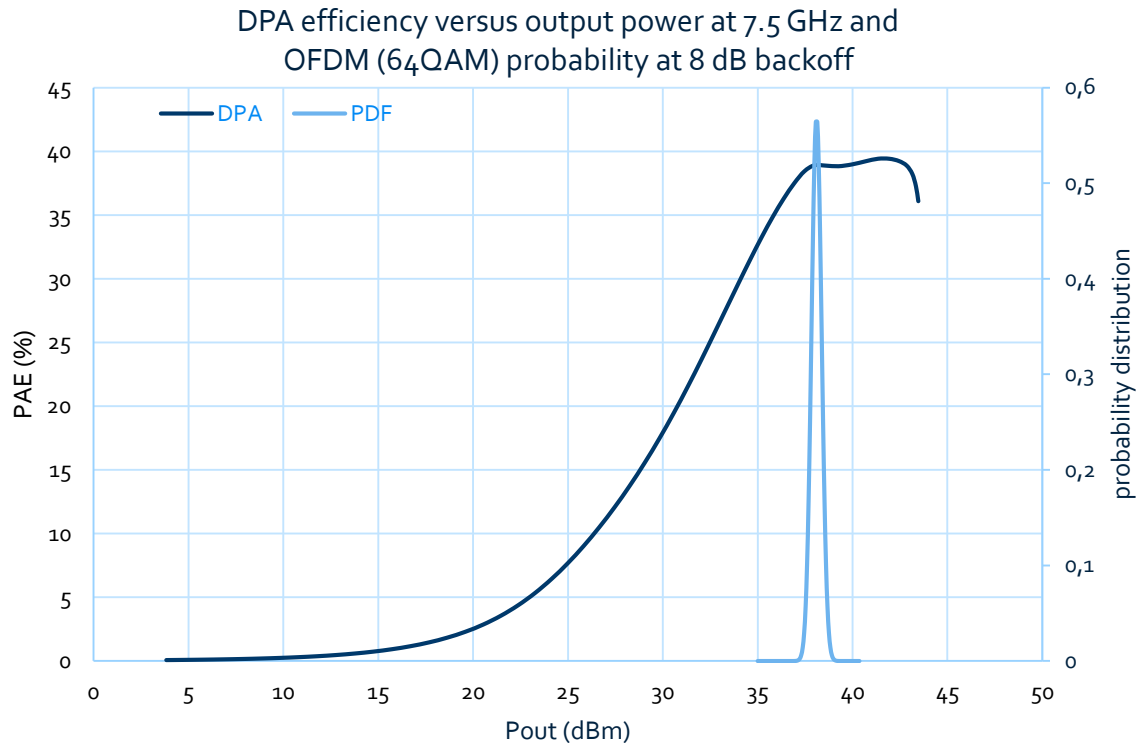
Amplifier design topology

- Doherty concept – mainstream
- Challenges: complexity, cost, size



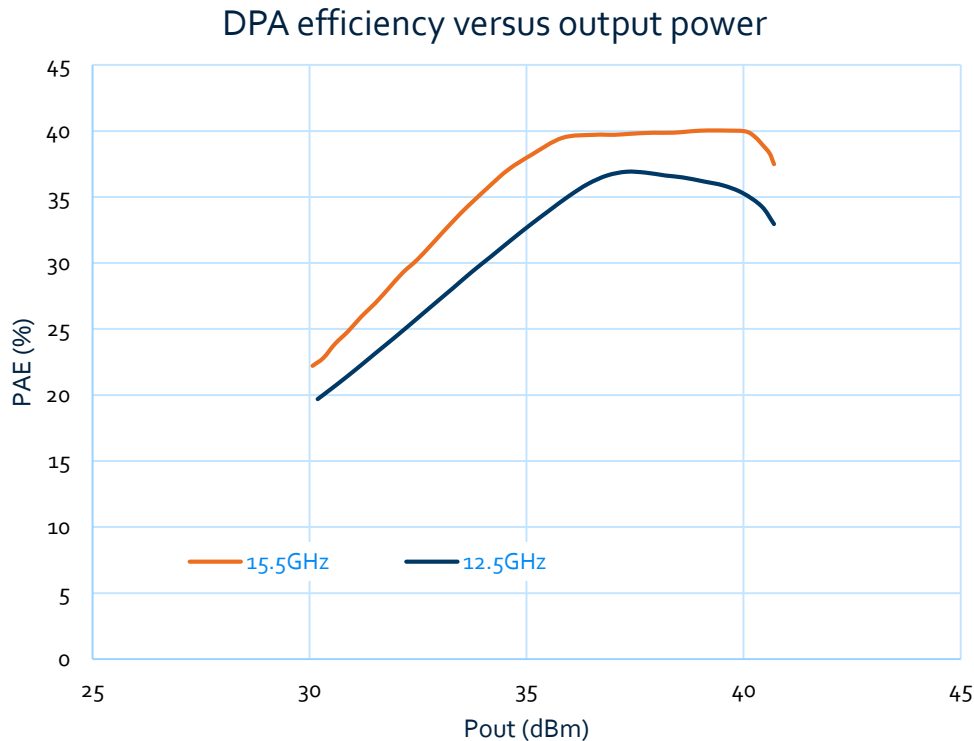
FR3 solutioning for 7/8GHz

- State of the art performance
 - High gain
 - High efficiency at average power level
 - Linearizable



FR₃ solutioning for 12/15GHz

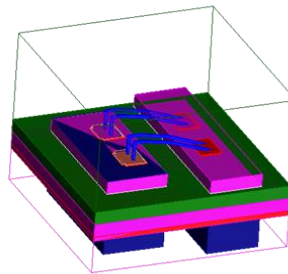
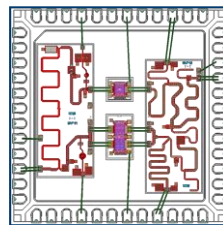
- State of the art performance
 - High gain
 - High efficiency at average power level
 - Linearizable



QFN approach

- Multi technology solution
- Low-cost
- Good thermal management
- Co-design: MMIC + RF & DC package

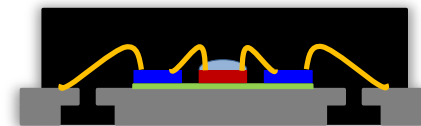
20W S-band DPA



« Leadframe »



Glue



Overmolding of the
QFN Package

Captivant2 program

- Strategic objectives :
 - strengthen European technological sovereignty by addressing critical components of the RF chain
 - Realize 40% energy efficiency in the full RF chain



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SINCE 1965



ASYGN

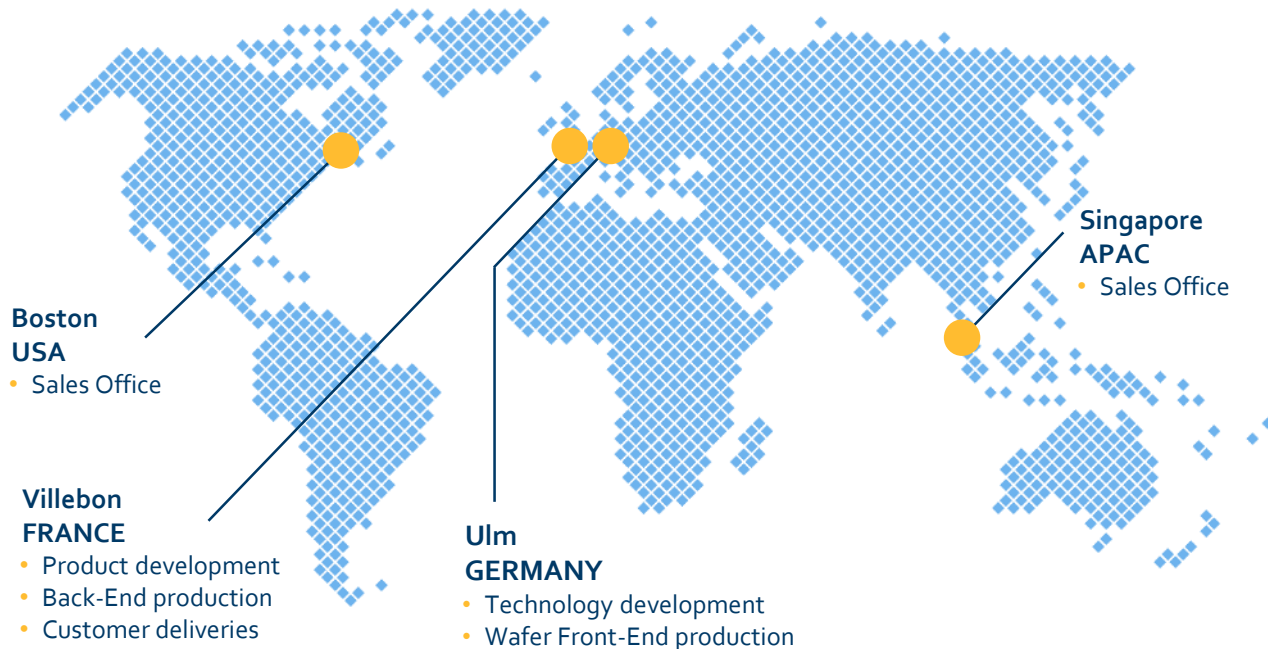
CISTEME

ABOUT UMS

We are a leading **European supplier** of RF MMIC solutions **MMIC solutions, GaAs and GaN technology and foundry services**, supplying best-in-class innovation to some of the most demanding customers in the world, such as **Space and Defense, Automotive, Telecommunication** and any other **Industries** in need of cutting—edge radio-frequency semiconductor solutions.

UMS in some key numbers:

- 2 production sites,
2 sales offices &
a **world-wide** network of
representatives & distributors
- 420+ dedicated team members
at our customers' service
- 29 years of experience
- >220 products in our catalogue
- 50/50 Joint Venture
Thales - Airbus



■ Conclusions & perspectives

- Energy efficiency and European technology sovereignty are strong driving forces
- UMS and its partners are pursuing solutions to address both these challenges
 - Innovation RF front end technology - GaN is the differentiator
 - Design methods - Doherty concept in combination with others
 - Advanced packaging – means to optimize for cost, performance, and size

Questions

■ Contact : gregory.uren@ums-rf.com





THANK YOU