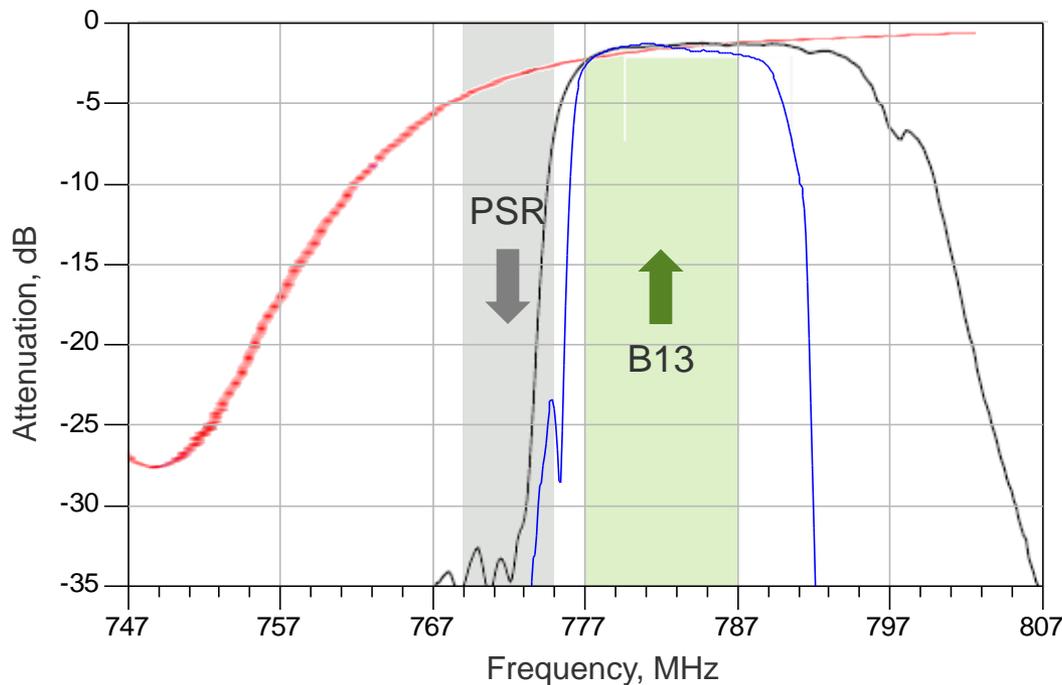


Some Trends In Multi-Band Multi-Mode RF Front End Components

Steep and Steeper: Playing Nice with Neighbors



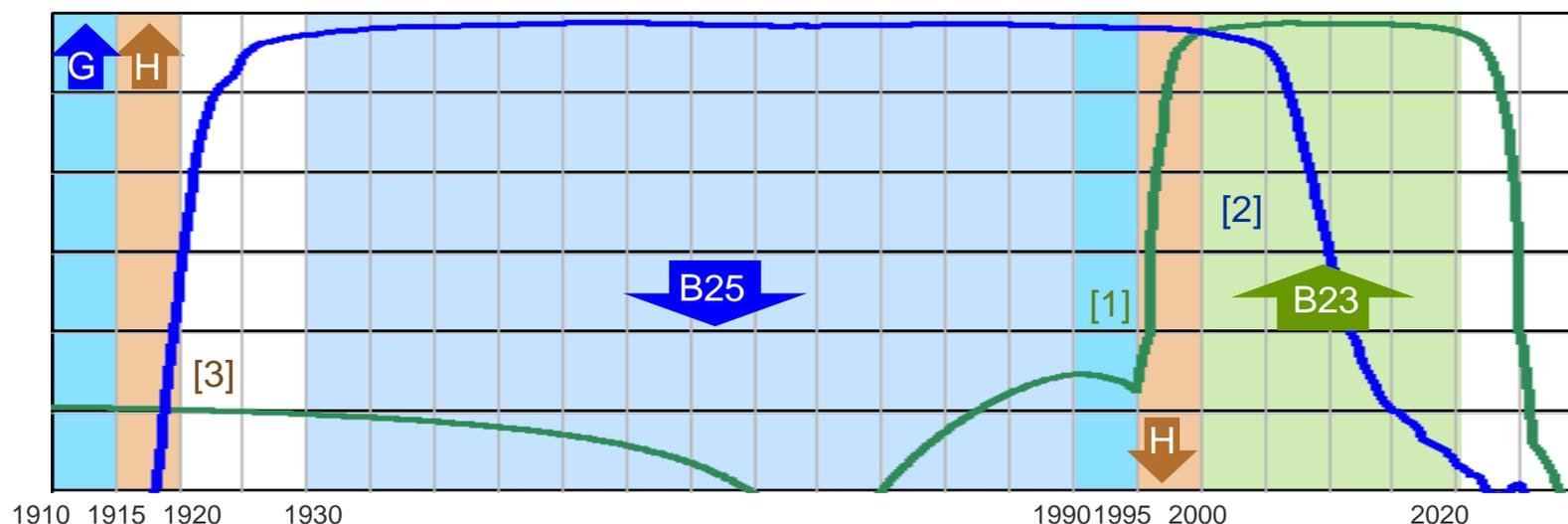
LC filter
Q~80, 22 MHz 2.5 to 20 dB
Doesn't protect PSR

SAW filter
Q~800, 4 MHz 2.5 to 20 dB
Partially protects PSR

FBAR filter
Q~3000, 1.5 MHz 2.5 to 20 dB
Fully protects PSR

B13 Duplexer Tx filter and notch filter (steepest side) normalized to 2.5 dB IL

PCS Asymmetry: Not Emitting vs. Not Blocking



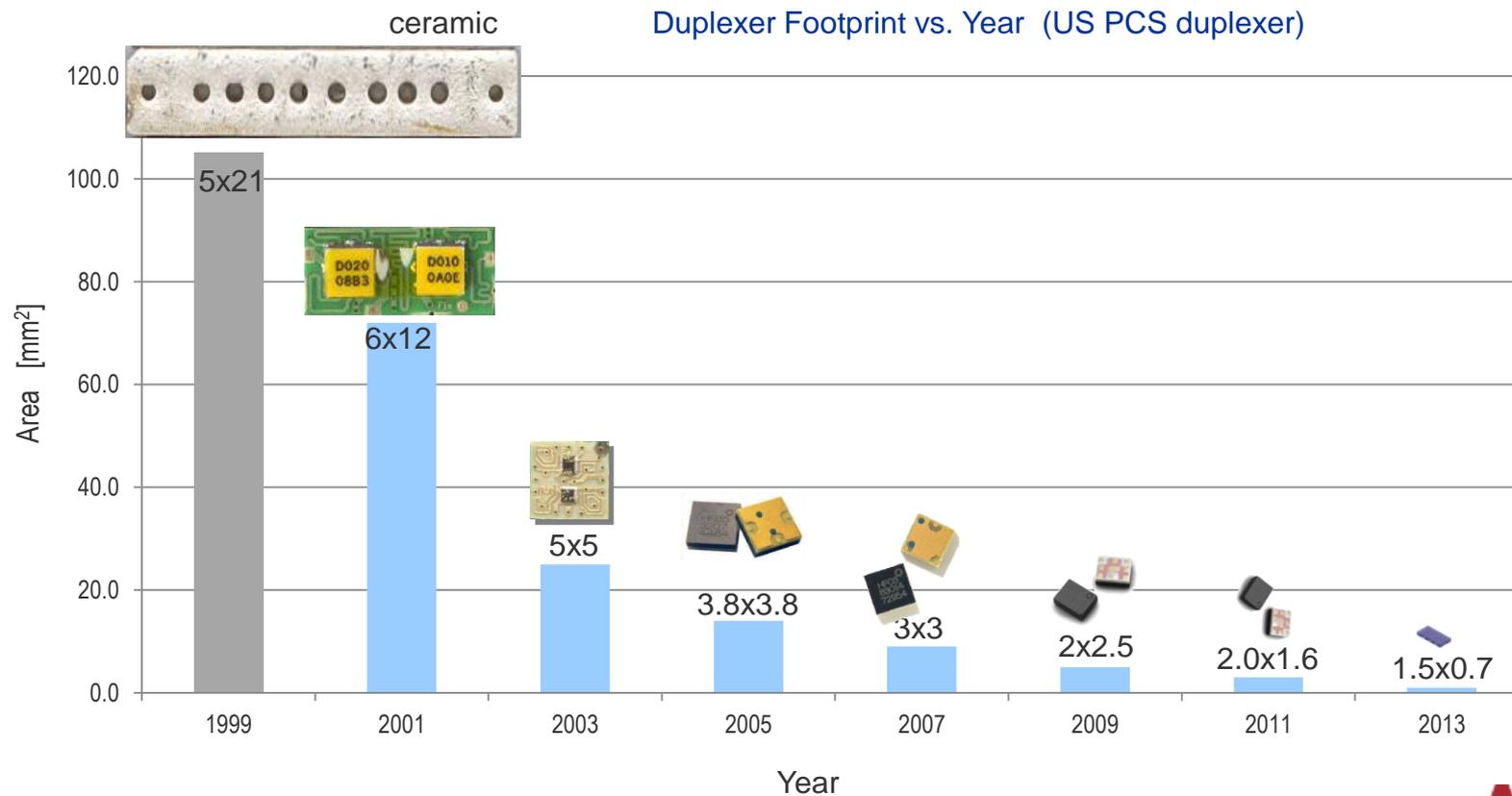
[1] For B23 Tx filter [simulated response]:
20 MHz BW =>full temperature compensation; filter reduces emissions into G Block: +

[2] For B25 Rx filter [measured response]:
65 MHz BW =>cannot temperature compensate; filter must pass B23 Tx spectrum: X

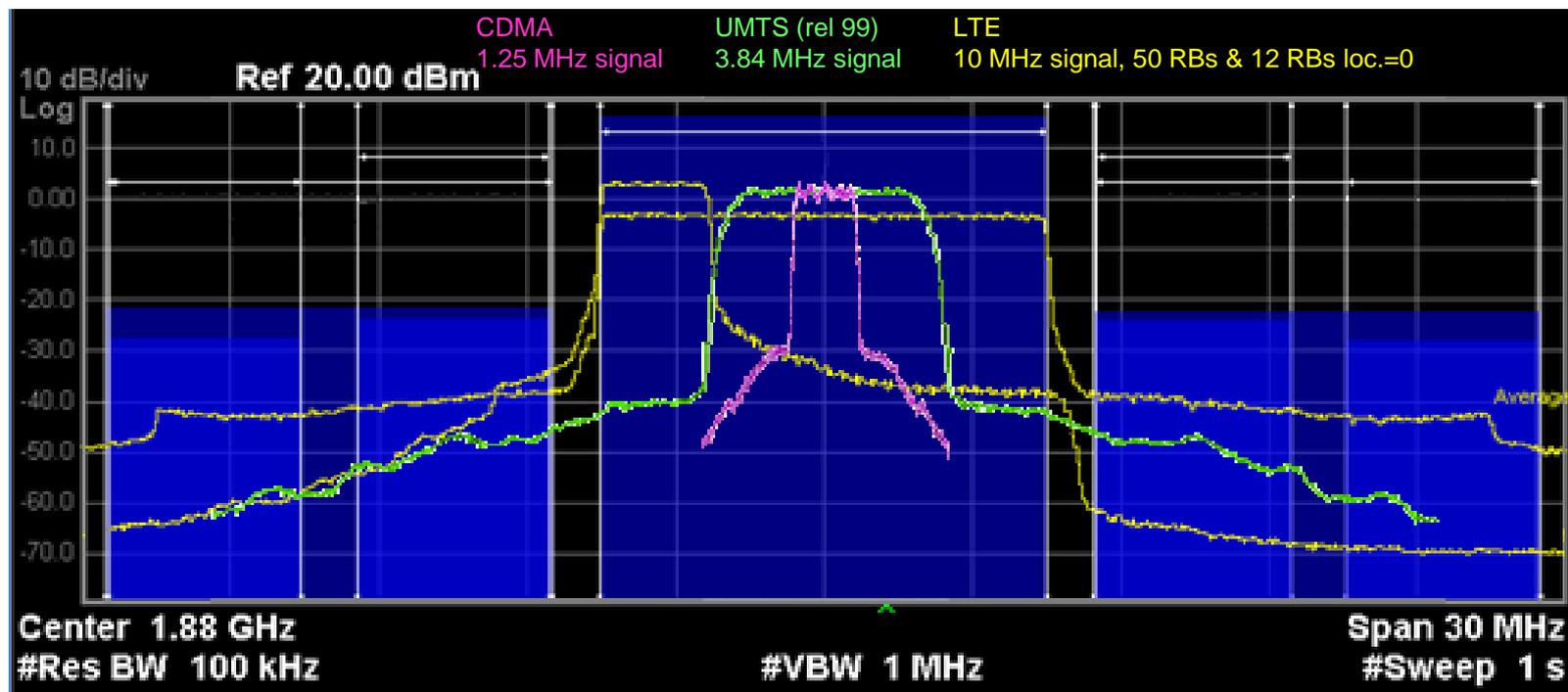
[3] For H Block:
A 10 MHz gap is not enough guard band to build a duplexer supporting PCS+G+H

The Incredible Shrinking Duplexer

Duplexer Footprint vs. Year (US PCS duplexer)

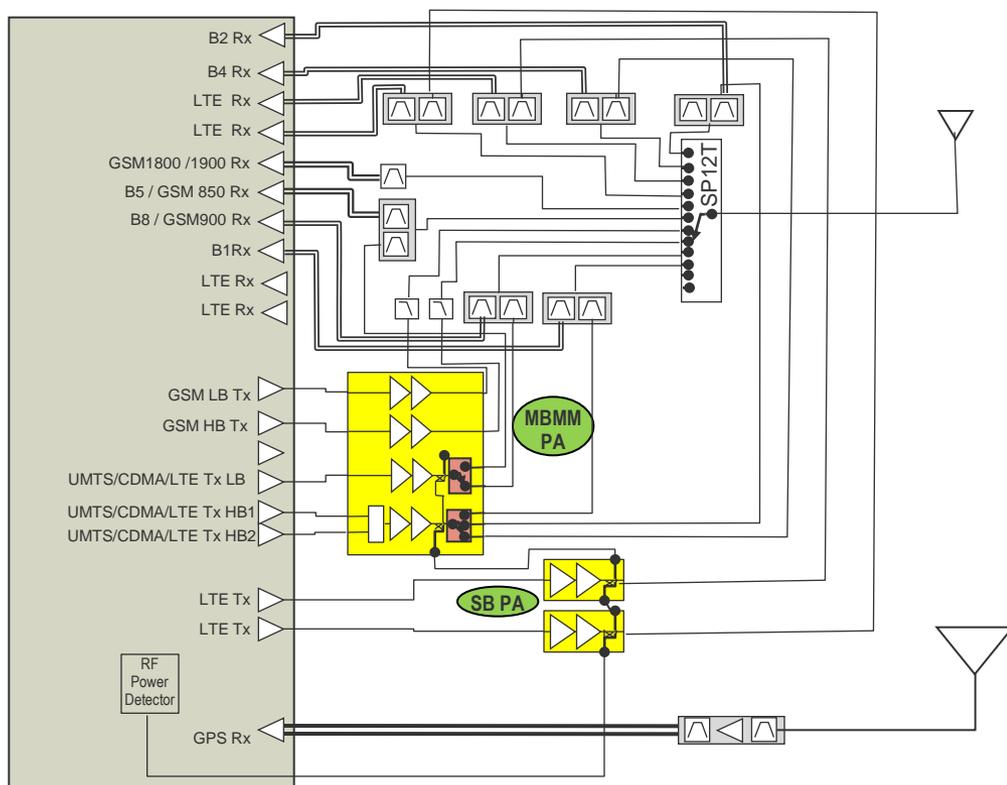


Modulation Matters



- Emissions will vary significantly depending on modulation type; under LTE they are dynamic
- Emissions performance depends on PA tuning. So does efficiency and gain.
- It's very hard to make a PA work equally well under all modulation cases

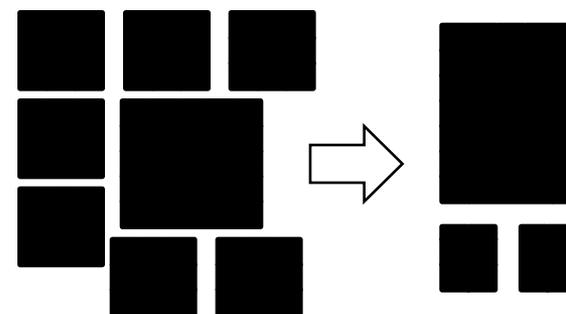
Doing More With Less – PAs



1 MBMM PA replaces
QB GSM PA + 5 SB Linear PAs

Chipset Partner's reference diagram
supports 11 bands, expandable to 13

Advanced techniques such as Envelope
Tracking and Digital PreDistortion used to
enhance performance beyond last
generation.



What Is the Use Case?

- My phone only works in the US
[carrier's bands – eg GSM+2 UMTS]
- My phone provides voice anywhere, and high speed data on my home network.
[2G/3G + local 4G – eg GSM +3UMTS + 2 LTE]
- My phone provides voice anywhere with data at home or at hot spots.
[2G/3G + local 4G + WiFi – eg GSM+3UMTS + 2LTE + WiFi]
- My phone works equally well anywhere for voice or data.
[2G/3G +something 4G everywhere – eg GSM + 4 UMTS + 5 to 7 LTE].
THIS IS INDUSTRY CAPABILITY AS OF 2012 (Give or take network maturity)
- My phone can work equally well on anybody's network for both voice and data.
[all bands everywhere – eg GSM + 5 UMTS + 17 non-overlapping LTE bands presently]
- My phone can adapt to any spectrum plan, present or future.
[100% adaptable – eg GSM +5 UMTS + unknown LTE bands]