

Interference Tolerance and Mitigation (WBU-ISOG, NYC Forum, May '12)

Vinay Purohit

CTO

Alcatel-Lucent Ventures

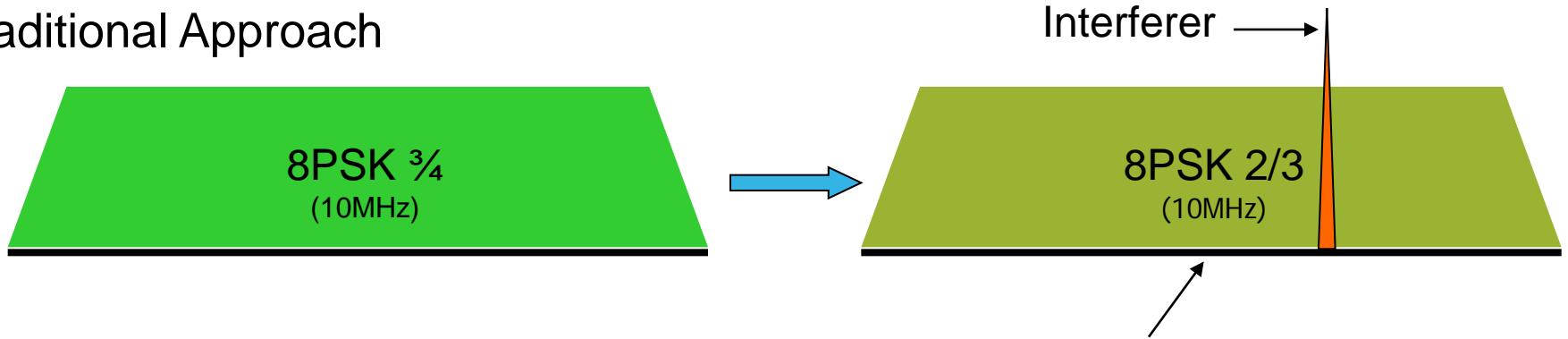
Introduction

- Multiple interferers without CID:
 - WiMax, WiFi, Radar, LO sweepers
 - Old equipment that did not get turned off
 - Incorrect configuration of modems, upconverters and/or antenna
 - Weather and solar events
 - Malicious users that may steal transponder bandwidth or block broadcasts
 - ...
- Consider use of new technology that tolerates severe interference
 - Rapid reconfiguration of carriers (not hitless)
 - Tolerate the interferer with no reconfiguration necessary (hitless)
- Technology referred to as VSA



Interference Tolerance

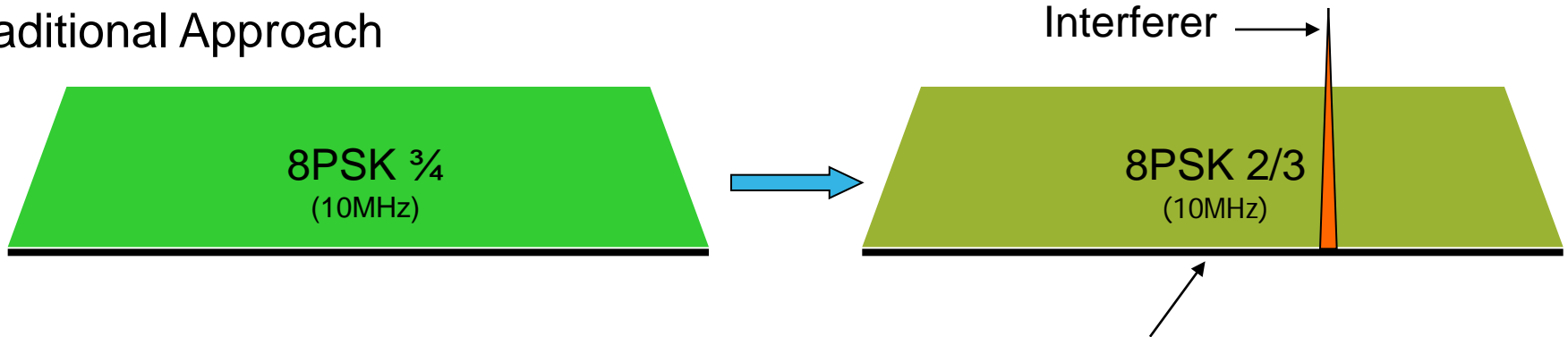
Traditional Approach



- ACM reduces code rate (and throughput) of entire carrier
- If interferer too strong, requires relocating entire carrier to a different center frequency

Interference Tolerance (Split Carrier)

Traditional Approach



- ACM reduces code rate (and throughput) of entire carrier
- If interferer too strong, requires relocating entire carrier to a different center frequency

VSA Approach



- Reconfigure carrier around interferer without impacting throughput
- Aggregate the two slices to create a virtually contiguous slice

Interference Tolerance (Multi-Carrier ACM)



8PSK $\frac{3}{4}$
(10MHz)

Instead of a single carrier



8PSK $\frac{3}{4}$ 8PSK $\frac{3}{4}$ 8PSK $\frac{3}{4}$ 8PSK $\frac{3}{4}$

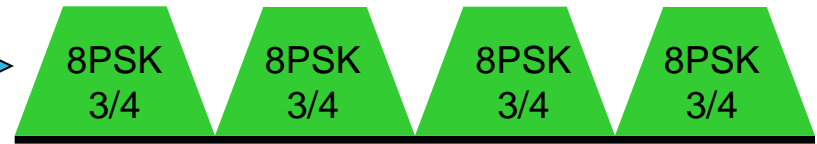
Start with multiple spectral slices each of B/N MHz

B : Required bandwidth (10MHz)
 N : Number of slices ($N=4$ above)

Interference Tolerance (Multi-Carrier ACM)

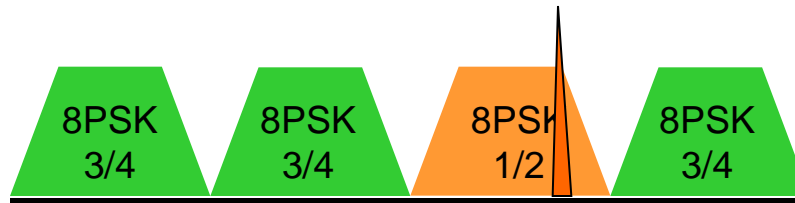


Instead of a single carrier



Start with multiple spectral slices each of B/N MHz

B : Required bandwidth (10MHz)
 N : Number of slices ($N=4$ above)

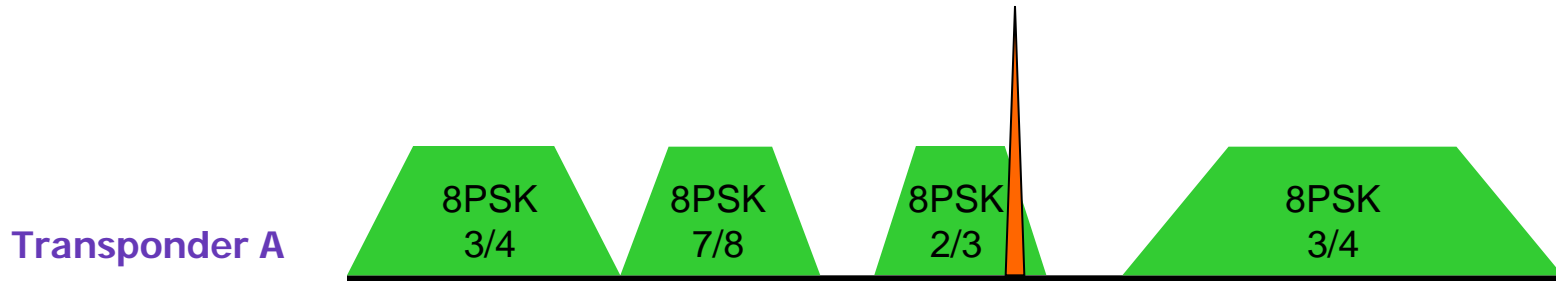


- Reduce code rate of the slice that's experiencing interference
- No "relocation" of slices
- Either ACM or manual adjustment of code rate of each slice
- Throughput degradation much lower compared to traditional ACM for single carriers

Interference Tolerance (Carrier Transplant)



- Use multiple carriers (not necessarily equal or even contiguous) of required aggregate bandwidth

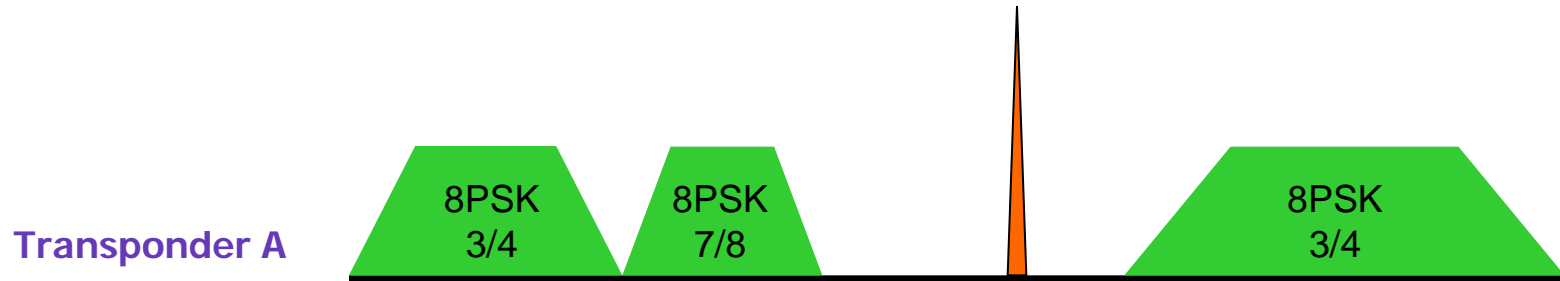


- When interference impairs a spectral slice ...

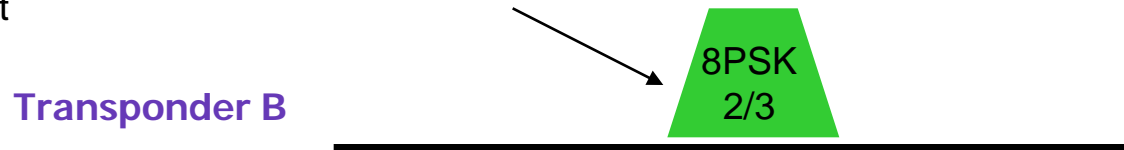
Interference Tolerance (Carrier Transplant)



- Use multiple carriers (not necessarily equal or even contiguous) of required aggregate bandwidth



- “Transplant” noisy spectral block to a different transponder
- No reduction in throughput



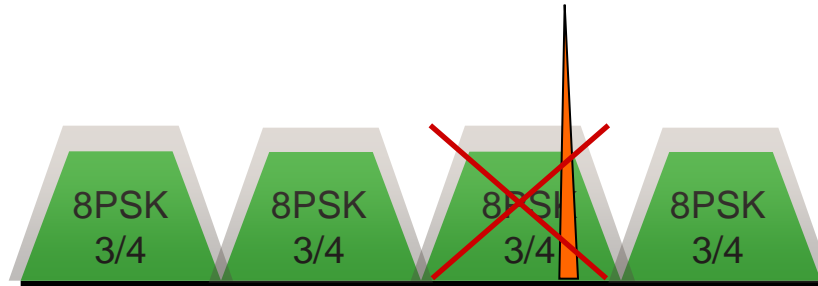
Interference Tolerance (Hitless)



- Start with multiple spectral slices each of B/N MHz
- Enable additional protection using multi-carrier FEC

B : Required bandwidth

N : Number of slices ($N=4$ above)



- Even with interference that wipes out one of the slices

=> Achieve **Hitless** delivery of user payload

And Many Other Modes ...

- Spread-spectrum mode that tolerates loss of one or more carrier slices
- Carrier slices may be mapped to Ku, Ka and C bands across multiple satellites, if required
- Carrier ID capabilities can be added in future for full identification of each constituent slice

Technology Status

- Multiple successful trials with real satellites
- VSA technology works for both broadcast and data (IP) applications
- Commercially available Q3, 2012

AT
THE
SPEED
OF
IDEAS