Rosenberger

Maximizing the Performance of LTE in Indoor Environment

Denis Ng

Director, Marketing & Infrastructure Solutions

Rosenberger Asia Pacific Electronic Co., Ltd.

LTE INDIA 2016

8th INTERNATIONAL CONFERENCE & EXHIBITION

MAY 05, 2016 • LE MERIDIEN, NEW DELHI

Copyright © Rosenberger 2016 – Proprietary / Confidential

Outline

Rosenberger

- Understanding the Technical Requirements for a high Speed, High Capacity LTE and LTE-A network
- In-building Coverage Solution for LTE-Advanced
  - *Passive vs Active DAS*
  - *High, Medium or Low Power Active DAS?*
  - *Inter-System Interference and PIM Considerations*
  - *In-building Coverage Strategies and Solution*
- Summary and Takeaways

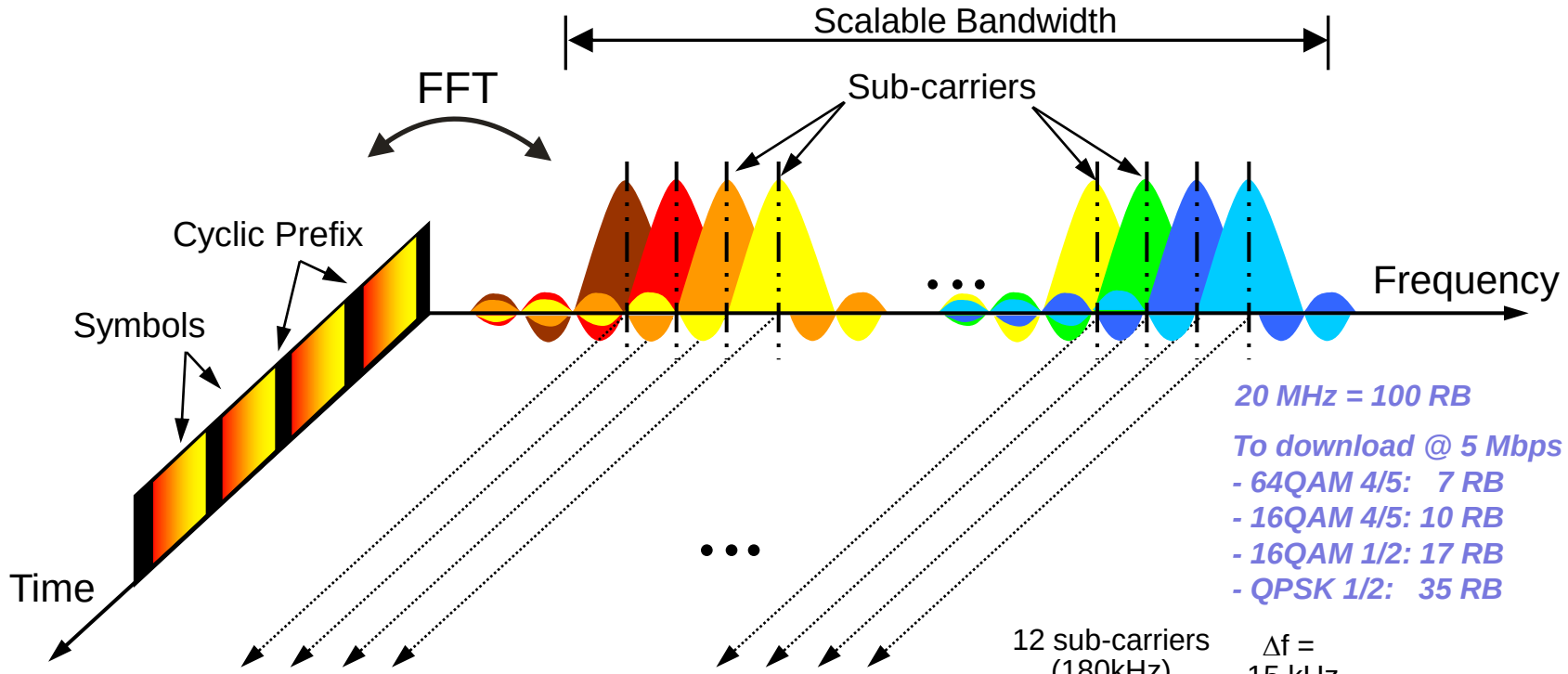
Copyright © Rosenberger 2016 – Proprietary / Confidential

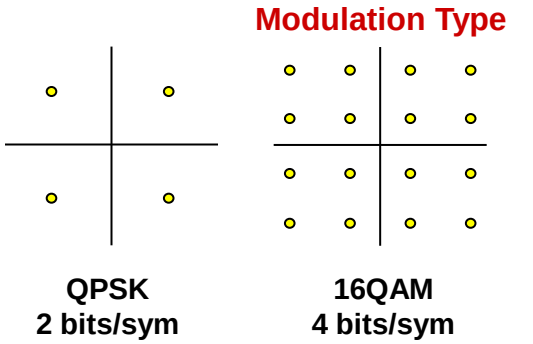
Technical Requirements for LTE and LTE-A Capacity

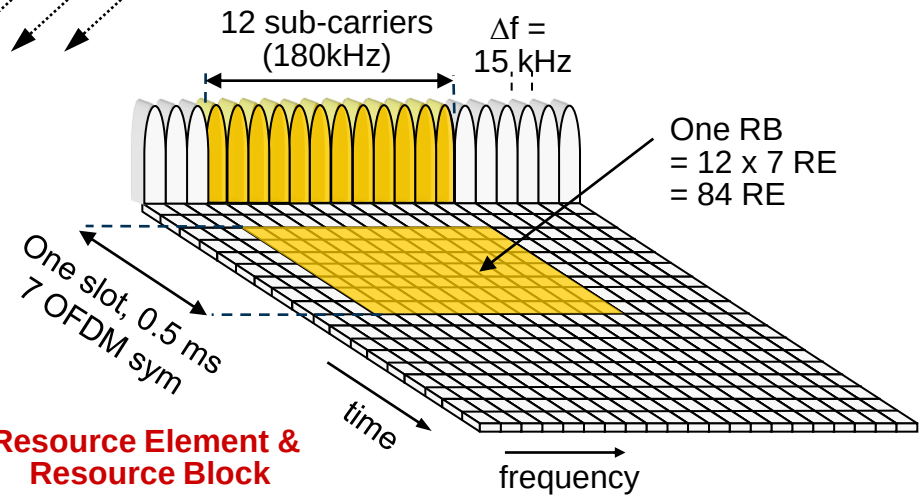
Copyright © Rosenberger 2016 – Proprietary / Confidential

The LTE OFDM Air Interface
How much capacity is available?

Rosenberger



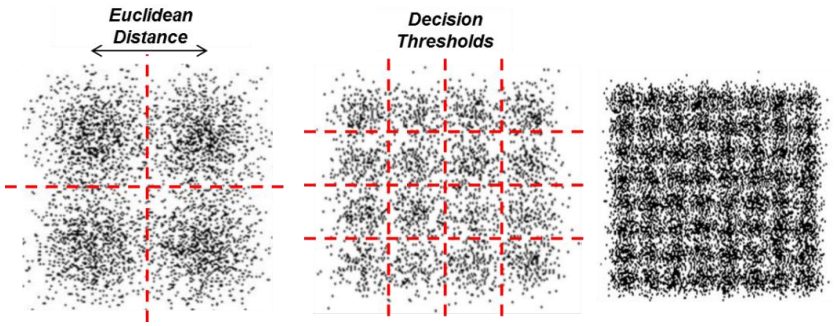




Basic Requirements for a High Speed LTE Network

Rosenberger

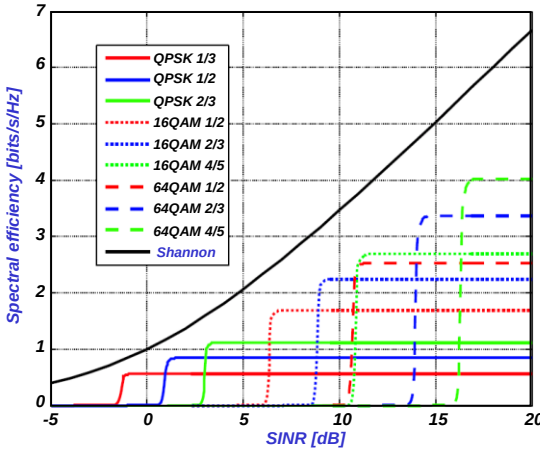
❑ High Order Modulation (HOM)



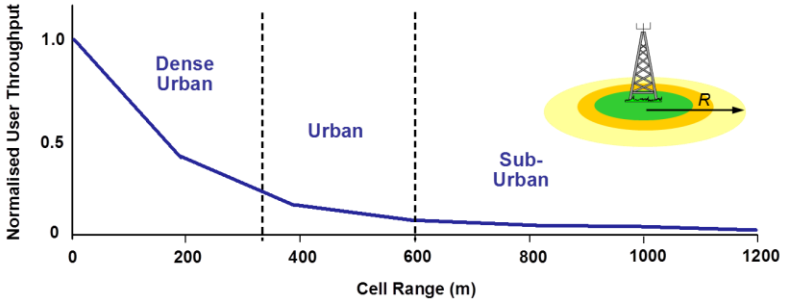
QPSK Modulation
2 bits/sym

16 QAM Modulation
4 bits/sym

64 QAM Modulation
6 bits/sym



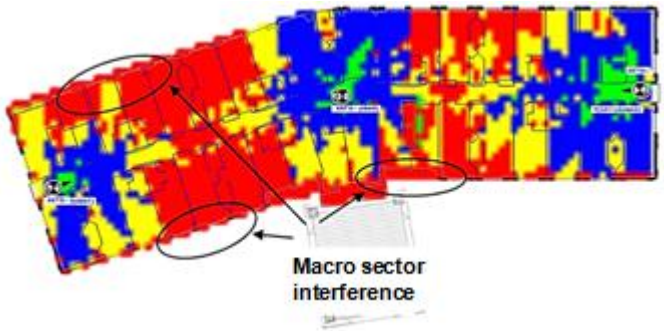
❑ Small Cells

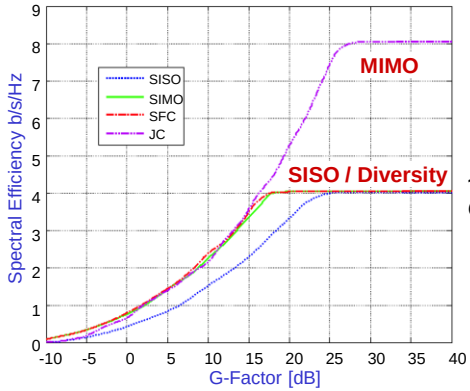


❑ MIMO

20MHz LTE
Up to 75Mbps (SISO)
Up to 150Mbps (2x2MIMO)

❑ Intercell Interference





~75 Mbps
@ 20MHz BW

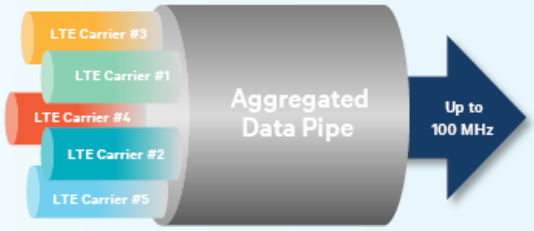
Different Dimensions of Improvements in LTE-Advanced

Rosenberger

LTE Advanced

Leverage wider bandwidth

Carrier aggregation across multiple carriers and multiple bands



Primarily higher data rates (bps)

Leverage more antennas

Downlink MIMO up to 8x8, enhanced Multi User MIMO and uplink MIMO up to 4x4. Coordinated multipoint (CoMP)

Higher spectral efficiency (bps/Hz)

Leverage HetNets

With advanced interference management (eICIC/IC)

Higher spectral efficiency per coverage area (bps/Hz/km^2)

Source : Ericsson

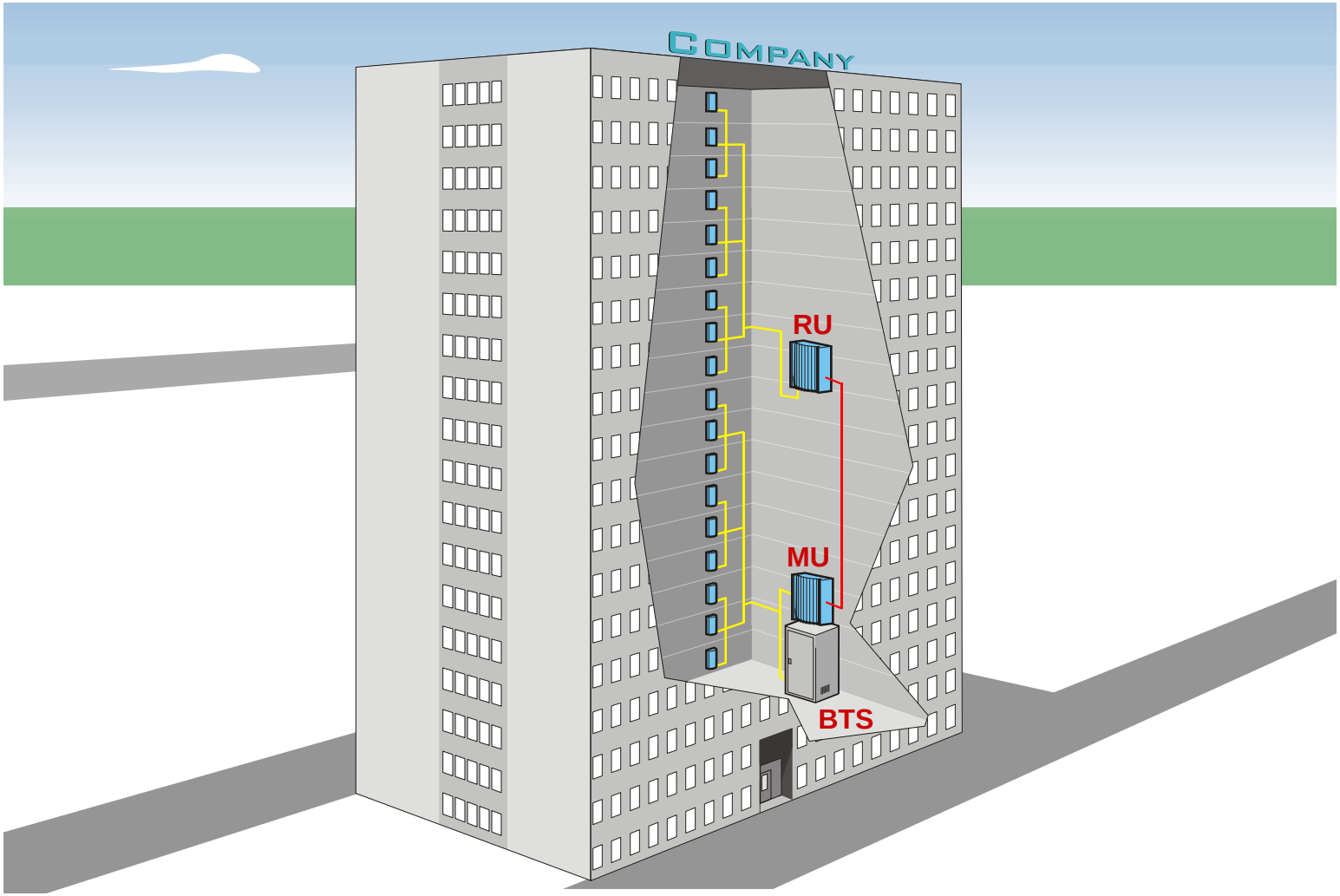
Copyright © Rosenberger 2016 – Proprietary / Confidential

In-building Coverage Solution for LTE-Advanced

Copyright © Rosenberger 2016 – Proprietary / Confidential

Passive, Active, or Hybrid DAS?

Rosenberger



Copyright © Rosenberger 2016 – Proprietary / Confidential

Passive DAS for LTE-A?

Rosenberger

Pros of Passive DAS

- An all-passive coaxial cable system is highly linear
- Capable of handling multiple downlink carriers with no measurable IM products
  - *IM3 of passive components typically in the range of -120 to -150 dBc*
- High system reliability and Cheap

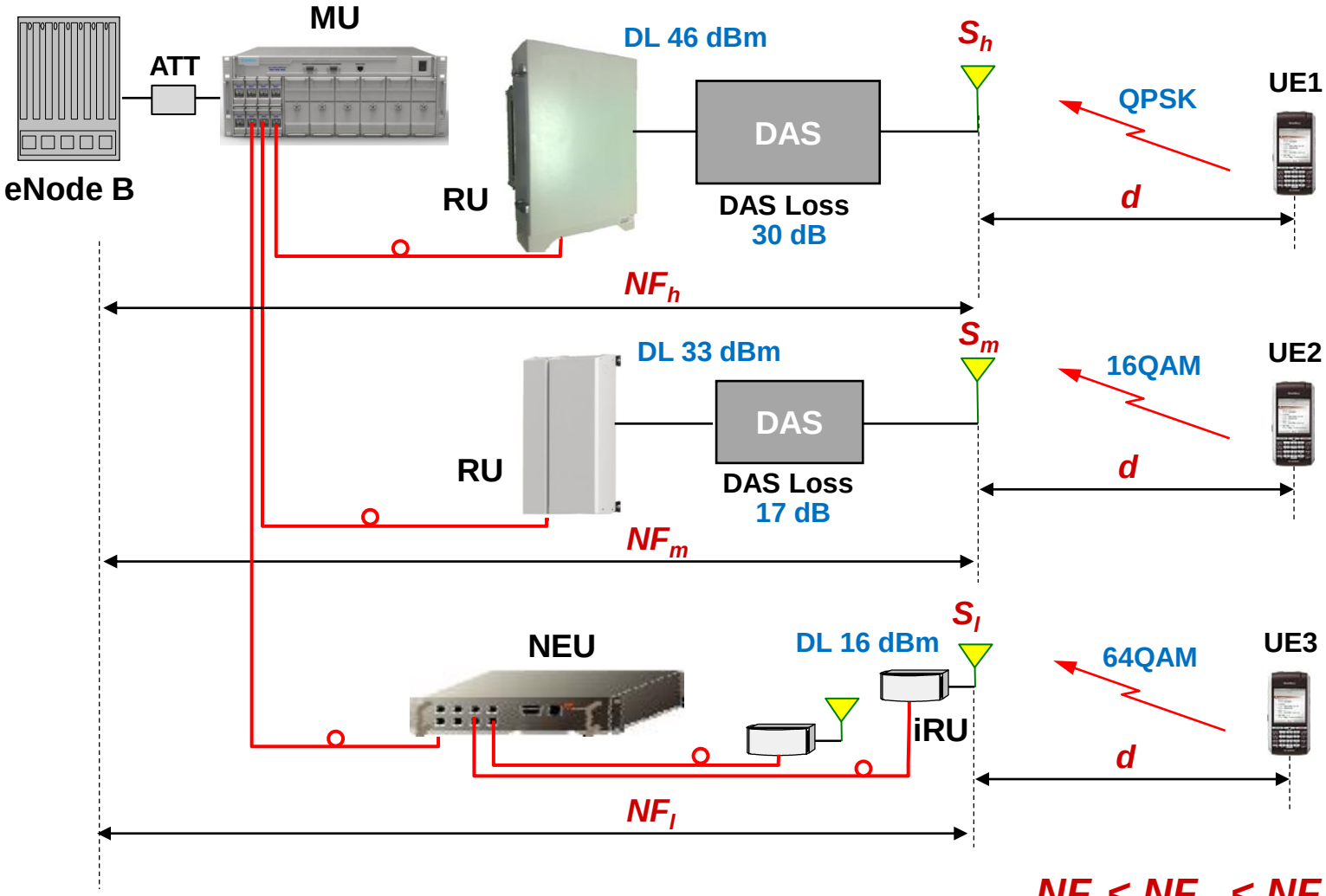
Cons of Passive DAS

- Feeder cable size is typically limited to 7/8” or 1-1/4”
- Not suitable for buildings that require long feeder runs
  - *Inherent insertion loss limits the size of installation to typically a 35 floor high rise building, or around 50,000 sq m*
- At high frequencies, the system loss becomes very high
  - *Lower DL coverage, poorer uplink sensitivity and reduced SNIR*
- Expensive to implement MIMO for LTE.

Copyright © Rosenberger 2016 – Proprietary / Confidential

High, Medium or Low Power Active DAS?

Rosenberger

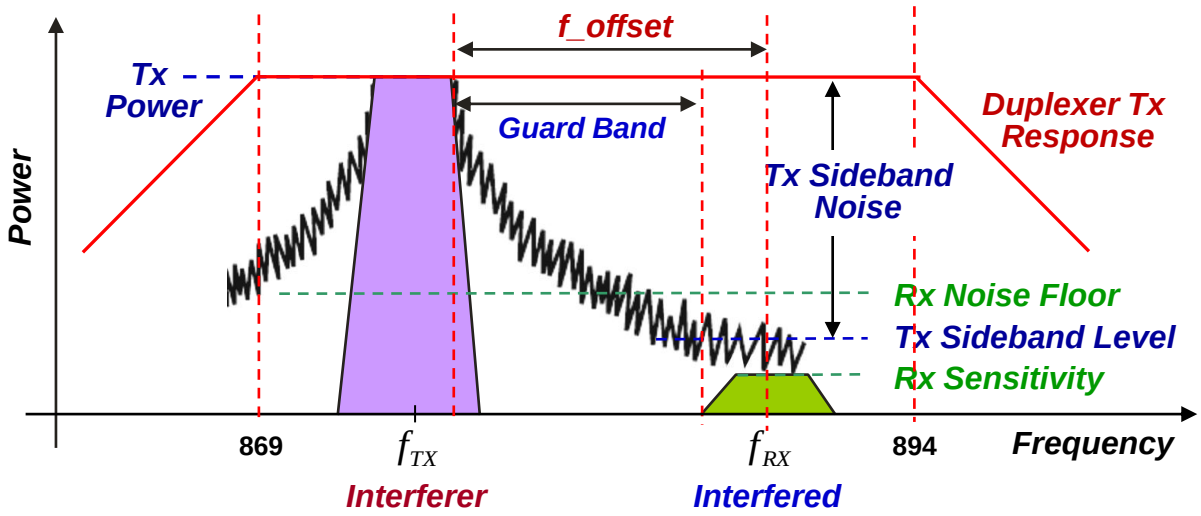


Copyright © Rosenberger 2016 – Proprietary / Confidential

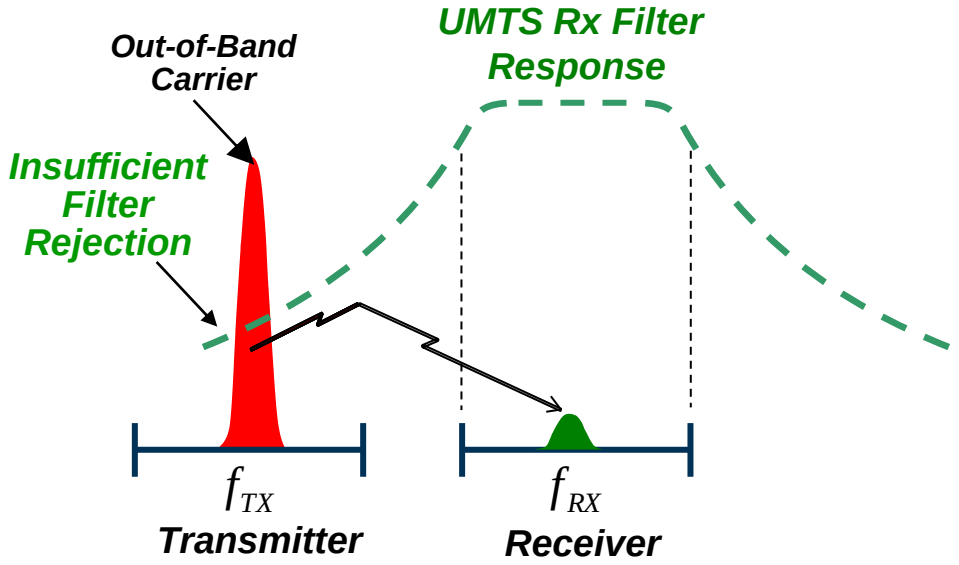
Uplink Performance
Inter-System Interference Considerations

Rosenberger

- **Spurious / Out-of-Band Emissions**



- **Blocking Considerations**

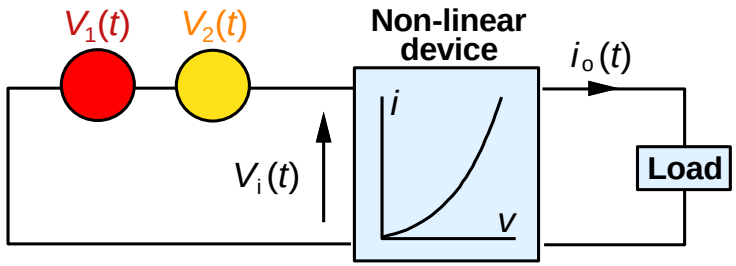


Copyright © Rosenberger 2016 – Proprietary / Confidential

Uplink Performance
Passive Intermodulation (PIM)

Rosenberger

- Intermodulation occurs when two or more carriers mix on non-linear device and create undesired output at other frequencies.
- In a communications system, this means that signals in the downlink may cause interference with adjacent uplink channels.

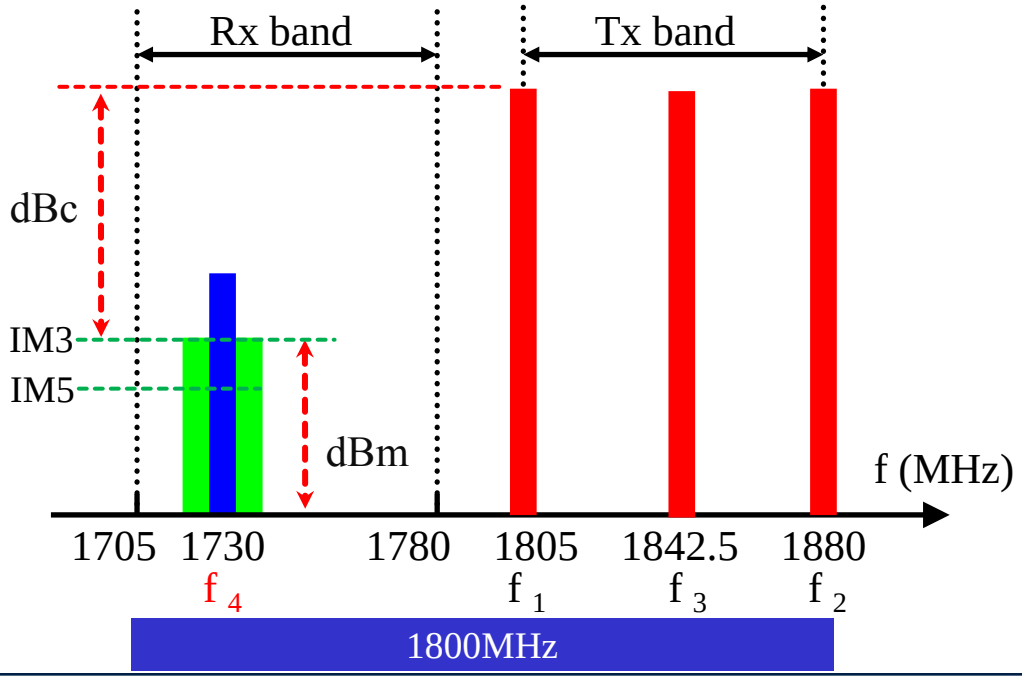


$$f_{IMm+n} = mf_1 \pm nf_2$$

IMD3 is always the **worst** case **!!!**

$f_{IM3} = 2 * f_1 - f_2$
$= 2\times1805 - 1880$
$= 1730\ MHz = f_4$

$f_{IM5} = 3 * f_1 - 2*f_3$
$= 3\times1805 - 2*1880$
$= 1730\ MHz = f_4$



Copyright © Rosenberger 2016 – Proprietary / Confidential

In-building Coverage Strategies

Rosenberger

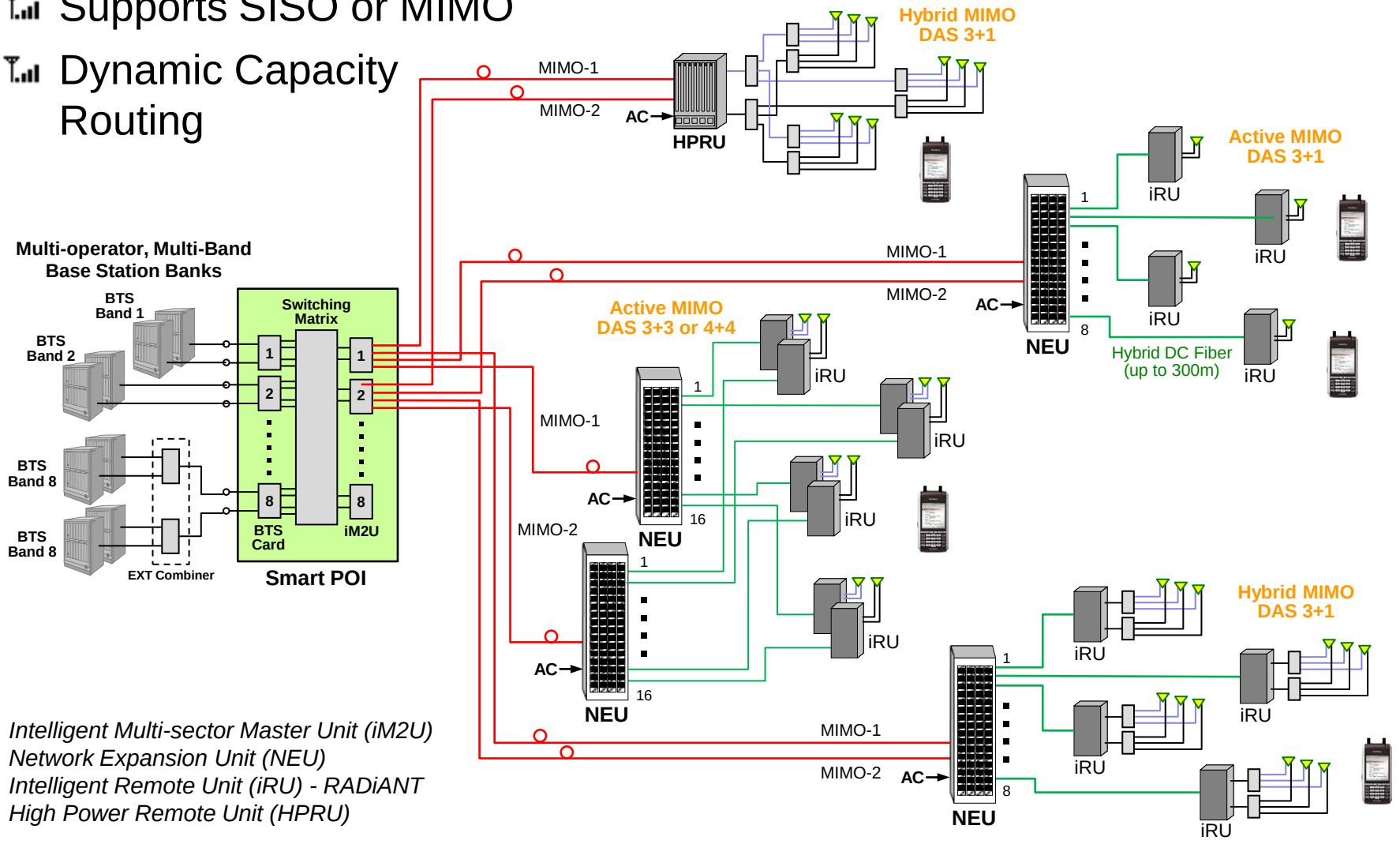
1. **Focus on TCO**
   - *Think long term, not short term; Multi-operator not single operator*
   - *Network should be easily scalable, support future technologies, and provide a flexible upgrade path*
2. **Ensure good quality connections, not just good coverage**
   - *In the past there has been a trade-off between coverage and capacity*
   - *Now, users expect both*
   - *Move from voice to data capacity – SNIR, MIMO, CA*
   - *Low noise figures are crucial to ensure maximum data throughput*
3. **Ability to move capacity rather than always provision for the peak**
   - *Mobile traffic is bursty and sporadic*
   - *Historically operators have always had to provision for peak traffic*
   - *Intelligent in-building coverage should allow the dynamic allocation of capacity to where and when it is needed*
   - *Capacity no longer needs to be hard-wired*
   - *Reduction in capex and opex costs as a result*

Copyright © Rosenberger 2016 – Proprietary / Confidential

“Smart” DAS MIMO Solution

Rosenberger

- Multi-operator, Multi-sector, Multi-band Active and Hybrid DAS
- Supports SISO or MIMO
- Dynamic Capacity Routing



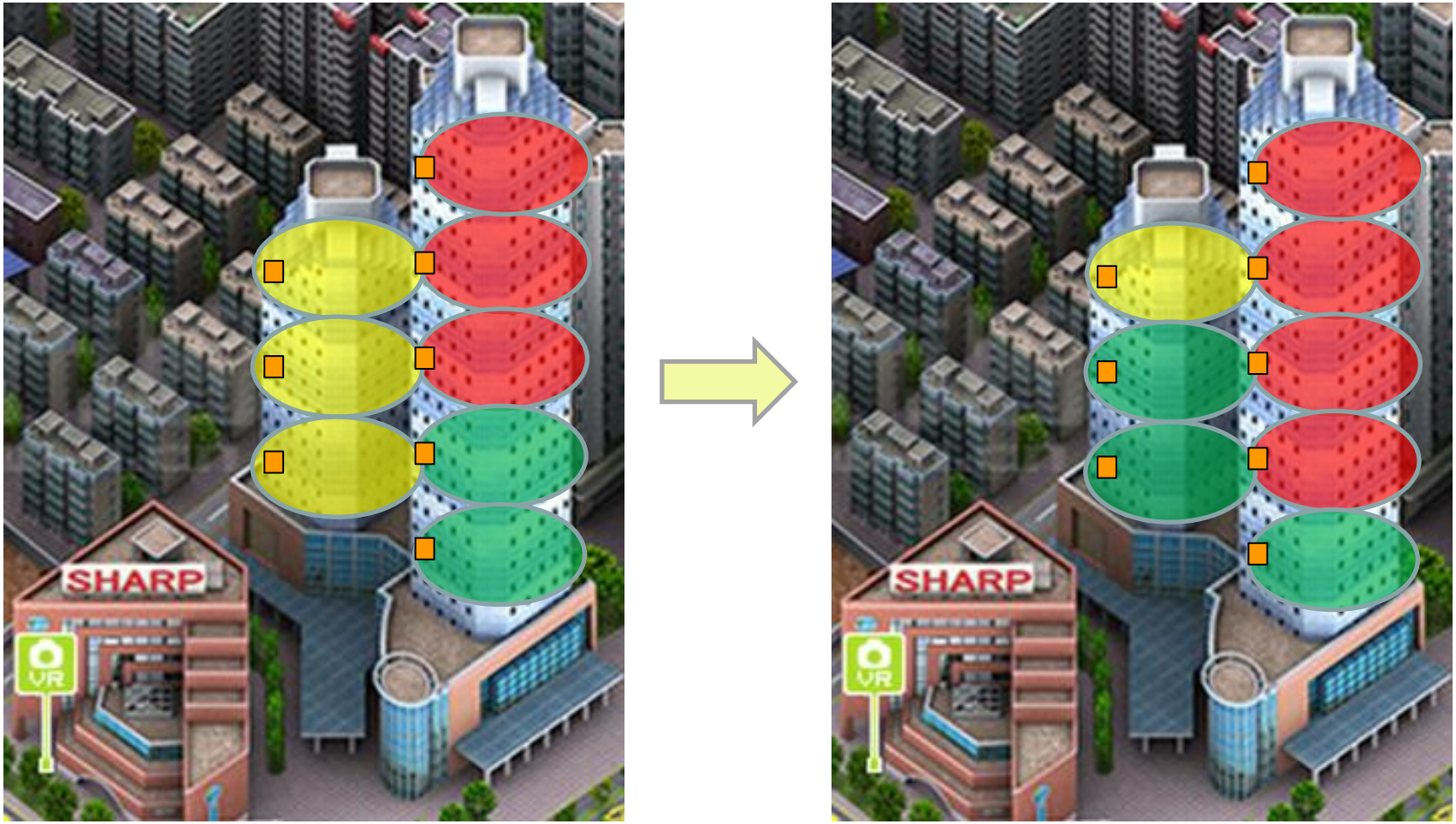
- *Intelligent Multi-sector Master Unit (iM2U)*
- *Network Expansion Unit (NEU)*
- *Intelligent Remote Unit (iRU) - RADiANT*
- *High Power Remote Unit (HPRU)*

Copyright © Rosenberger 2016 – Proprietary / Confidential

“Smart” DAS
Dynamic Capacity Routing

Rosenberger

- Dynamic capacity routing allows the size of sectors to be changed to accommodate temporary surge in traffic within the DAS network.

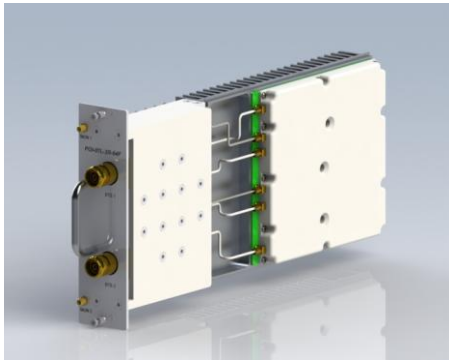


Copyright © Rosenberger 2016 – Proprietary / Confidential

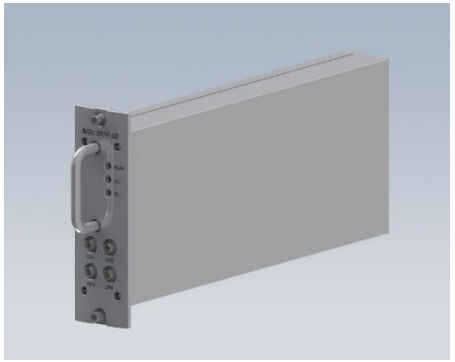
“Smart” DAS Components

Rosenberger

Smart POI Unit



Smart POI – BTS Card



Smart POI – IM2U

NEU

High Power RU

Modular PA Unit

Low Power RU (RADiAnt)

Hybrid Fiber/DC Cable

Copyright © Rosenberger 2016 – Proprietary / Confidential

Summary and Takeaways

Copyright © Rosenberger 2016 – Proprietary / Confidential

Summary and Takeaways

Rosenberger

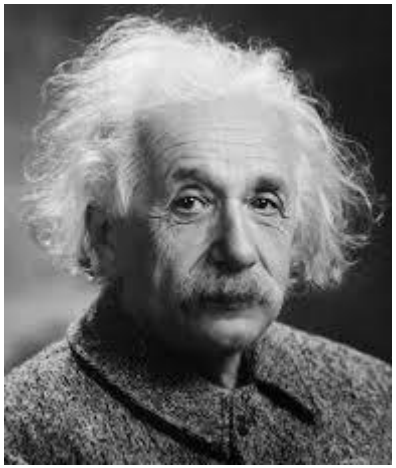
- LTE is designed as a wireless high speed data network.
  - *Requires Small Cell size AND Interference Management*
  - *Maximize SINIR through careful antenna placements to operate at 64QAM and improve MIMO performance*
- LTE-A capacity options
  - *MIMO and Sectorization*
  - *Carrier Aggregation*
- How well can Passive DAS support LTE-A?
- How to enhance upload speeds?
  - *Again, time to rethink on Passive DAS*
  - *Ensure sufficient isolation between co-located systems*
  - *PIM specs – No such thing as cheap and good!*
- Rosenberger is a Total Solutions Provider for muli-operator, IBS equipment and have successfully deployed active and passive IBS solutions in 15 countries throughout Asia Pacific, Middle East, & South America

Copyright © Rosenberger 2016 – Proprietary / Confidential

A Final Quote …

Rosenberger

There is nothing that is a more certain sign of insanity than to do the same thing over and over again and expecting different results.



Albert Einstein

Copyright © Rosenberger 2016 – Proprietary / Confidential

THANK YOU

www.rosenbergerap.com

Rosenberger

Denis Ng
Director, Marketing & Infrastructure Solutions

E: denis@rosenbergerap.com
T: +65 6696 6039
F: +65 6696 6039
No. 3 Anxiang Street, Block B,
Tianzhu Airport Industrial Zone
Beijing 101300, China