JMA wireless

Maximizing your 4G performance and preparing for 5G

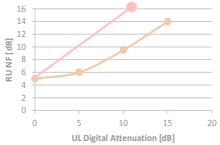
Connecting the mobile world

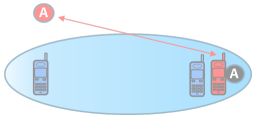
What do we ”sell”

- Are you being paid per dBm in the network?
  - No…. Per Mb
  - So focus on how much data can be supported
  - **Do not use ”dBm” as the only KPI!**
- Can your DAS handle 5G in the future?
  - 5G is not fully define yet, but modulation will be more complex and DAS quality even more important
  - Make sure your 4G is utilized to a maximum, before throwing investment at 5G
  - Delay / Latency is a critical parameter…. The JMA DAS has less than 1µS delay

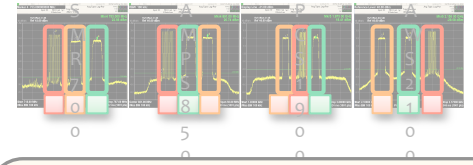
The impact of JMA DAS performance

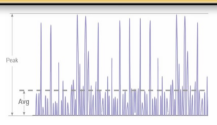
- High Dynamic Range
- Optimized IP3
- Handles Near-Far issues





- High Average to Peak
- Multi protocol, multi operators
- High usable DL power





UL Quality

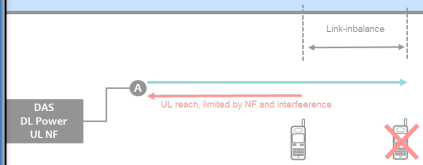
Low Noise Figure

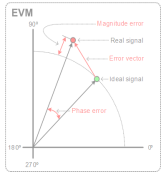
Improved DAS performance
More Capacity
More Revenue

DL Performance

EVM Performance

- Highest UL dataspeed
- More UL Capacity
- UL-DL Balance





Low EVM
- Highest possible dataspeeds
- More data capacity

Enabling Capacity

- Migration from 2G, 3G over 4G towards 5G is all about maximizing the data throughput per MHz of Spectrum
- Obviously the DAS cannot be allowed to degrade the need for increased spectrum efficiency

To simplify this we can use the below "formula" capacity (Network economy per investment):

DL Capacity = (#OfSectors x CA x (Bandwidth x MIMO)) x SUM [■EVMPAPR] - (Macro Interference + PIM + Inter Sector Interference)

UL Capacity = (#OfSectors x (Bandwidth x MIMO)) x EVM - (SUM [■NFUL IP3 PIM] + UL Interference + Inter Sector Interference)

Planning Parameter

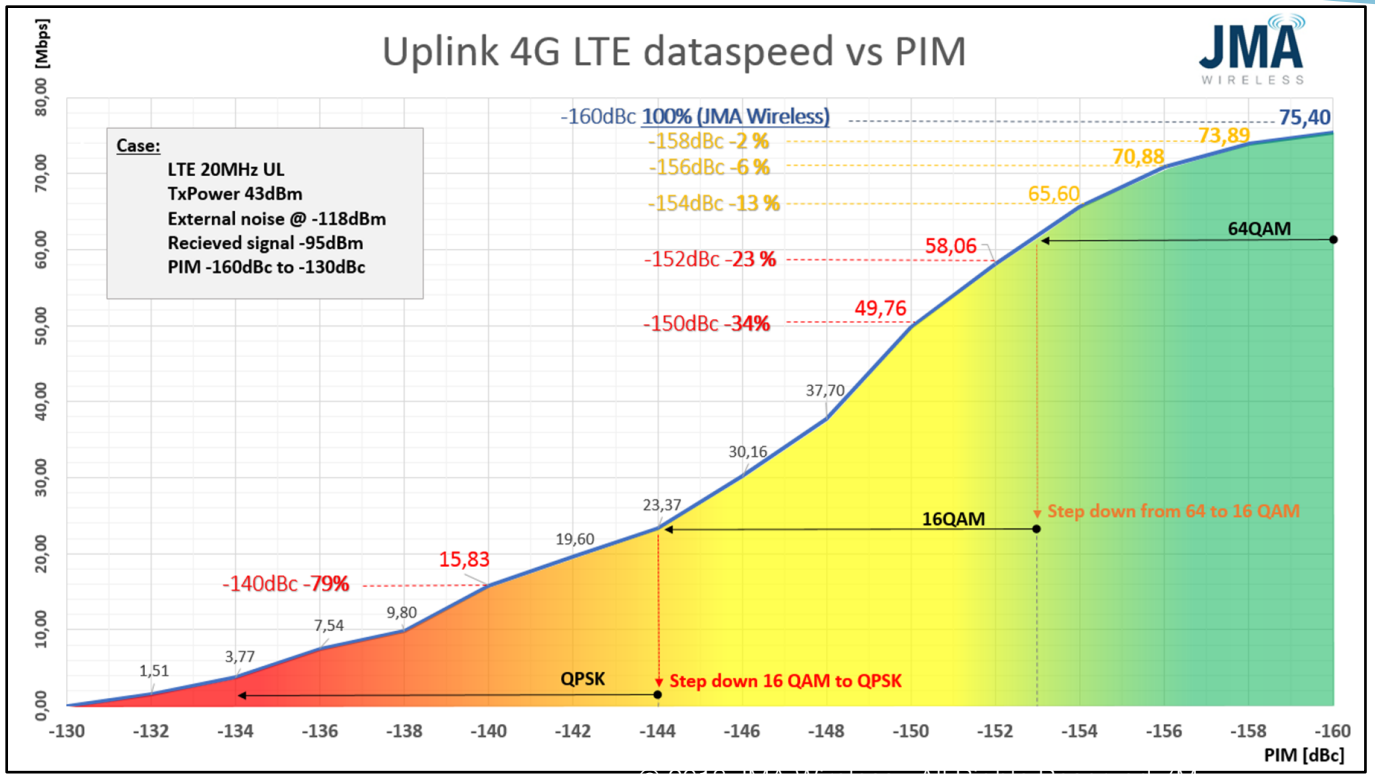
DAS Performance Parameter

On the investment side it is also pretty clear:

Network Economy (Capacity) = Investment x Network Planning x DAS Performance

It makes no sense to save 20% on the DAS investment, if the DAS performance degrades 50% of traffic Revenue !

PIM, Passive Intermodulation



Get the whitepaper on PIM impacting 4G

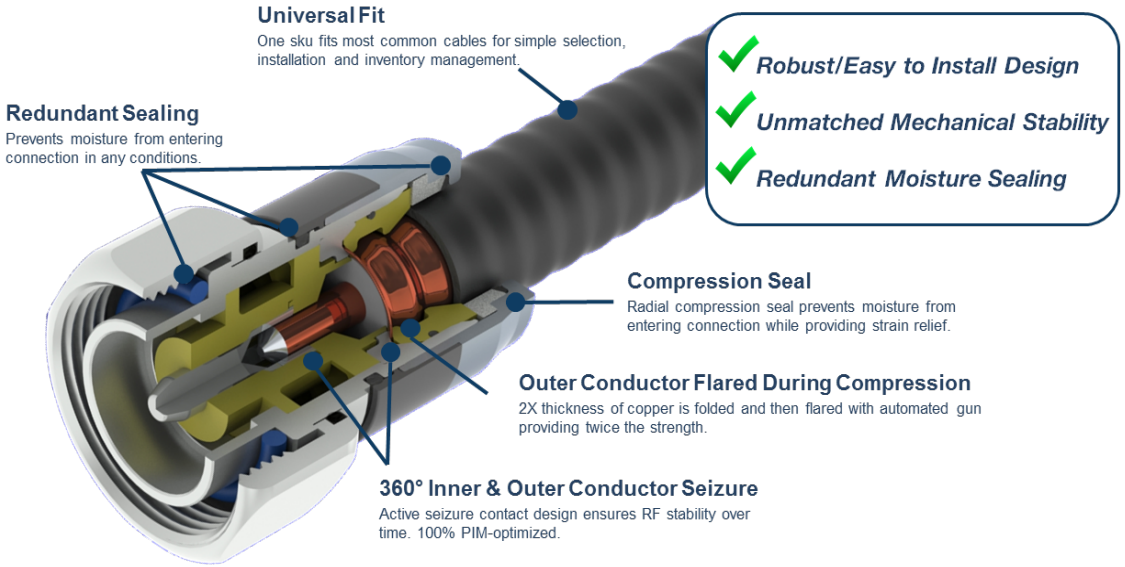
Compression Connector Technology

Compression Technology

JMA Wireless provides the fastest and most reliable connector solution on the market today.

Fast Installation

Simple, repeatable installation reduces contractor error, saving time & money.



Operators can yield up to 80% savings on installation time.

Animation

EVM and Radio Capacity

Can your DAS handle 5G in the future?

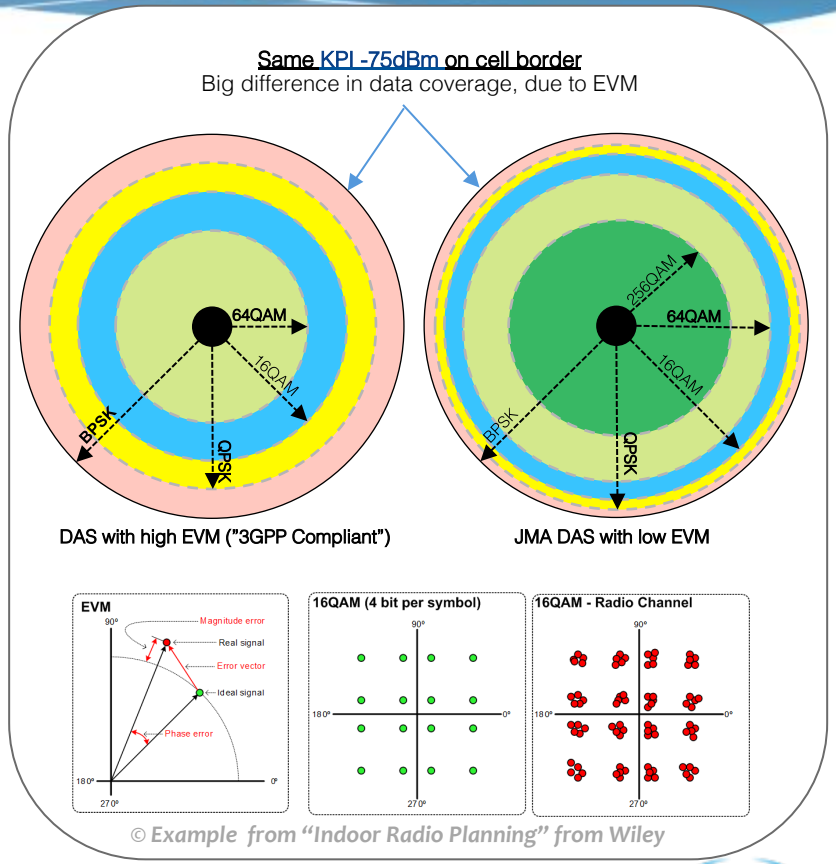
- 256QAM requires an EVM less than 2-3%
- 1024QAM requires EVM less than 1%
- 5G is not fully defined yet, but modulation will be more complex and DAS quality even more important

3GPP specification on EVM is pretty relaxed

- JMA-TEKO DAS has EVM<1%
- Higher order modulation schemes are supported (256QAM, 1024QAM)
- Best throughput over the entire sector
- 3GPP allows up to 12% EVM!
  - Being "3GPP compliant" is not goodenough

EVM will impact your business case

- The better the EVM, the more throughput per
  - investment, resulting in a better business case



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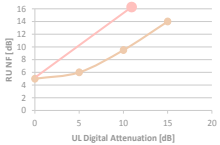

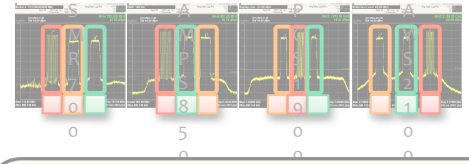

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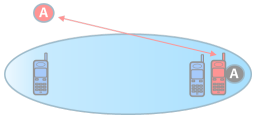

- Highest UL dataspeed
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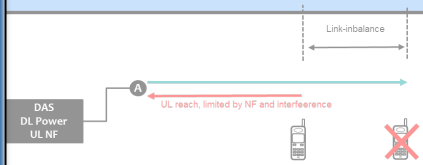
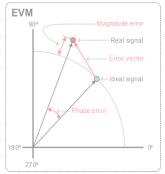
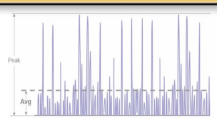




- Low EVM
- Highest possible dataspeeds
- More data capacity



UL Quality

Low Noise Figure

DL Performance

EVM Performance

Improved DAS performance
More Capacity
More Revenue

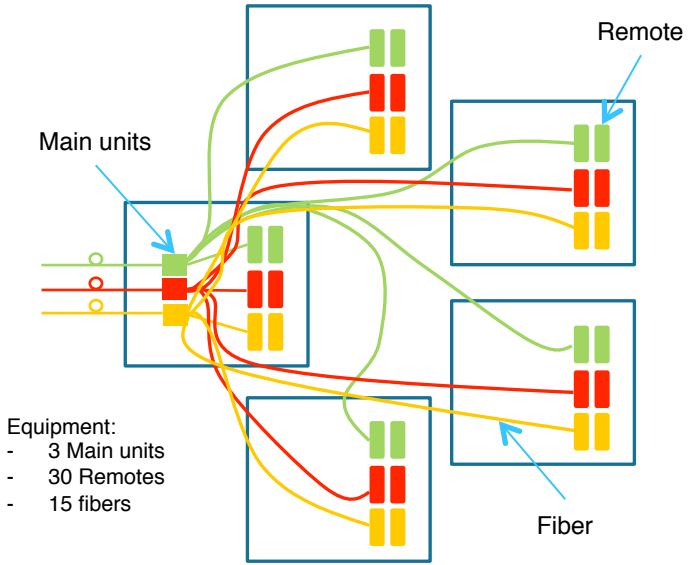
How do we assure high data speed at the lowest cost?

Connecting the mobile world

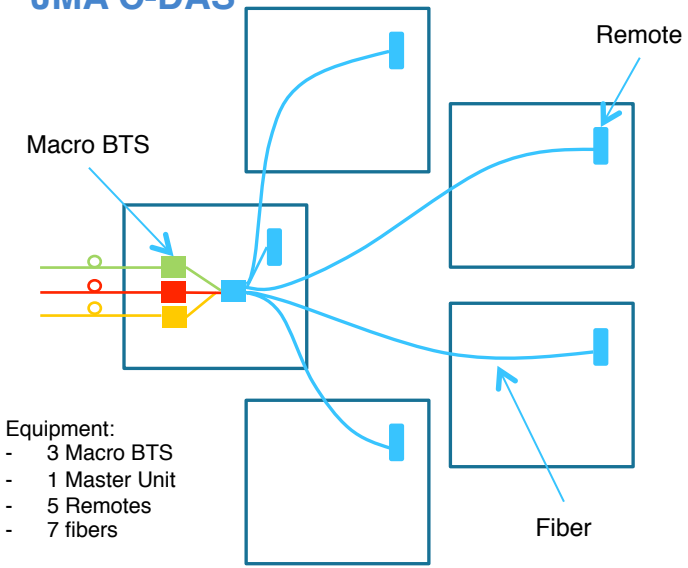
Comparison example (active equipment)

Comparing the conventional approach with the JMA solution for 5 buildings, coverage for 3 operators and 2 bands.

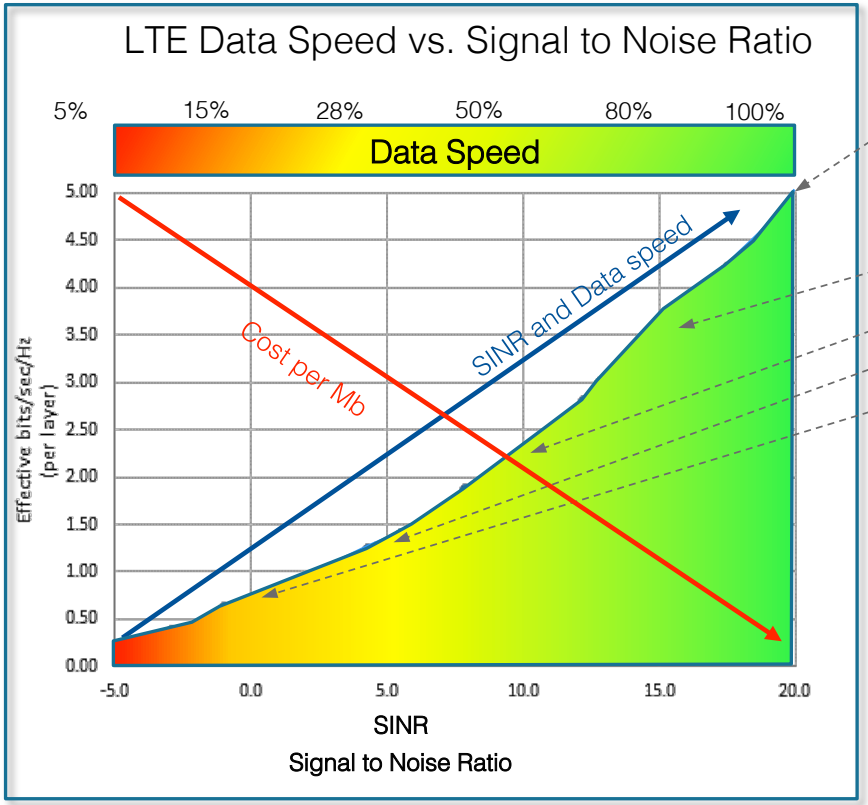
Conventional



JMA C-DAS



Achieving high data speed in 4G networks



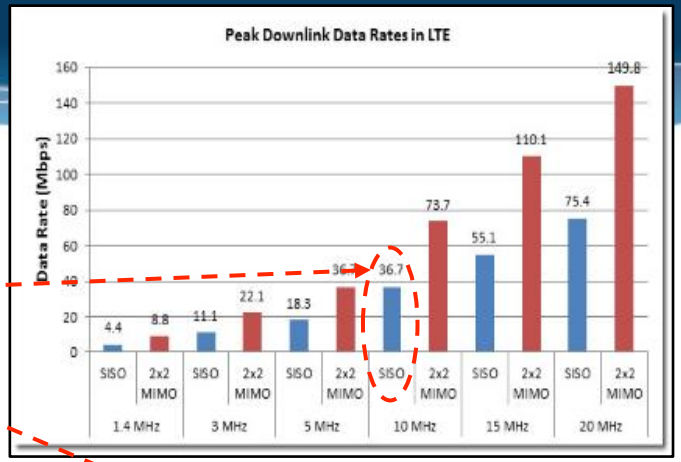
Spectrum efficiency degradation

- If we use good ”signal to noise” 20dB SINR as reference (for 100% throughput), we can see on the graph that
  - 15dB SINR is 80% throughput
  - 10dB SINR is 50% throughput
  - 5dB SINR is 28% throughput
  - 0dB SINR is 16 % throughput

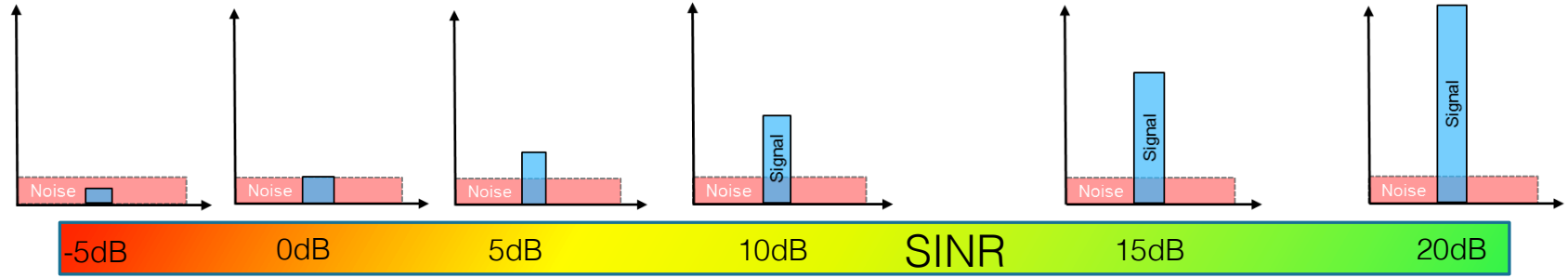
4G example

10MHz SISO LTE carrier, 37Mbps peak

- SINR really impact the throughput, significantly
- With low SINR, data speed falls, data production cost per Mb increases
- This impacts the business case



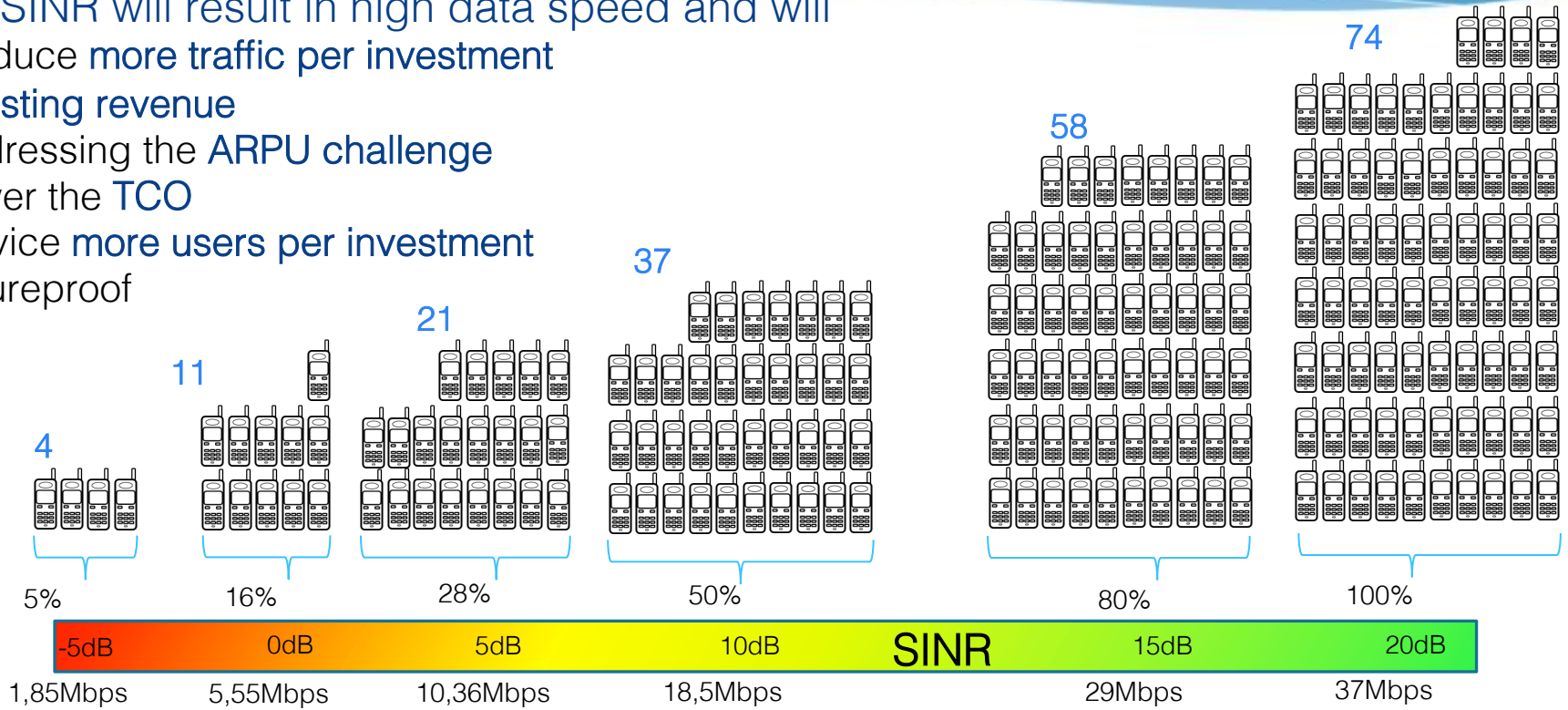
Data capacity using LTE (4G) is very dependent of the channel configuration, the core network and backhaul. The Base Station settings plays a major role, scheduling settings etc. These numbers are general 3GPP assumptions.



Assuring the business case and the future

Good SINR will result in high data speed and will

- Produce more traffic per investment
- Boosting revenue
- Addressing the ARPU challenge
- Lower the TCO
- Service more users per investment
- Futureproof



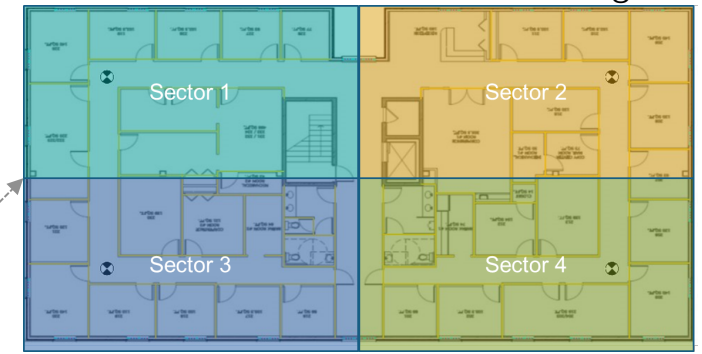
10MHz SISO LTE carrier, 37Mbps peak, WEB browsing is 0.5Mbps in average load per user

Simulations

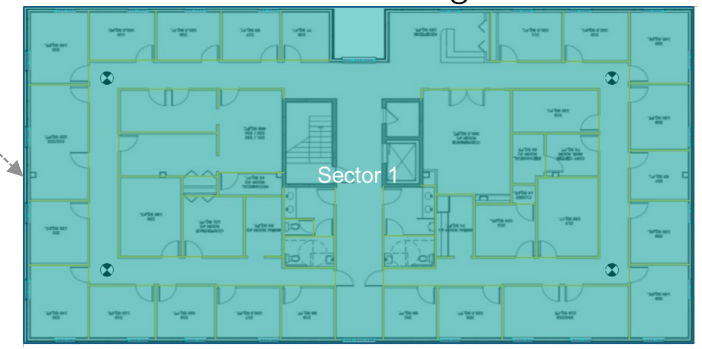
The real case

The office floor in IBW with walls

Four Small Cells needed for coverage

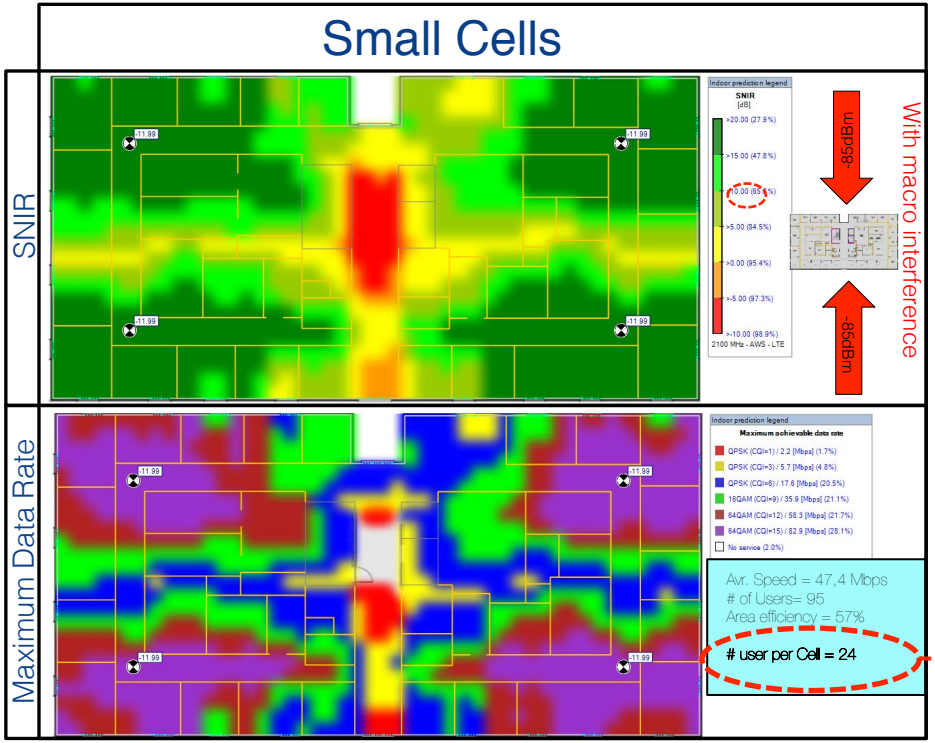


JMA DAS one cell coverage

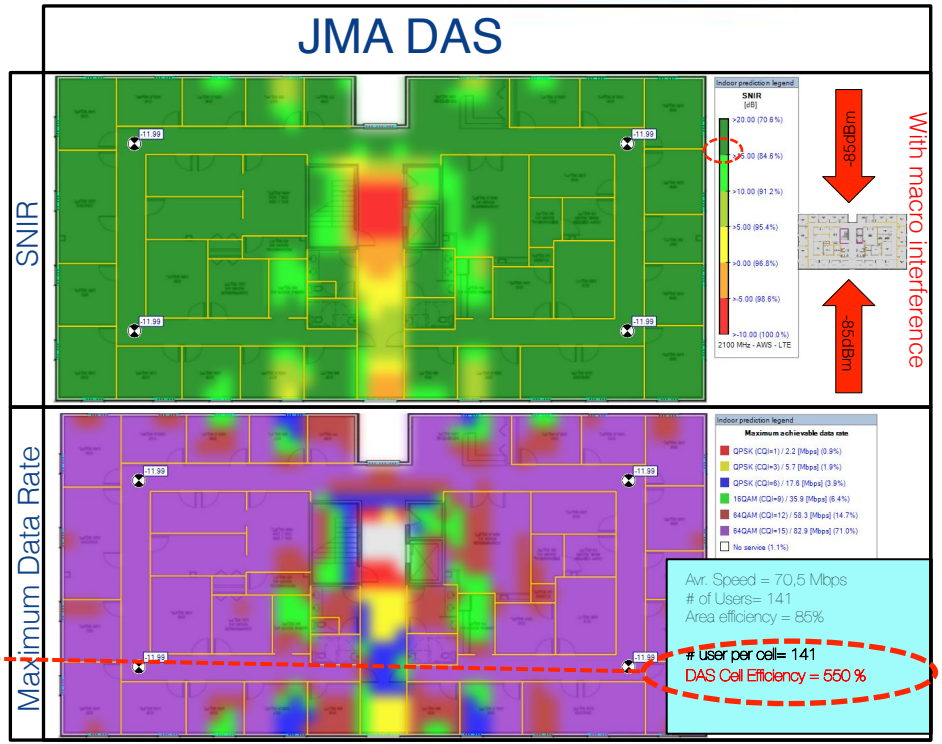


Comparison – with macro outdoor signal

Small Cells



JMA DAS



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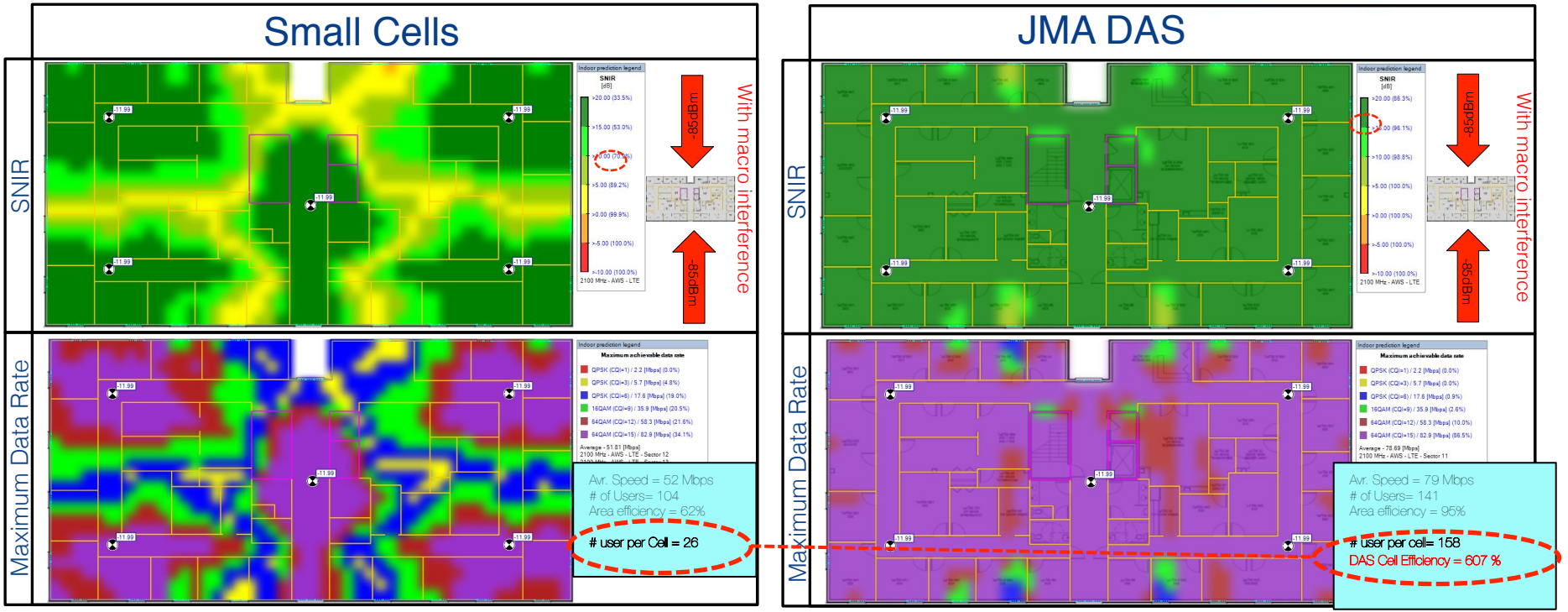

It’s Your Stadium... you can choose.

A

3 Mobile Operators:

or

B

3 Mobile Operators, 5Bands, with integral Digital Electricity:

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JMA Assuring the path to 5G

Connecting the mobile world.

So…. Here we go again !

It's the same old catch-up game, since 2-3G !

- Data is growing and growing
- ARPU is falling !
- The Service Providers need more efficient solutions, to produce more for less!
- New tools for planning
- More backhaul

However some things remains the exactly the same !

5G Facts

- Final 5G specification locked in 2020
- Will use existing and new bands
- RF Performance will be key
- Some services will use distributed functionality
- Massive MIMO will be limited to Macro and outdoor
- 4x4 MIMO for indoors in hot-spots

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5G, what can we expect?

No doubt, the main motivation behind 5G is

- The never-ending need for more data capacity over the RF spectrum.
- The need to optimize the response time / delay, the so called “latency”.
- Smart-buildings and Smart-Cities will also rely on a lot of machine/to/machine “M2M” communications.
- Connected devices to support Internet of Things ”IOT” applications will be a strong enabler to open up this future market.
- Superior radio performance will be key, so will infrastructure to support it.
- Massive MIMO will support very efficient radio-links both indoors and outdoors.

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5G impact on equipment and installations

5G will rely to a large extent on the existing mobile bands, with the addition of new licensed and unlicensed bands. Existing “low bands” such as 800 through 2600MHz is expected to be the base layer of blanket-coverage supporting the 5G functionality in general.

New bands and RF Performance

- New bands on higher frequencies, like 3.5 Hz and even up to millimeter-wave above 24GHz will be added to support extreme bandwidths of data in very short range, typically in a “stand-alone” cell.
- The high performance of the JMA infrastructure, supporting beyond 256QAM modulation schemes, and the ability to handle a wide RF spectrum over fiber and RF cable infrastructure is key.
- CAT6 based systems will not support the RF bandwidth needed for 5G systems, typically limited to around 300MHz of total bandwidth CAT6 based systems are limited by the CAT6 media and have to ”slice” and compress slots of the RF spectrum to overcome the limitations. This signal conversion compromises the RF performance and adds latency. Furthermore, the risk is also to add additional Noise Figure to the system, limiting the Uplink data capacity.

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RF Performance is key for any RF system!

5G challenges on the RF link performance
- Lower latency (digital DAS will add delay, latency)
- Distributed network functionality
- Higher modulation rates 256QAM, 512 QAM etc.

Maximize your 4G
- Do not rely on 3GPP specifications only
- This will not even support 4G to the maximum!

- JMA utilize the best from Analog and Digital
  - Digital POI
  - Step attenuation
  - Capacity Switching
  - Monitoring

- JMA; No added digital delay (will limit TDD and 5G)
- JMA; Highest possible bandwidth over the fiber
- JMA: No compression
- JMA; No EVM impact
- JMA; Support 256/512QAM (5G)

5G

Maximize your 4G before investing in 5G!

Questions & Answers….

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