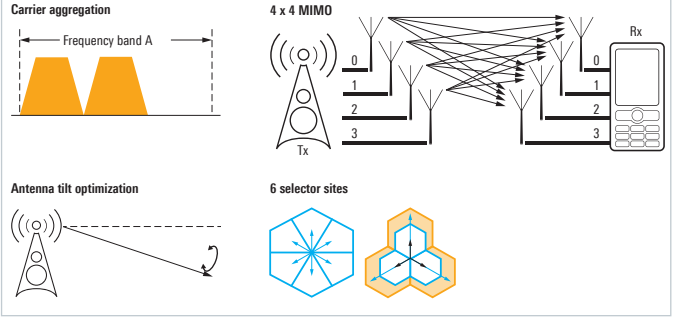
Enabling smart macro network enhancements

Rohde&Schwarz mobile network testing solutions enable operators to efficiently increase network capacity via hardware-related, capacity-enhancing features such as antenna tilt optimization, carrier aggregation, 4x4 MIMO and 6-sector sites.

Main hardware-related, capacity-enhancing features



Your task

Mobile network operators need to continually upgrade network capacity in order to cope with higher data consumption, keep their subscribers loyal and attract more subscribers from the competition. Network capacity has to be measured before and after upgrades to verify capacity gains and justify the investment.

Studies show that just a few higher loaded cells can affect the performance of a huge number of users. User satisfaction is not determined by the average network performance, but the performance of every cell in a cluster counts and should be optimized.

Network capacity can be increased by simply modifying the existing macro cell site grid (antenna tilts) or by upgrading to new features. The main goal is always to increase the amount of data that can be transmitted over a given number of air interface resources (including minimizing interference with neighboring cells).

The four main hardware-related, capacity-enhancing features are antenna tilt optimization, carrier aggregation, 4x4 MIMO and higher sectorization. The main task in antenna tilt optimization and higher sectorization (3 → 6 sectors) is to optimize the overlapping areas of cells. The overlapping areas should be large enough to ensure that handovers work properly, but as small as possible to limit interference with the neighbor cells. 4x4 MIMO is only beneficial if the environment/topology offers sufficient multipath richness. Mobile network operators want to identify those regions and validate the increasingly complex simulations.

T&M solution

Multiple T&M solutions are available to support the operator during capacity upgrades:

- The network performance test from Rohde&Schwarz provides immediate insight into the network capacity available to end users before and after capacity upgrades, using the same drive/walk test route (see separate application card: PD 3607.4258.92)
- In the case of antenna tilt optimization and higher sectorization, network scanners (R&S®TSMW, R&S®TSMA, and R&S®TSME) collect data and R&S®ROMES4, the universal software platform for network optimization and troubleshooting, analyzes the data and helps users determine the root cause of problems such as pilot pollution, etc.
- The test and measurement solution for testing MIMO in the network is to use commercial smartphones with unmodified hardware, which means using the internal antennas
  - The Rohde&Schwarz solution for 2x2 MIMO testing – with commercial smartphones (internal antennas) including QualiPoc Android software inside test device containment modules (TCM) in a vehicle roofbox – has been confirmed by a world leading operator to be the right approach for end-to-end assessment. It reflects reality and is ready for smartphone antenna evolutions.

- To prepare for 4x4 MIMO when commercial smartphones are not yet available and for 2x2 MIMO troubleshooting purposes, network scanners and R&S®ROMES4 can support and provide inputs for the business case to direct the operator's investment to the beneficial regions
- Carrier aggregation is supported with QualiPoc Android software in the smartphones used for testing data rates and capacities in live networks (also as part of the network performance test)

Results and key benefits

- Optimized capacity by minimizing intercell interference (identification of root cause of pilot pollution, etc.)
- Lower costs by directing 4x4 MIMO investments to the right regions
- Faster problem identification by monitoring the effectiveness of base station resource allocation (cell-based analysis tools)

Benefits for mobile network operators are

- More satisfied subscribers
- Lower churn rate
- Being more attractive than competition (by having higher network capacity and lower costs)

Key features

In combination with the R&S®ROMES4 analysis tool, our scanner features are based on measuring coverage (reference signal receive power, RSRP) and signal quality (signal to interference and noise ratio, SINR). Compared with a commercial smartphone, a network scanner measures with much better RF accuracy.

The RSRP figures can be measured with all visible cells at the same time, providing deeper insight into the overlapping areas of cells.

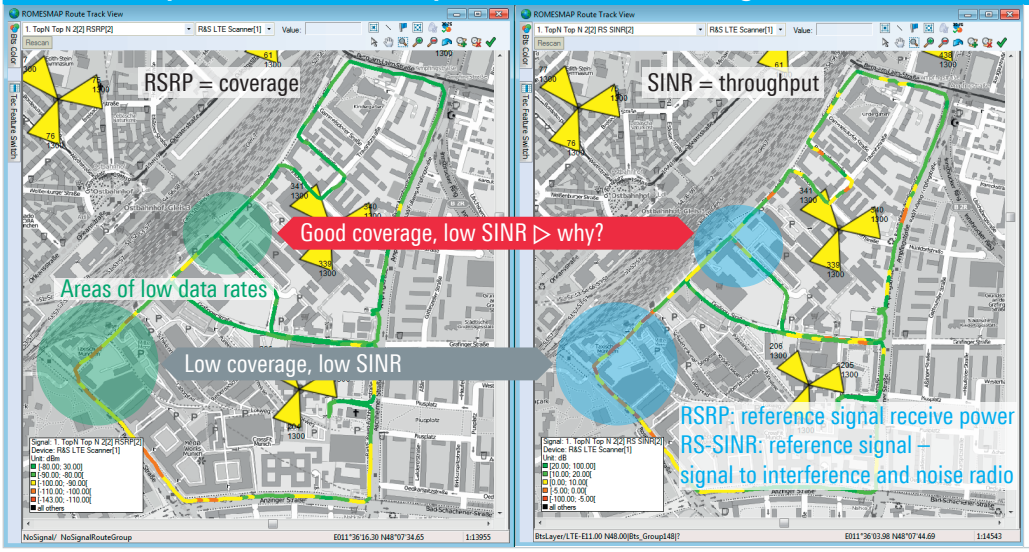
The scanners' unique LTE downlink allocation analyzer provides a clear view of how efficiently the base station can allocate resource blocks on the air interface to users. If many users get a low modulation and coding scheme (MCS), then the network should be optimized and troubleshooting should start. Minor changes can result in major and cost-efficient improvements for the operator.

The 4x4 MIMO test solution from Rohde&Schwarz (four R&S®TSME scanners plus R&S®ROMES) measures, or better, estimates the channel matrix components and calculates the rank and the condition number of the channel matrix, i.e. it measures the 4x4 MIMO feasibility of the environment. As a really unique feature, these results provide details about the environment and the part of the frequency band in which 4x4 MIMO is typically feasible. The network scanners always work passively and non-intrusively and do not affect the running network during the measurements.

Additional information

For more information on the test and measurement solutions and products (R&S®TSME, R&S®TSMA, R&S®TSMW, R&S®ROMES4, QualiPoc Android software, TCM, R&S®DATA-NPT, etc.) discussed in this application card, please contact your Rohde&Schwarz Sales representative or visit www.rohde-schwarz.com.

Result example with real data: impact of too much coverage (best server RSRP and RS-SINR)



In areas where coverage of different cells overlaps a lot:

- Power levels are high (RSRP in LTE)
- Interference levels are also high (low RS-SINR)
- Cell performance may be low ▷ pilot pollution

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