

# AEROFLEX

A passion for performance.



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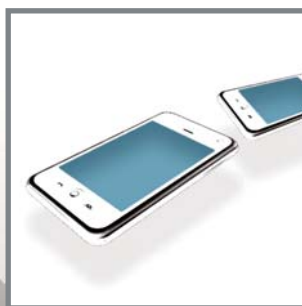


## The E500 - Delivering Network Performance and Capacity

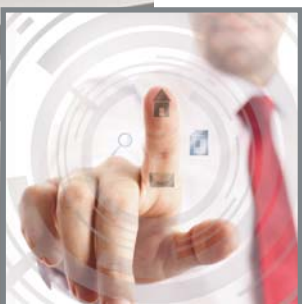
# The Ultimate in Real-life Network Performance Testing



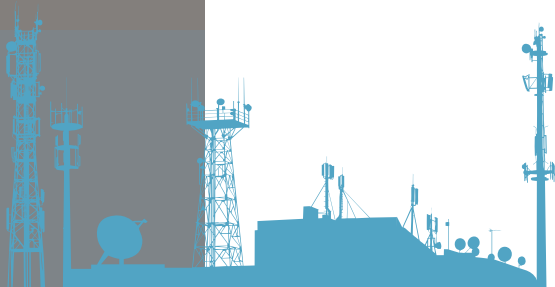
The Aeroflex E500—the most comprehensive 3GPP performance and capacity test system.



With the ability to emulate from tens up to tens of thousands of mobile devices across multiple cells and different radio access technologies, the E500 provides a test solution that builds on the scalability of the TM500 to validate network performance as experienced by end users.



The E500 with integrated data services can measure the complete performance from RF through the packet core including interaction with other users, the simulated RF environment and mobility. This is essential to accurately replicate real-world user behavior profiles such as web browsing, emails, downloading, video streaming and VoLTE, together with mobility across the radio access network.



# A need for increased network performance testing

While Long Term Evolution (LTE) technology has become functionally more robust, there still remains a significant challenge prior to commercial network rollout: Ensuring the complete LTE infrastructure performs under loaded conditions and delivers an optimum experience to the wireless subscriber. There have been several well-publicized cases of existing mobile networks straining under the load of data-hungry devices to the extent that the network can no longer function. To avoid such situations, operators are seeking for reassurance that the network can at the very least manage the requested capacity without failure.

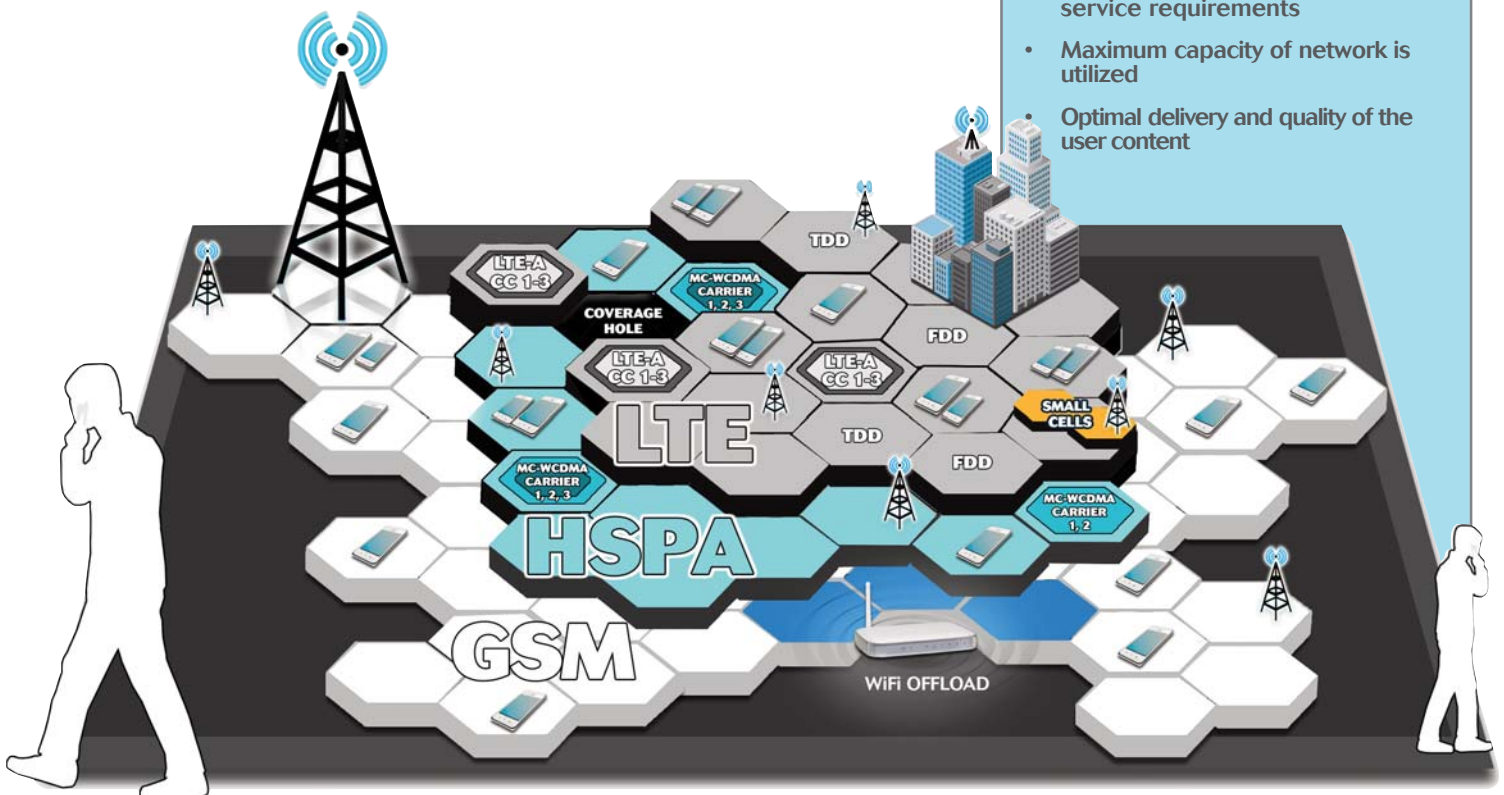
## Network Evolution

As the complexity of the ever-evolving network increases, the importance for more rigorous and accurate testing is crucial. Driven by the increased data rates, the RF interface is the fastest evolving part of the network. As seen in the illustration below, the complex environment with overlaying technologies means macro and small cells co-exist, increasing interference and complexity. Realistic RAN testing requires Multi-RAT capabilities over increasing number of radio bands. In some locations traffic may also be off-loaded to non-cellular technologies (WiFi).

Historically, such testing has been performed in labs using real mobile devices for end-to-end testing via RF, or by replacing the base station with a simulated load. The use of real handsets becomes impossible to coordinate when thousands of handsets would be required to create enough load. Another factor is more intelligent base stations in LTE (e-NodeB) which are able to prioritize different subscribers and services under heavy load conditions. These two factors require LTE capacity emulators generating real application data interfacing to the base station (eNode-B) rather than deeper in the network.

### Increased network testing is required to ensure:

- Resource availability meets service requirements
- Maximum capacity of network is utilized
- Optimal delivery and quality of the user content



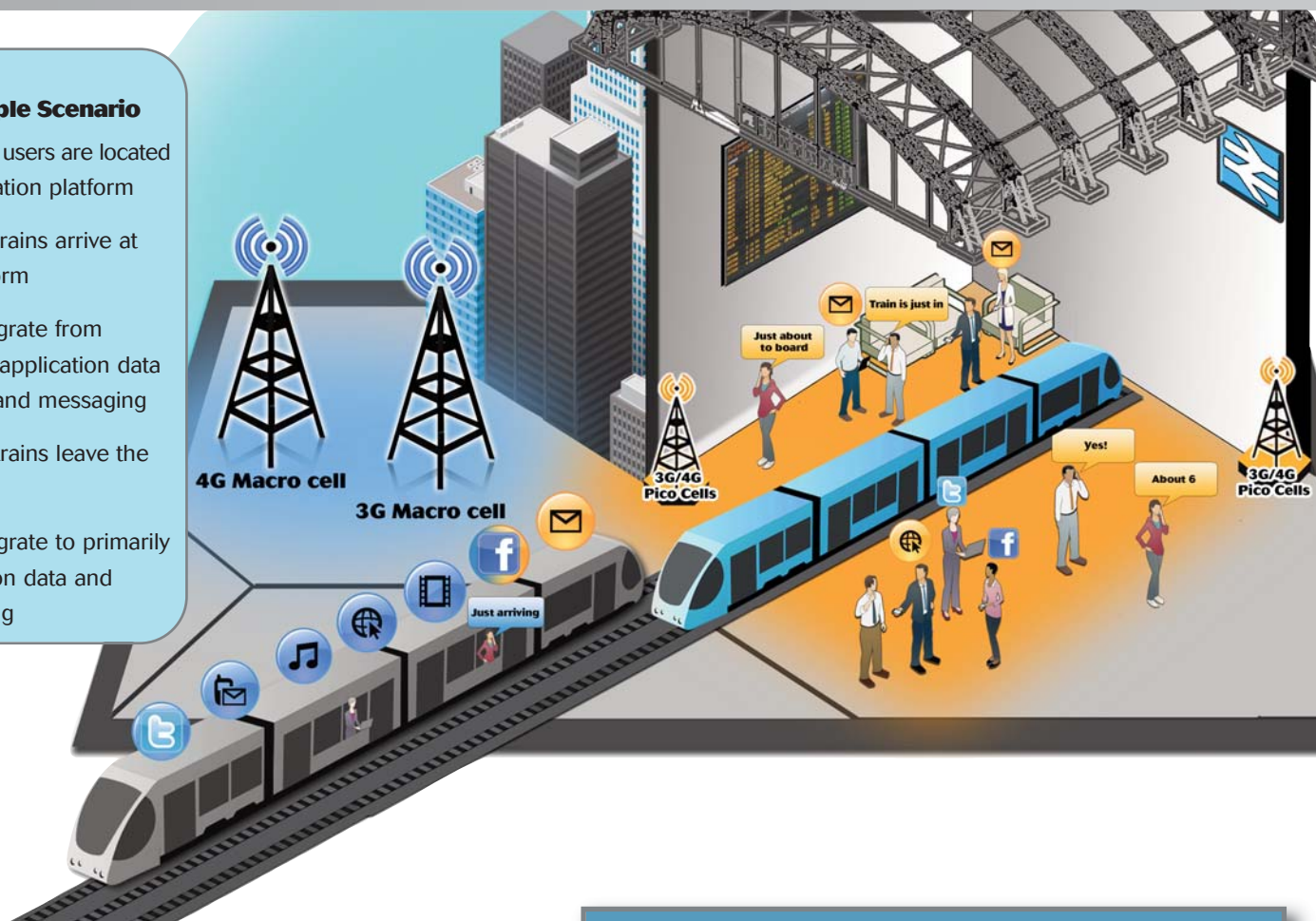
Radio Access Environment (2014+)

# Performance

## Real-life Scenarios

### The Example Scenario

1. Stationary users are located on the station platform
2. Multiple trains arrive at the platform
3. Users migrate from primarily application data to voice and messaging
4. Multiple trains leave the platform
5. Users migrate to primarily application data and messaging

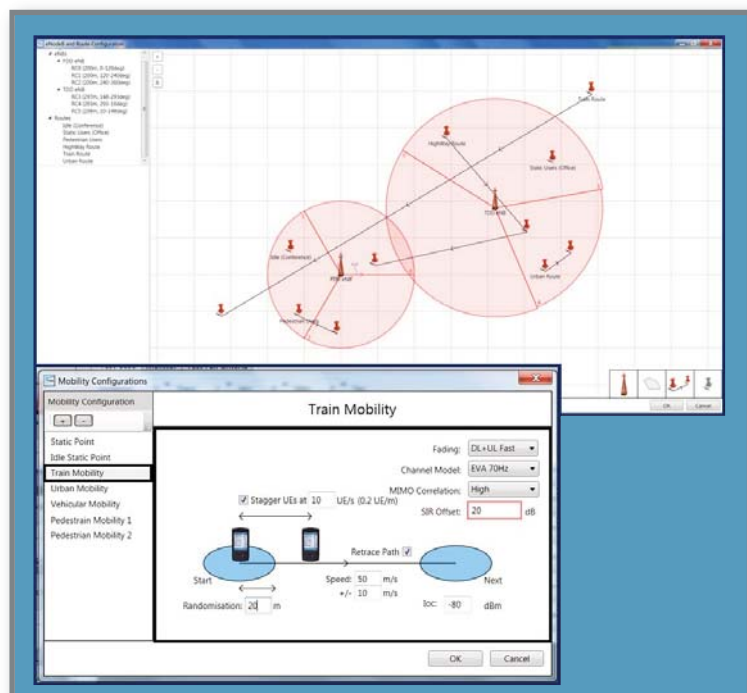


### What does the network need to manage?

- ▼ Handle signaling and data capacity bursts as train arrives
- ▼ Maintain QoS for application users on platform
- ▼ Manage the handover requests as the network load balances between macro and small cells located on the platform
- ▼ Maintain good quality for voice (VoLTE) users

### How do you measure your network performance?

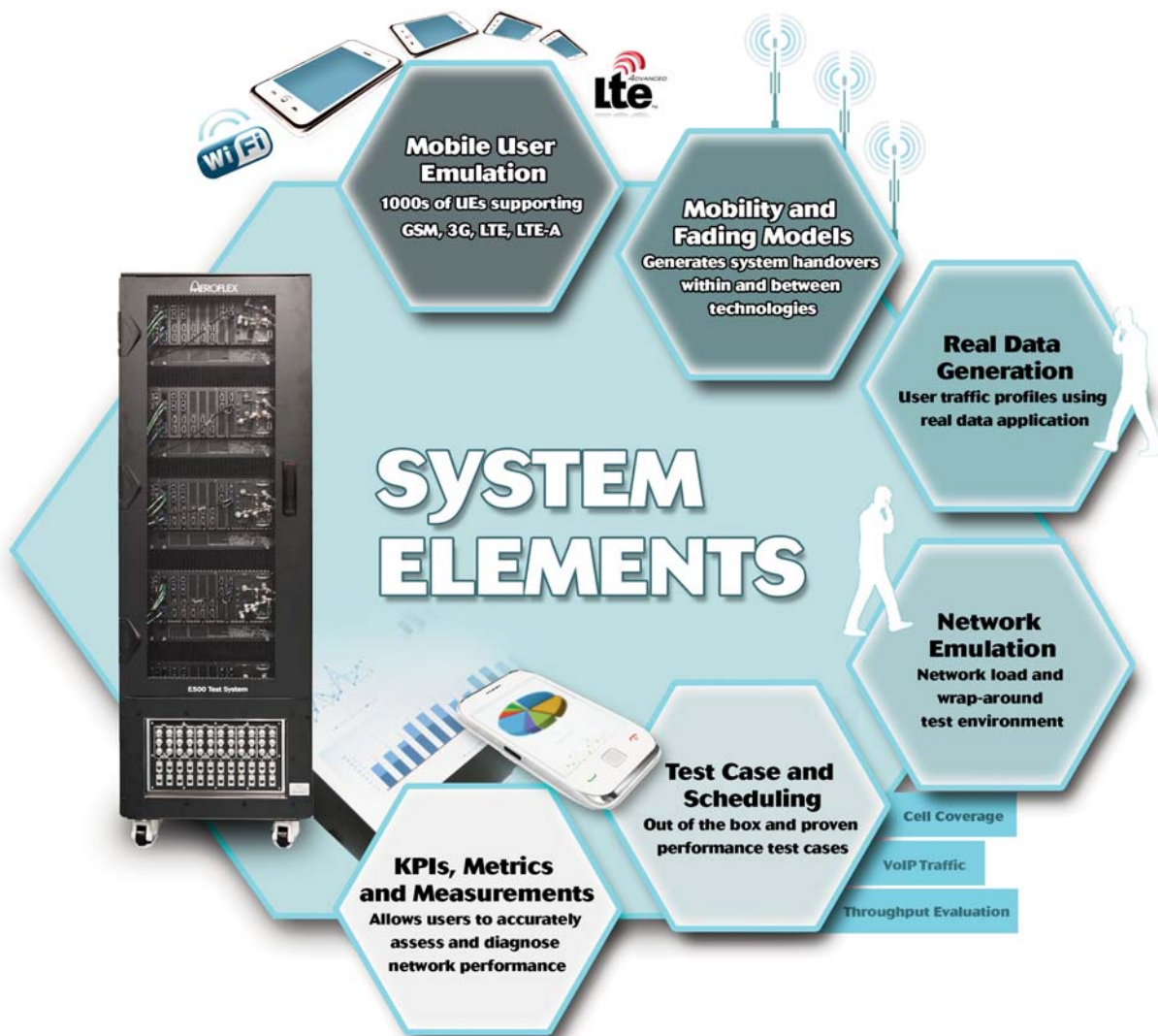
- ▼ Call statistics (dropped, attach attempts, rejects)
- ▼ Handover statistics (attempts/failures/successes)
- ▼ Voice statistics and quality (MOS),
- ▼ Application and data QoS statistics



# The Solution

The Aeroflex E500 is a powerful and easy to use network performance test system based upon the TM500; the industry standard test mobile for advanced network function and feature validation.

The system is fully scalable, connecting to tens of base station sectors, emulating thousands of mobile devices and modeling real RF channel conditions. Each mobile can support multiple cellular technologies (2G, 3G, 4G), and using advanced mobility models can create inter and intra technology handover scenarios.



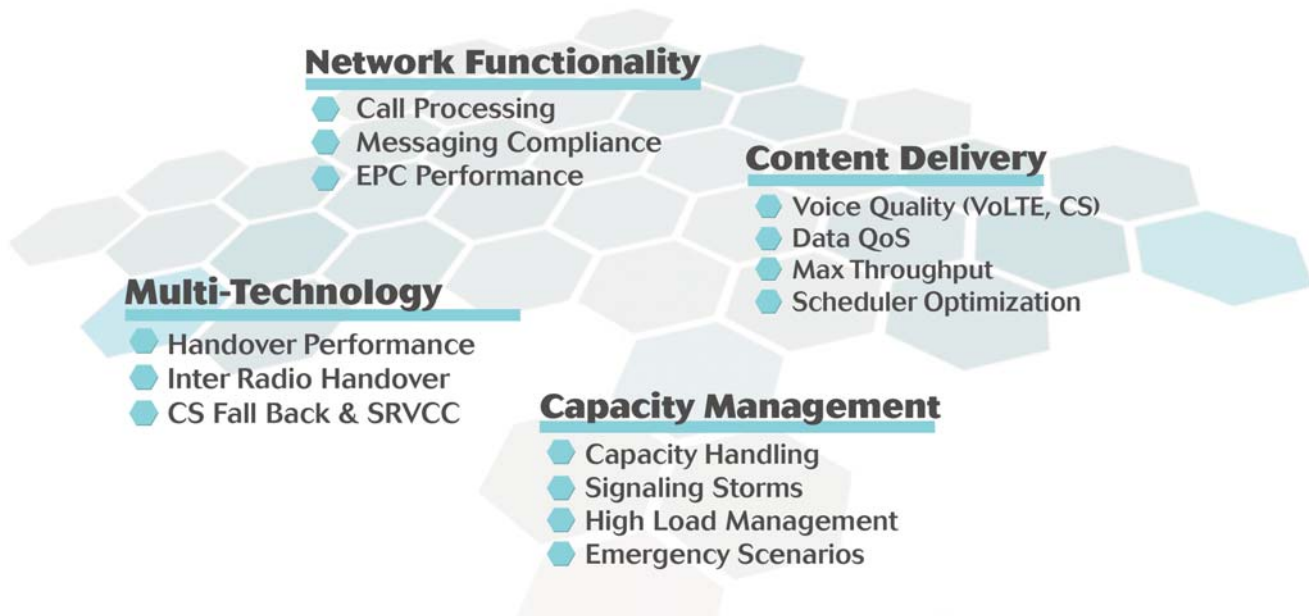
Real world user data applications can be generated for each mobile allowing true 'end-to-end' IP performance analysis. Repeatable test scenarios can be scheduled to produce a comprehensive set of system measurements and KPIs, allowing the user to assess network performance at a protocol, application or system level.

# Performance

## The Solution

### Test Scenarios

Aeroflex provides a set of core test cases which the user can use to assess the performance of network features (e.g. VoLTE, Mobility Management) within a loaded network environment.



Each test case has been validated in collaboration with major network infrastructure vendors. Users can modify key parameters of the test case to suit their test requirements and assign pass/fail criteria against the system metrics. Aeroflex can also design test cases to a customer's exact specification through its global market solutions team.

### User Operation

The design, scheduling and analysis of complex test cases is made easy via an intuitive graphical user interface. Test scenarios managing thousands of mobiles having individual mobility and data applications profiles can quickly be created and executed within a drag-and-drop environment. Upon test completion, measurements and KPIs can be viewed or exported to third party tools for post processing and advanced analysis.

Aeroflex also provides remote control interface operation so that the tool can easily be integrated as part of a test automation environment.



## Real Data Services

The E500 supports multiple real stateful data applications enabling true end-to-end data generation and analysis per emulated mobile device. Test cases can easily be configured for thousands of application data flows and allocated to different mobile device groups with different traffic profiles.

Example list of real data services:

Usage	Application protocols
Web access and browsing	HTTP
File transfer	FTP, P2P
VoLTE/VoIP	SIP, RTP
Email access	POP3, SMTP
Video streaming/OTT	RTSP

## Performance KPIs and Statistics

To enable complete performance analysis, the E500 produces a comprehensive set of measurement logs, KPIs and protocol metrics during and after each test case run.

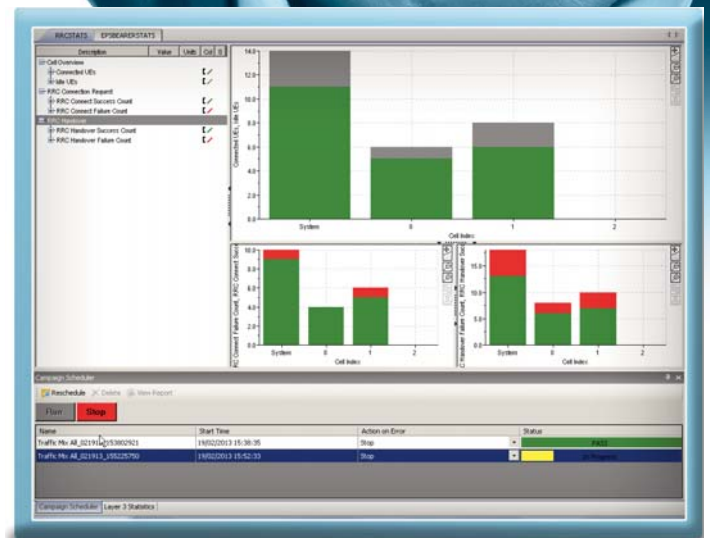
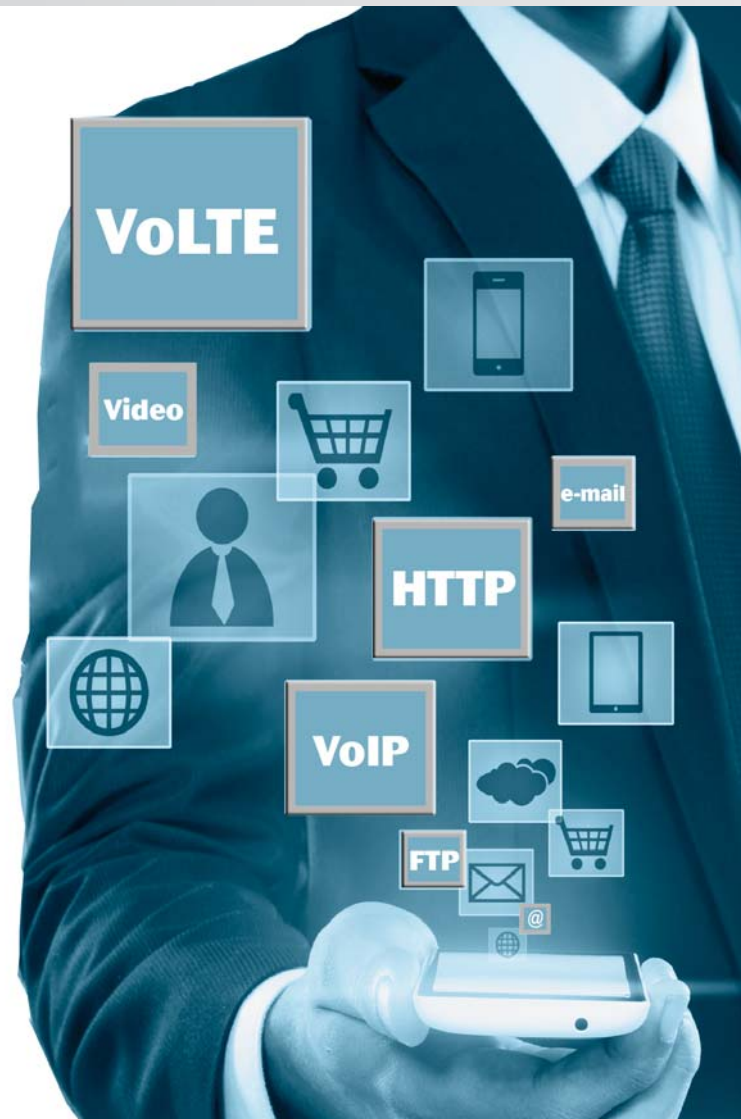
Examples of metrics:

### Data Applications Metrics

- ▼ Throughput per bearer, packet loss, latency and jitter
- ▼ TCP statistics e.g. FTP and HTTP
- ▼ RTSP streaming statistics
- ▼ Voice MOS

### Call and Mobility Metrics

- ▼ Attach and connection statistics (successes, failures, re-tries, delay)
- ▼ Call Attempts Per Second (CAPS)
- ▼ Handover attempts, successes and failures
- ▼ Handover rate per second



# Why choose Aeroflex?

Aeroflex test mobiles are regarded as the industry standard for functional and system testing of cellular networks. This drives market-leading technical performance and roadmap deliveries, positioning Aeroflex test engineers at the forefront of network performance testing technology and development.

Our post-sales support helps our customers to consistently deliver projects reliably and on time. Aeroflex has a global team of highly experienced application engineers that understand not just our products but also the challenges that engineers face in their day-to-day jobs. Whether we are providing support online, by phone or in person, the customer's project deadlines and priorities are paramount.

Our highly customer-focused support is one of our key differentiators, and is one of the reasons why so many of our customers trust Aeroflex to supply test systems for major projects and why so many have continued to work with Aeroflex over many years.



## Global Support

- ▼ Experienced E500 applications engineering team
- ▼ System commissioning and training
- ▼ Technical support
- ▼ Regular software updates
- ▼ Hardware servicing and repair

## Test Services

- ▼ On-site application support
- ▼ Test case design and implementation
- ▼ E500 system operations (resident engineer)
- ▼ System metrics and reports

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**AEROFLEX**  
A passion for performance.



Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.

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