

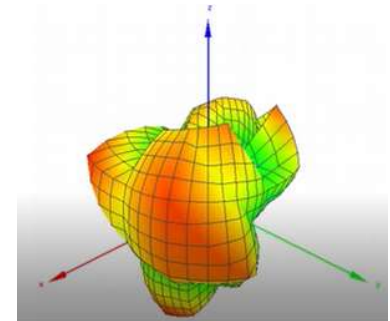
5G NR Challenges for OTA Testing

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Agenda

- What is OTA Testing?
- Challenges to OTA testing
- Near Field and Far Field Impact
- Solution Aspects to OTA Testing



What does OTA mean?

Over The Air : Below 6 GHz it means only performance

- The goal of OTA testing is to characterize the wireless performance of the devices with the help of clearly defined test methodologies and performance matrices.
- Antenna radiation pattern ,TRP ,TRS , MIMO ..but also RSE
- Complements conducted measurements instead of performing redundant tests
- Reduce the need for field testing to allow operators to introduce better devices to the market faster.



Above 6 GHz it means ... **Everything**

Why there will no longer be an Antenna Connector ??

At 26 GHz Propagation loss is so much ,How do we maintain link budget

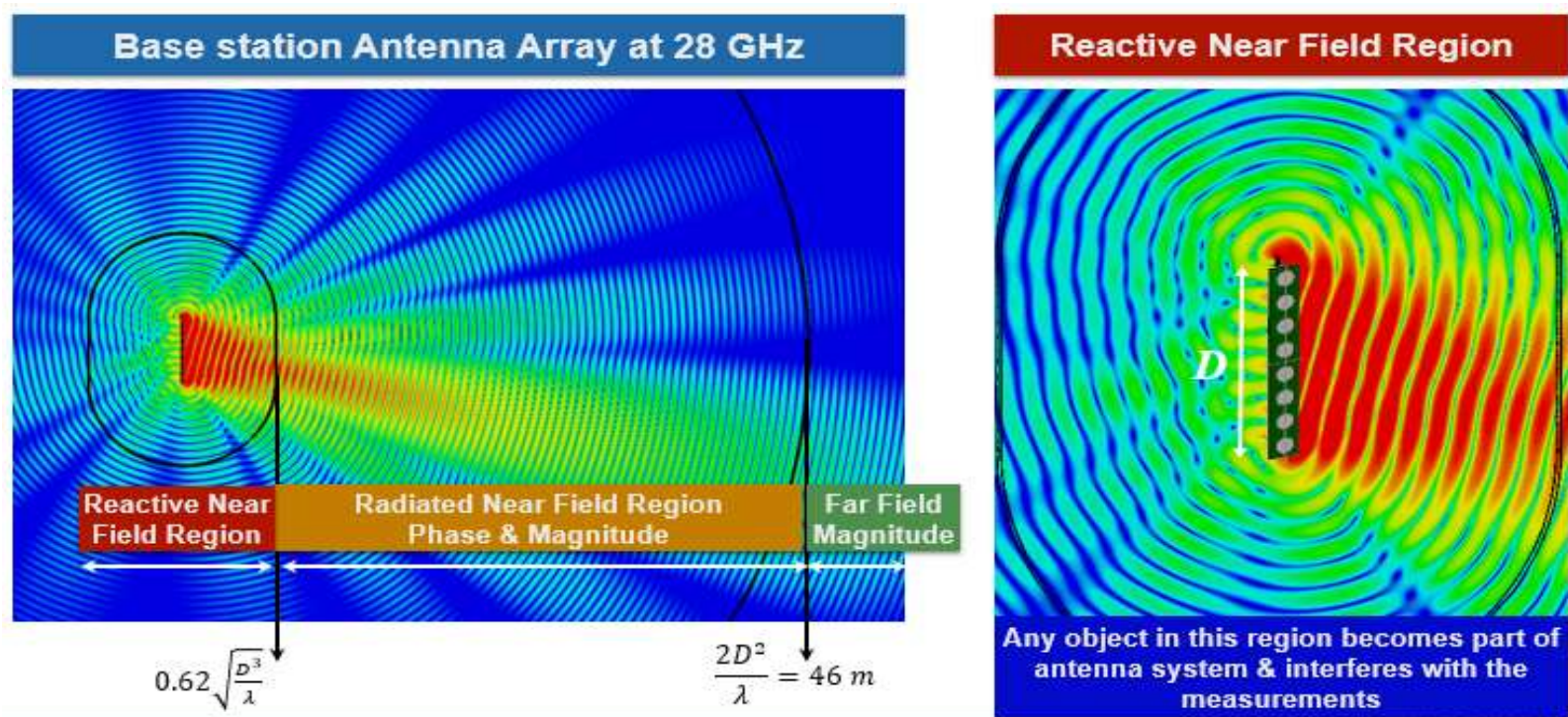
- Example – At 900 MHz Free Space Path loss over 1 km is 91 dB
- At 26 GHz Free Space Pathloss increases to 121 dB, so how do we get this 30 dB ?

Electrically steered Beamforming is the only Answer .

This leads to concept of an Antenna Connector being impractical

Near Field and Far Field

The electromagnetic fields surrounding an antenna are divided into 3 main regions:



Near Field and Far Field contd...

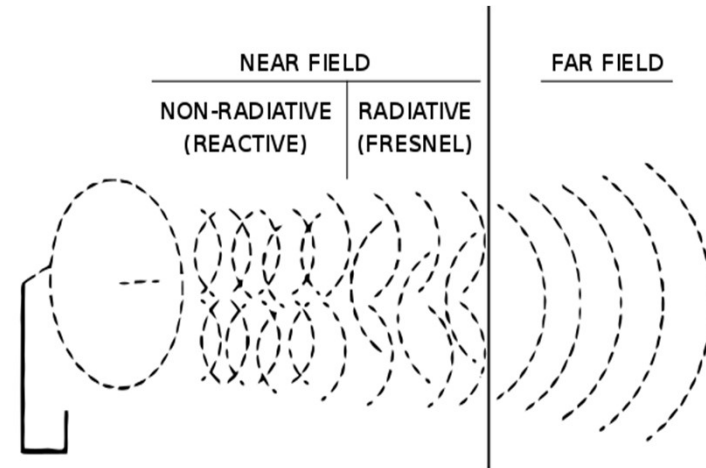
❖ The NF is divided in reactive region and radiative region.

- **Reactive**

This is given by electromagnetic coupling and is typically only few centimeters range. Not part for the OTA discussion as too short

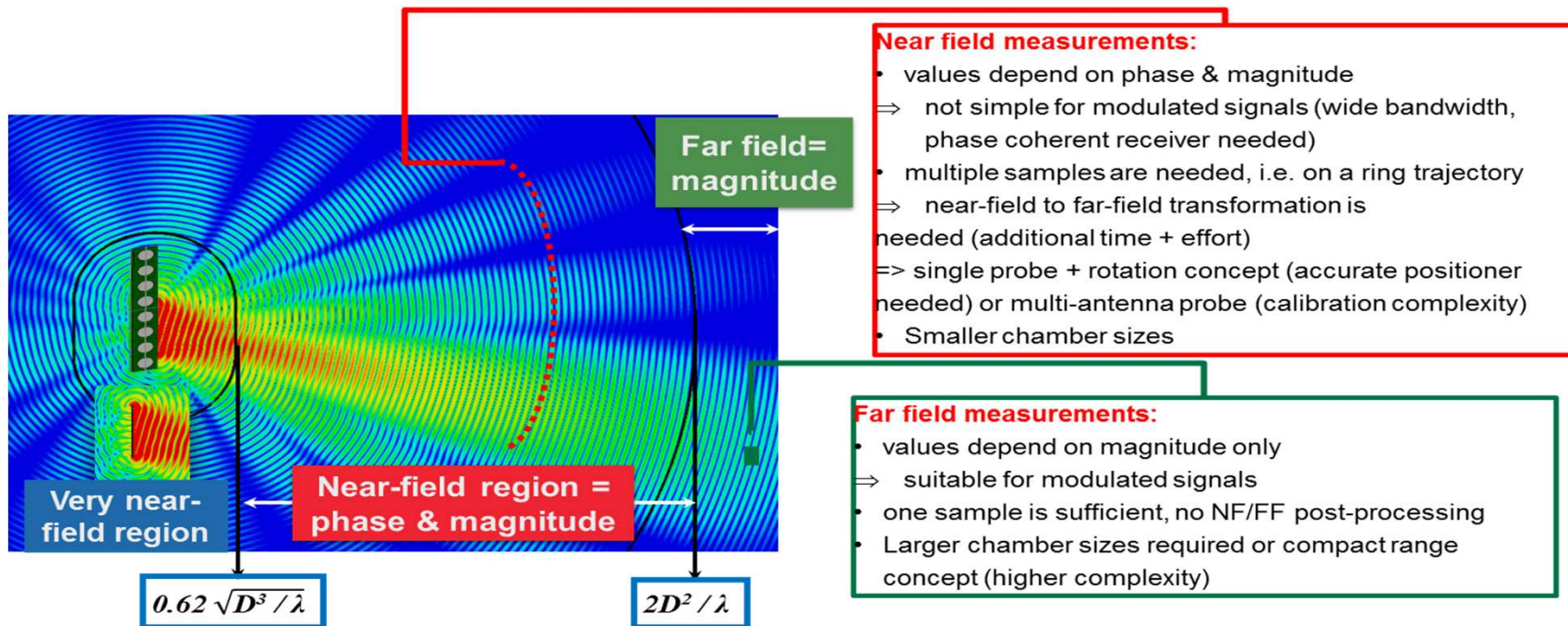
- **Radiative**

The wave is not yet fully formed and it is dominated by multipole type fields. It is very difficult to predict the relation between E and H and it is not possible to measure parameters which are direction-dependent.



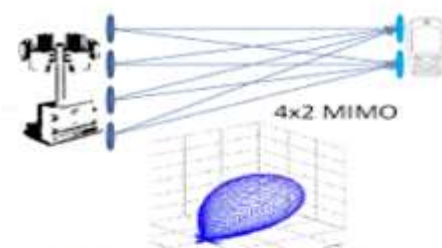
❖ In the FF, the electromagnetic wave is already well formed and it has electric dipole characteristics. The signal power decreased as the square of the distance.

Near Field and Far Field contd..



Market Need for OTA Test

- ❖ With wireless radios dropping in cost, wireless interfaces are now incorporated into a variety of consumer products including phones, cameras, games, PCs, APs, base stations etc.
- ❖ OTA testing is starting to displace traditional conducted testing because
 - Low cost consumer devices typically have integrated antennas that are impractical to access and remove for testing.
 - New generation MIMO and beamforming devices have antennas that play an integral role in device performance



MIMO and beamforming
require OTA testing...



Bluetooth
Wi-Fi
CDMA
WCDMA/HSPA
GSM
LTE

... and so do multi-radio
smartphones that typically lack
antenna connectors

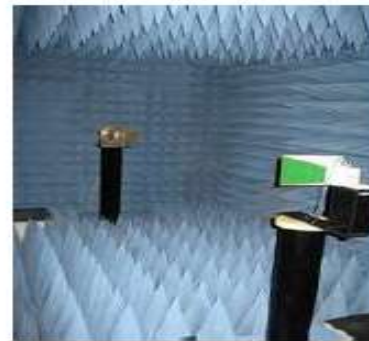
Measurement Chambers Types

Reverberation vs. Anechoic Chamber



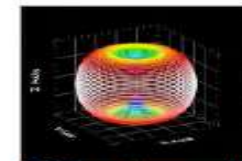
Reverberation chamber

- Reflective metal walls
- Metal 'stirers' scatter energy which enters the antennas uniformly from all directions
- Impossible to discern the shape of the field pattern, but total energy can be measured

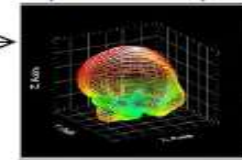


Anechoic chamber

- Absorptive walls minimize standing waves that cause signal fluctuation
- Far-field conditions ensure predictable power vs. distance
- 3D field pattern measurements done using DUT rotation

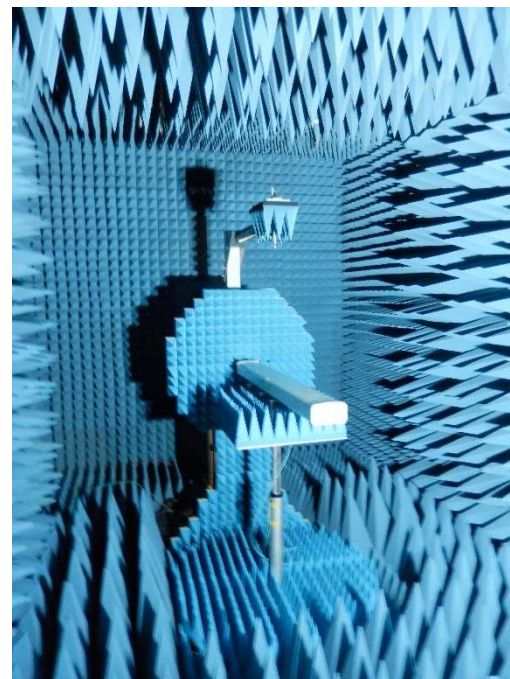
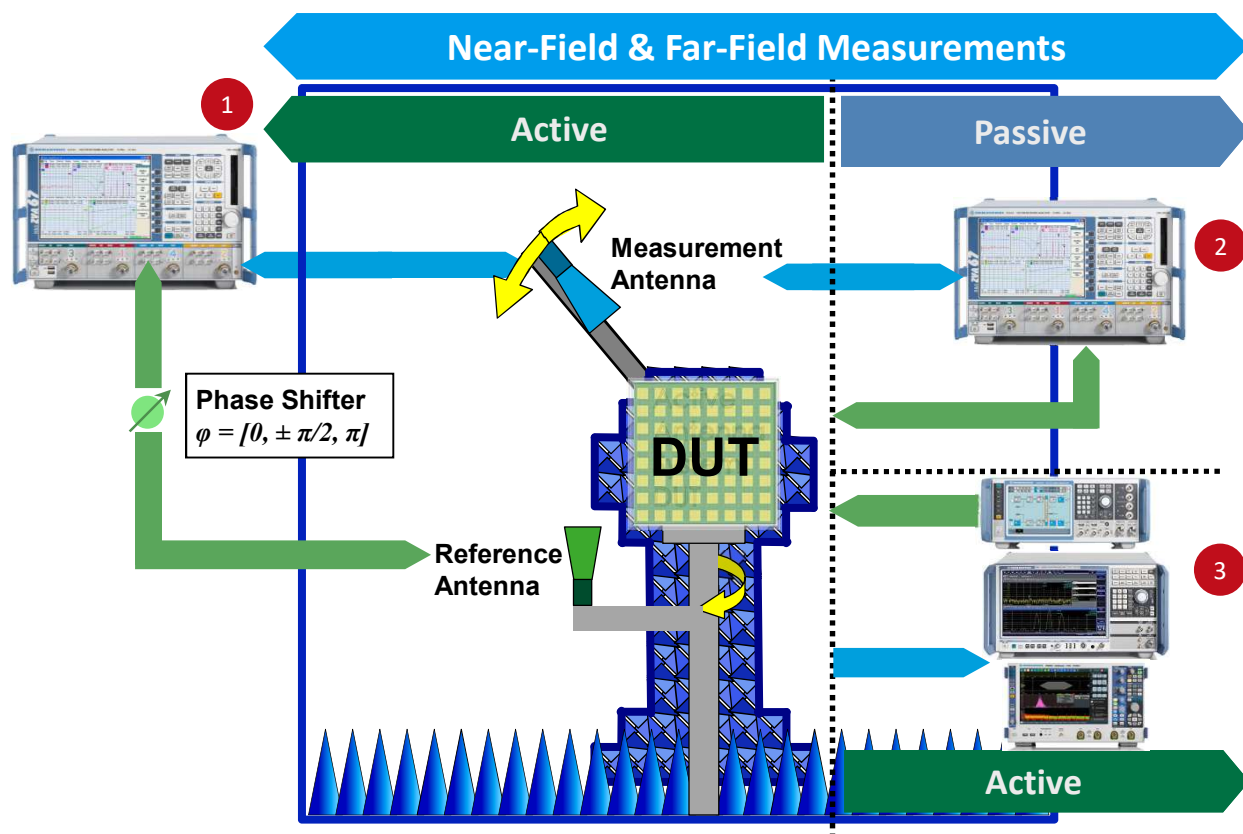


Dipole antenna pattern

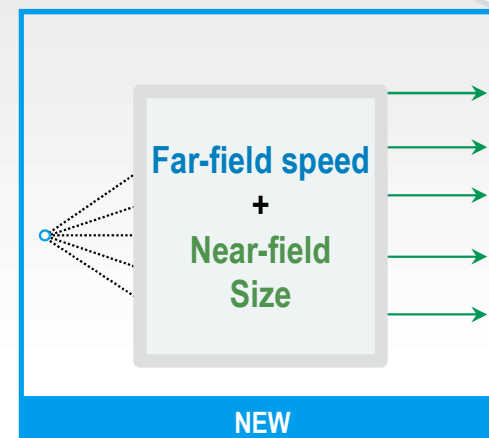
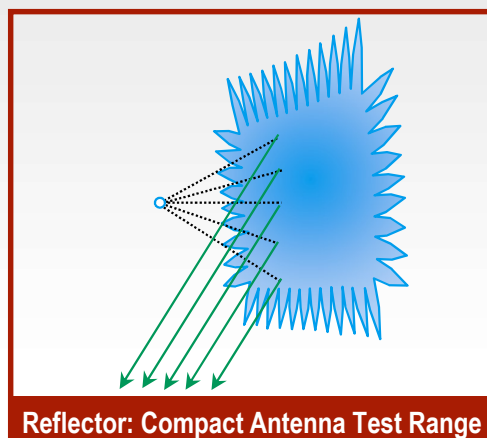
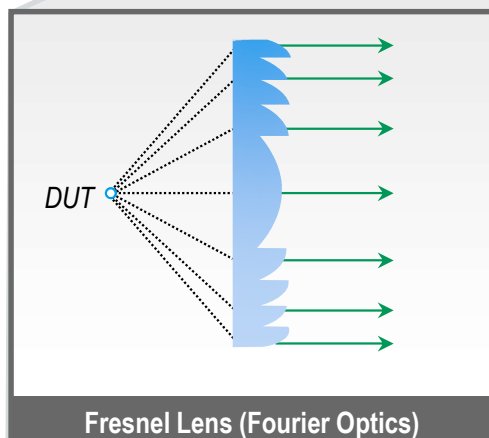
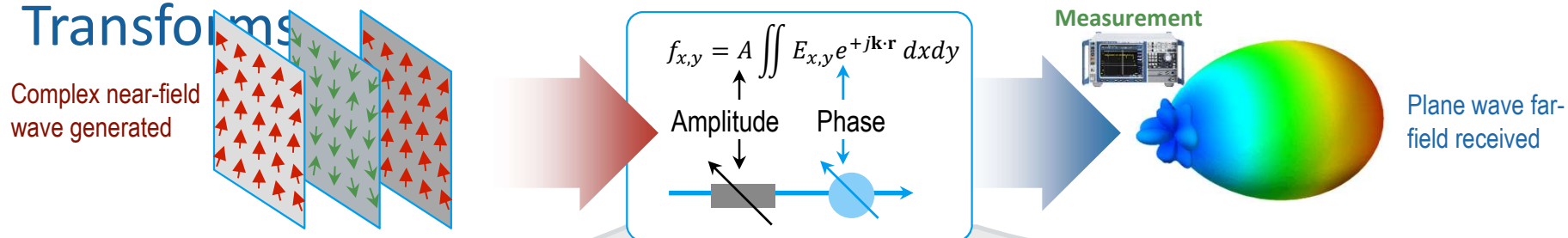


Typical pattern against a phantom head

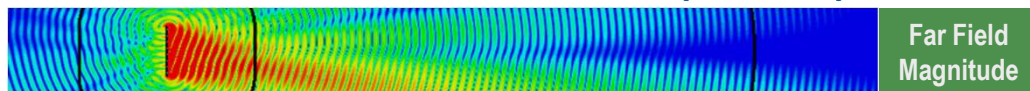
Spiral Scanner for Active & Passive Antenna Testing



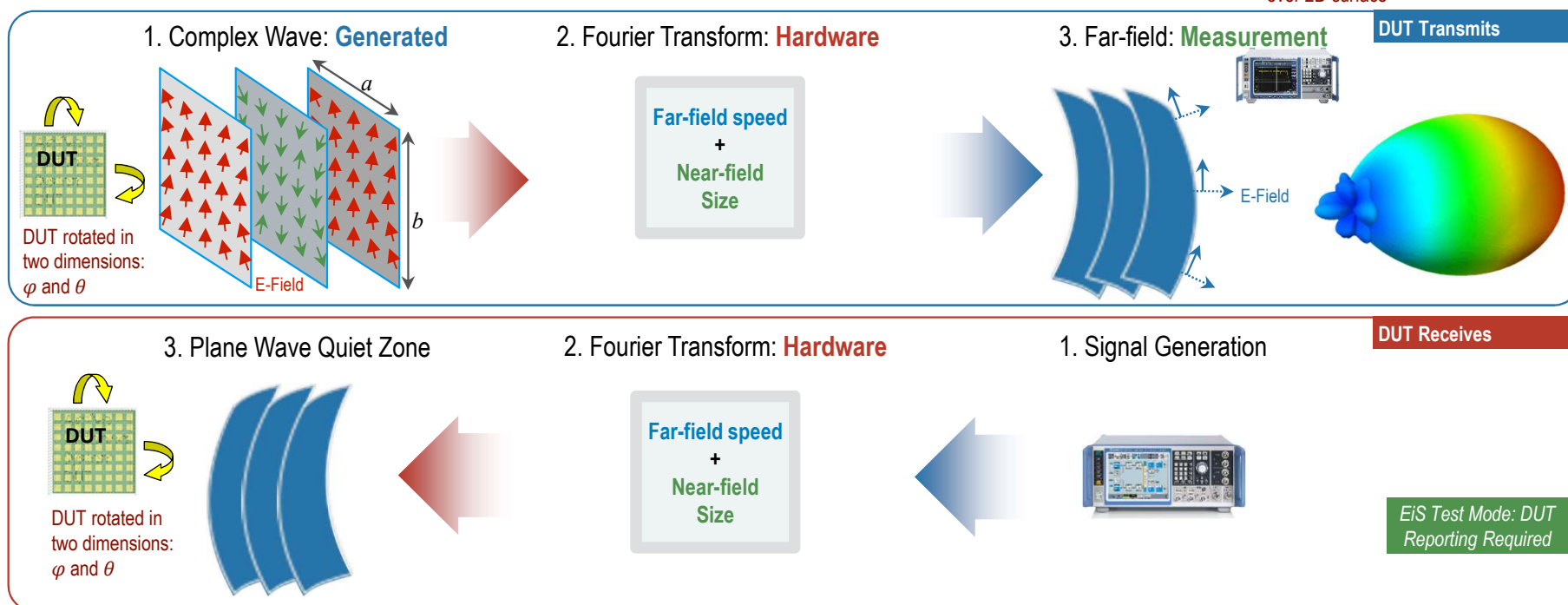
Far-field in Near-field Systems: Hardware Fourier Transforms

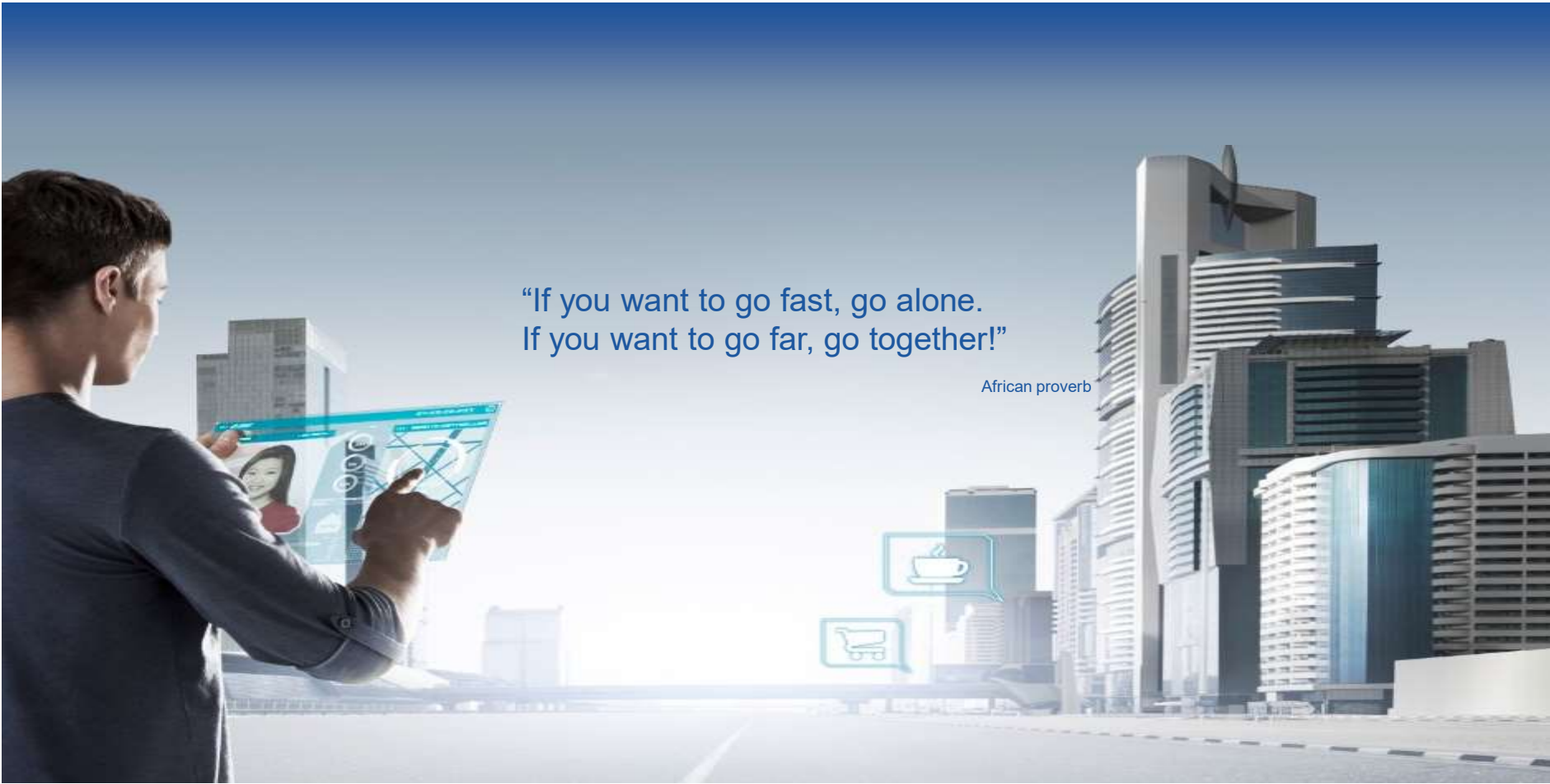


Plane Wave Converter (PWC) – Far Field Speed, Near Field



Far field E-field
measurements
over 2D surface





“If you want to go fast, go alone.
If you want to go far, go together!”

African proverb

Thank You

