



# An Update from the LTE/SAE Trial Initiative

**LTE World Summit  
Berlin, May 2009**

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Chairman LSTI Proof of Concept Group

[www.lstiforum.org](http://www.lstiforum.org)

# The LTE Business Ecosystem....

- **The environment**
  - A high performance, low cost-per-bit mobile broadband technology
- **The living organisms**
  - The companies and markets that thrive within this technology landscape...

**regulators** **investors**  
**Consumers** **infrastructure**  
**test equipment** **operators** **Application developers**  
**industry bodies** **chipsets** **terminals**

**...all the stakeholders**

# **The Need to Nurture**

**In the early days,  
players need to co-operate  
to establish a healthy  
ecosystem**





39 members helping to establish a healthy ecosystem

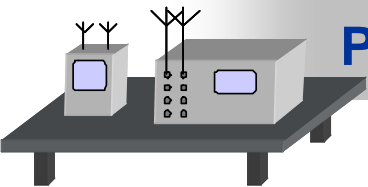
## **LSTI's Objectives:**

- **Stimulate early development of the LTE/SAE ecosystem**
- **Foster technology alignment across equipment vendors**
- **Demonstrate LTE/SAE capabilities against industry requirements**

**Take LTE/SAE from standards  
to commercial rollout**

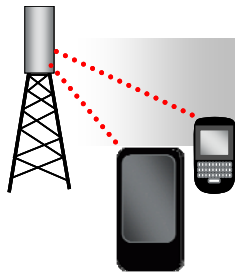
# LSTI Activities

## From Standardisation...



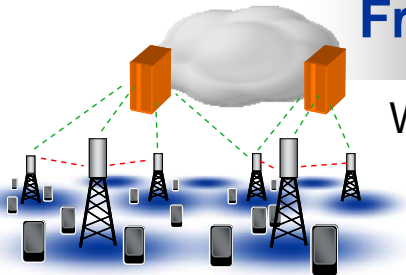
### Proof of Concept

Can the design be implemented? Are the performance targets achievable?



### Interoperability

Does everyone have the same interpretation of the standard?



### Friendly Customer Trials

What can it deliver in near commercial conditions?

...to **Commercial Rollout**



**T R I A L                      I N I T I A T I V E**  
LONG TERM EVOLUTION                      SYSTEM ARCHITECT EVOLUTION

## **Proof of Concept**

***What performance and functionality is achievable today with real equipment?***

# “Proving The Concept” of LTE/SAE

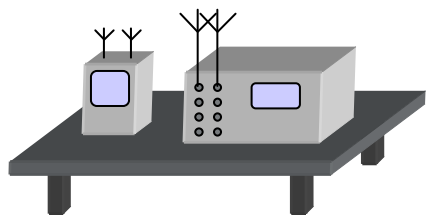
Lab tests



Multi User End-End



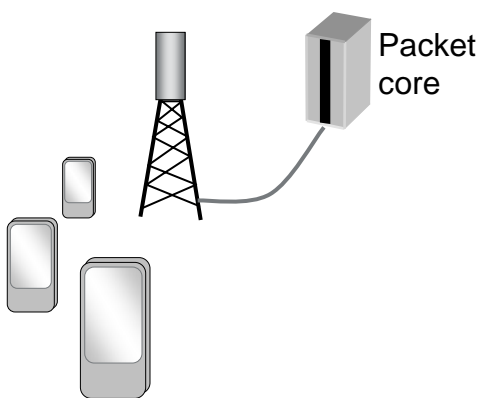
Multi Cell Live Air



Peak data rates

Vehicle speeds

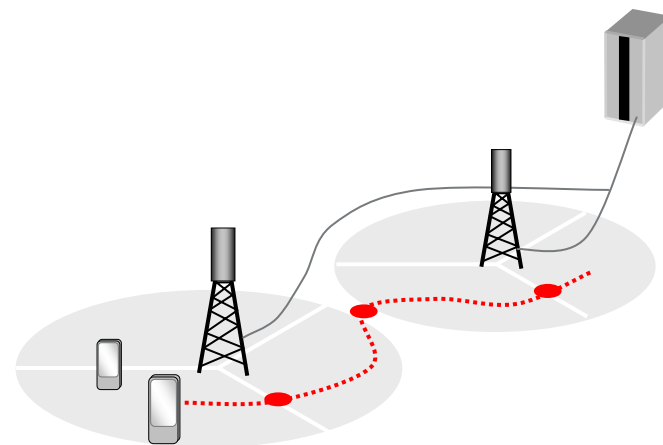
Radio latency



Multi user scheduling

Connection Setup time

End-End Latency



VoIP

Real world Data rates

MIMO gains

QoS

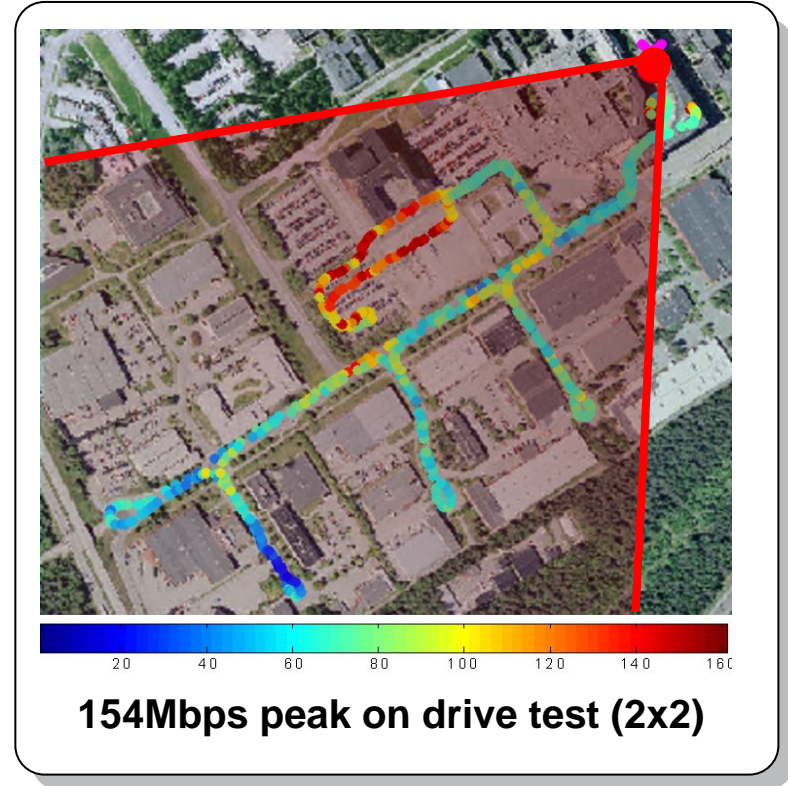
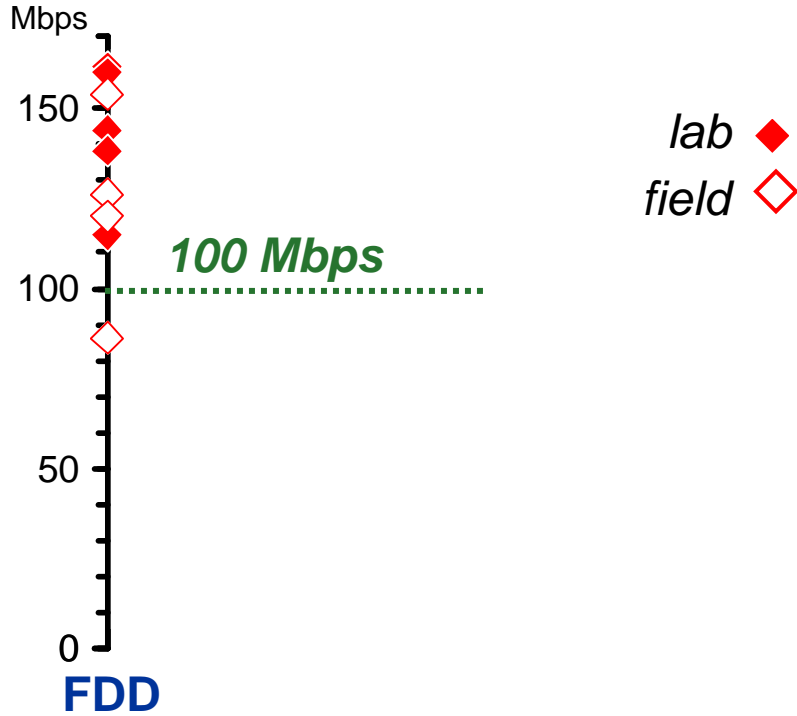
Handover

Early testing focused on fundamental performance in ideal conditions...

...later tests required end to end architecture and real world scenarios

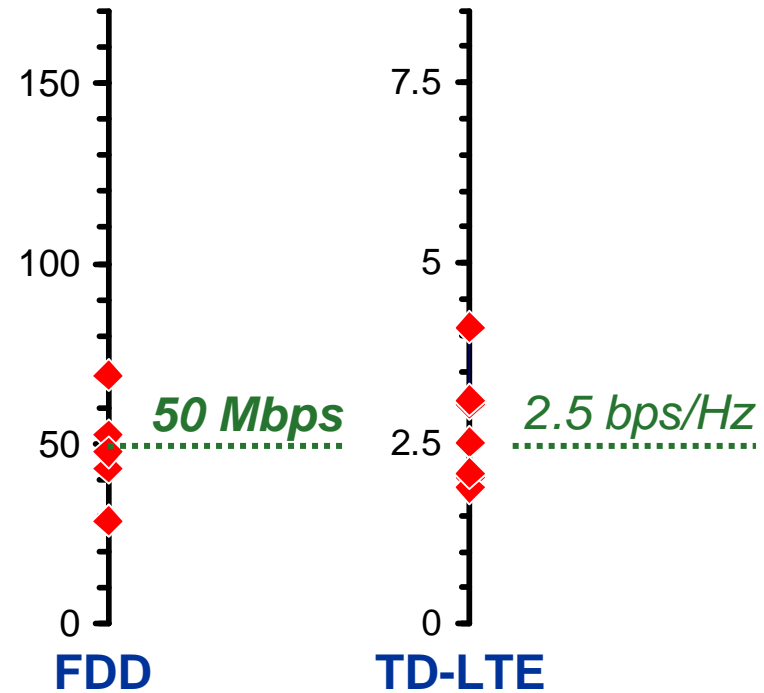
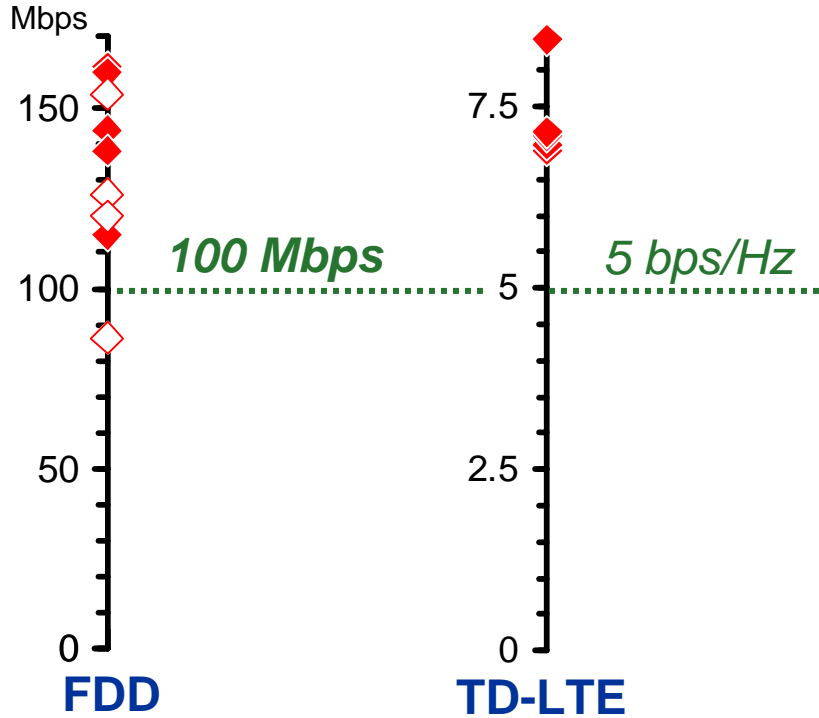


# Proof of Concept LTE Data Rates



Peak rates measured in the lab and field have been compiled....

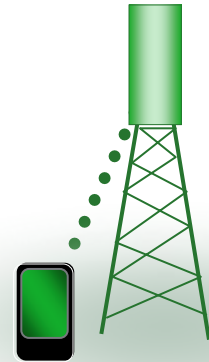
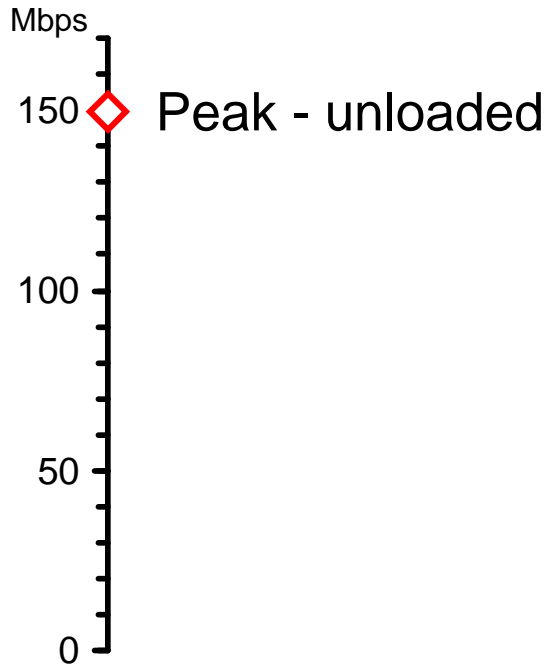
# Proof of Concept LTE Data Rates



**Early FDD and TD-LTE equipment can achieve targets for peak rates**

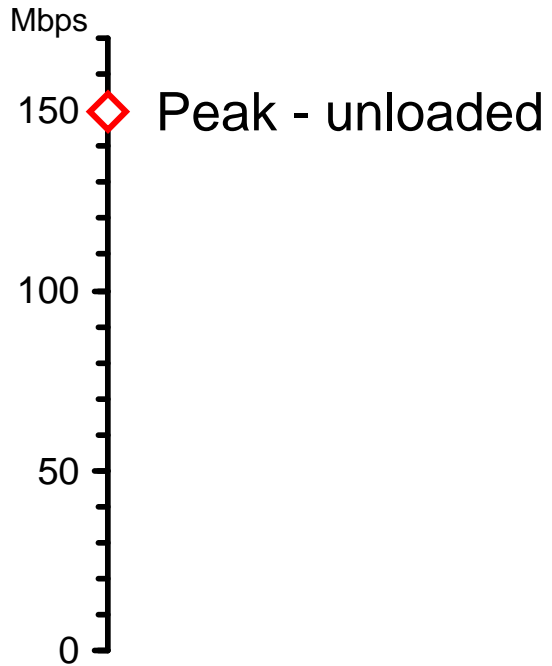


# Proof of Concept LTE Data Rates



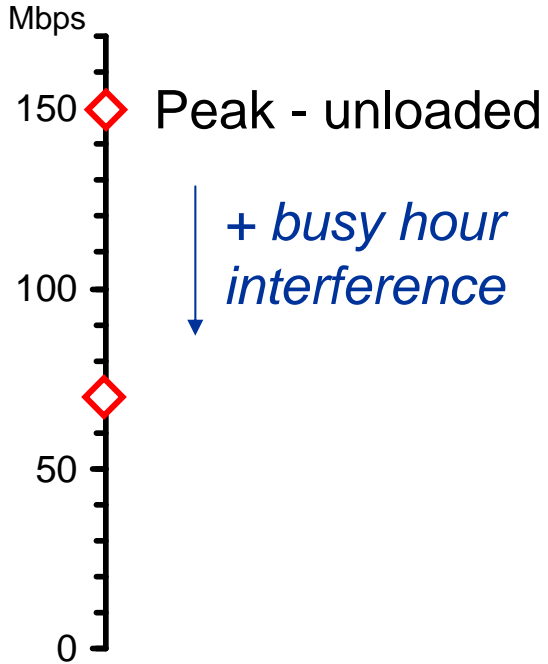
**Early FDD and TD-LTE equipment can achieve targets for peak rates**  
**...this is measured with one user with optimal signal conditions**

# Proof of Concept LTE Data Rates



**But in the real world....**

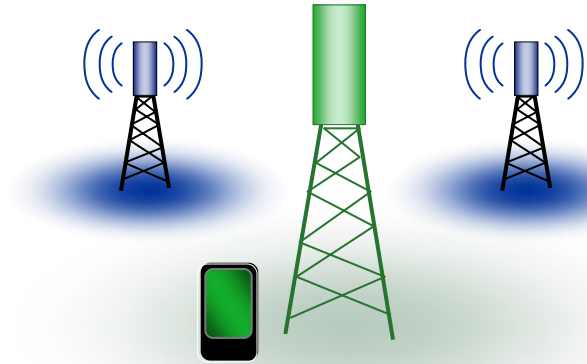
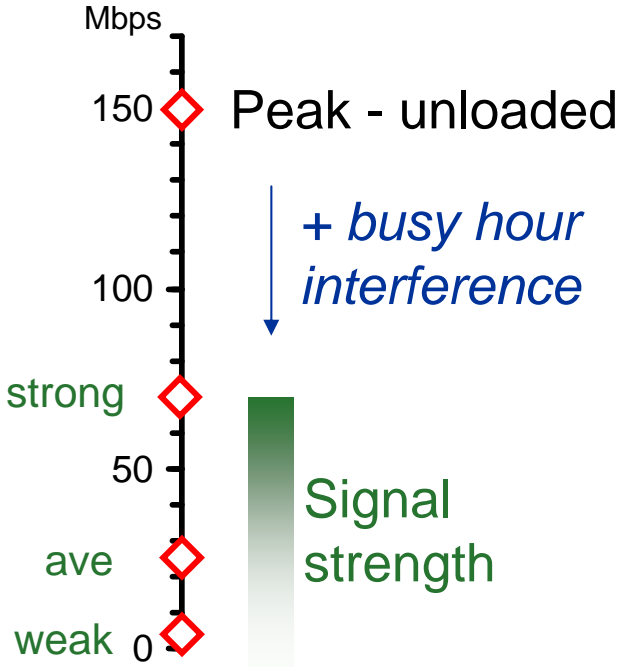
# Proof of Concept LTE Data Rates



But in the real world....

- 1) There may be interference from other cells

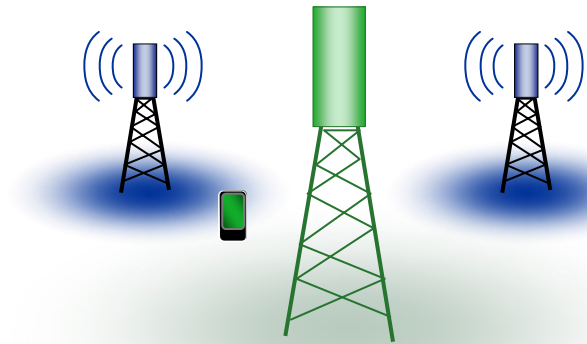
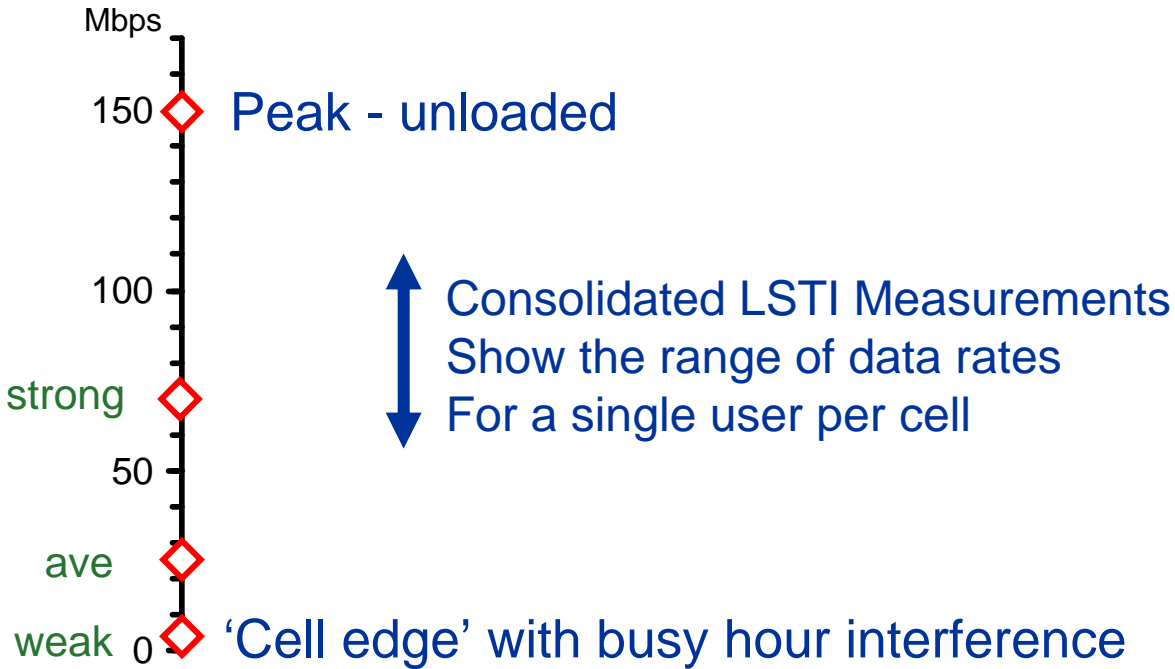
# Proof of Concept LTE Data Rates



But in the real world....

- 1) There may be interference from other cells
- 2) The user will not always be close to the base station

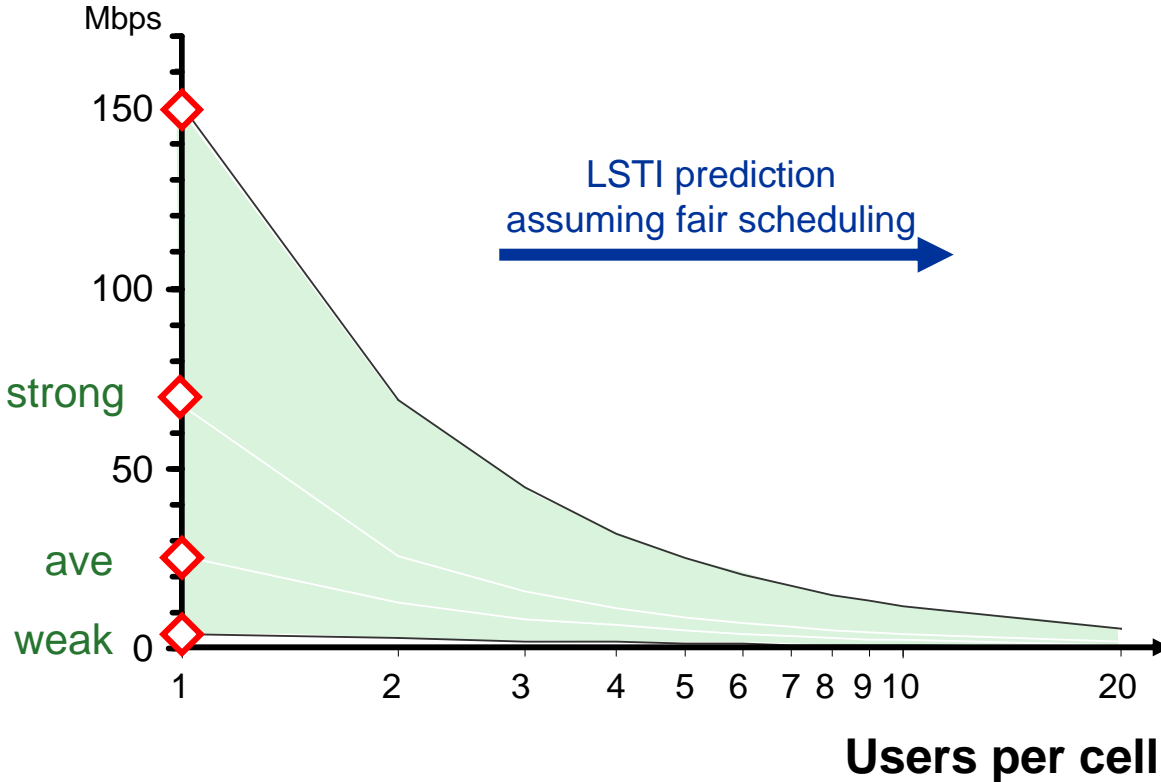
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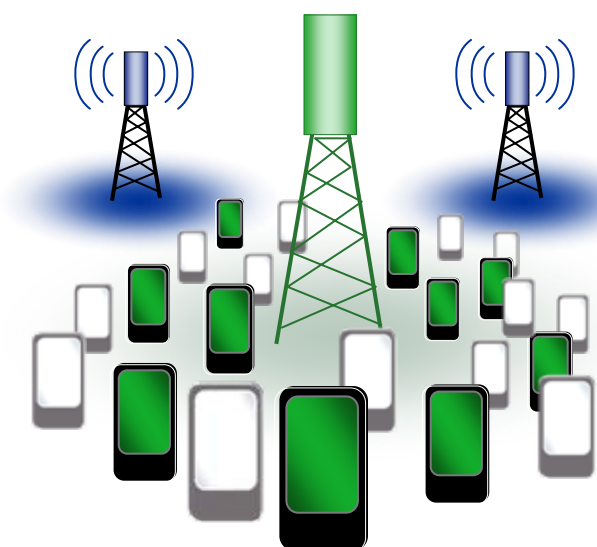
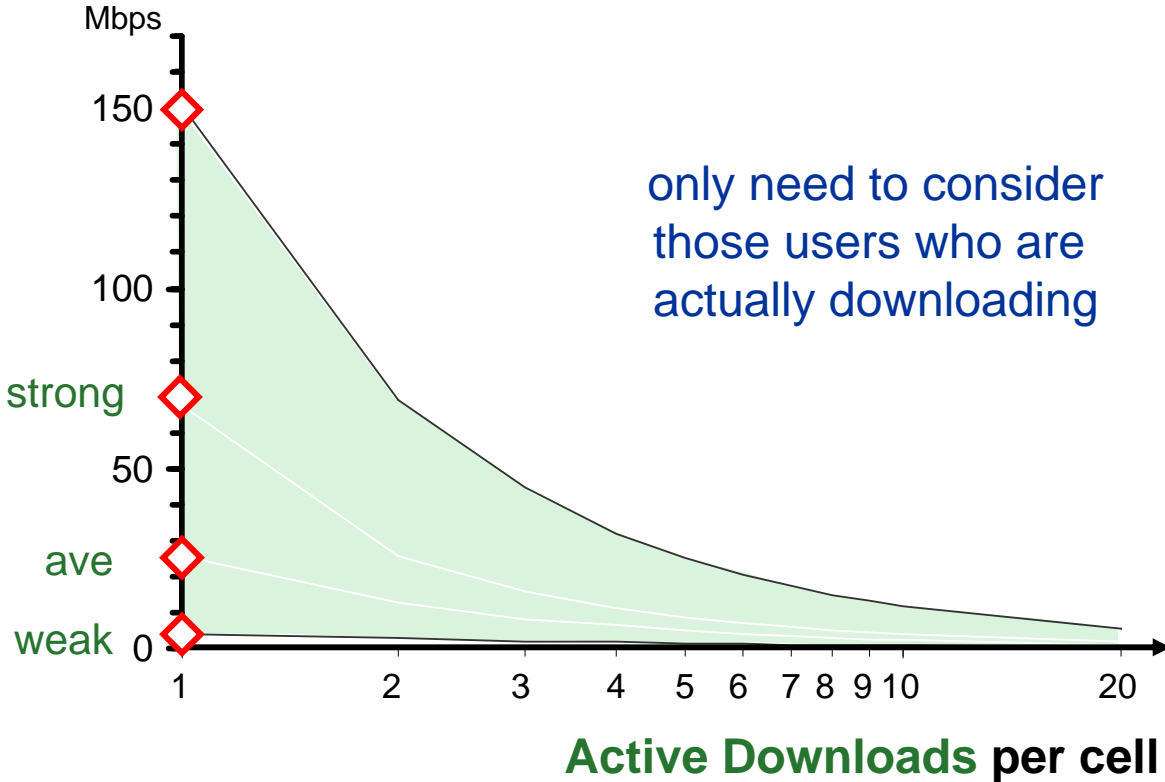


## But in the real world....

- 1) There may be interference from other cells
- 2) The user will not always be close to the base station
- 3) Cell throughput will be shared amongst several users



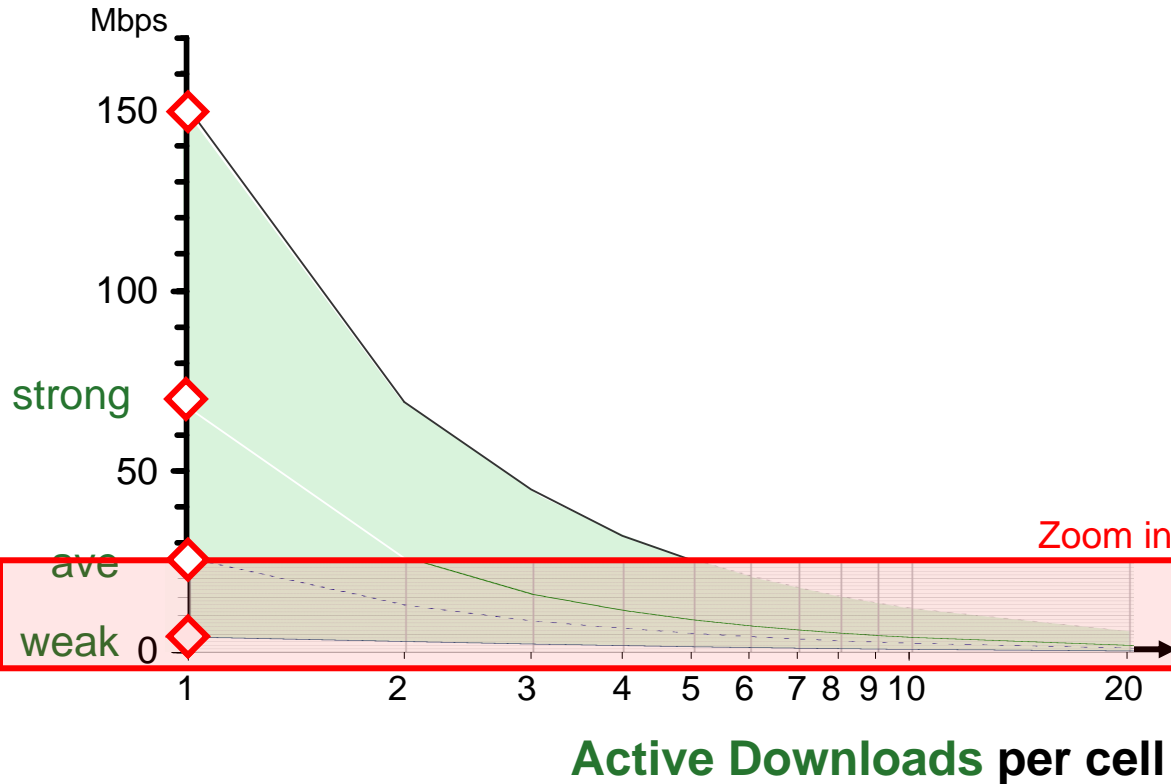
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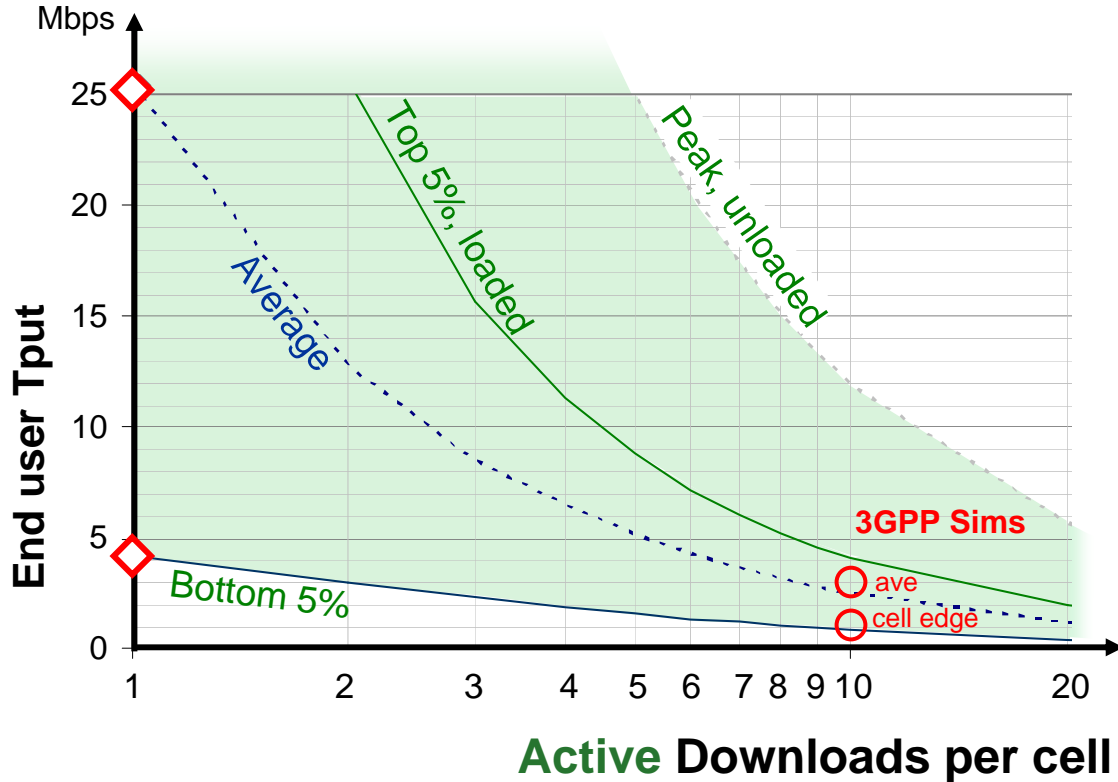
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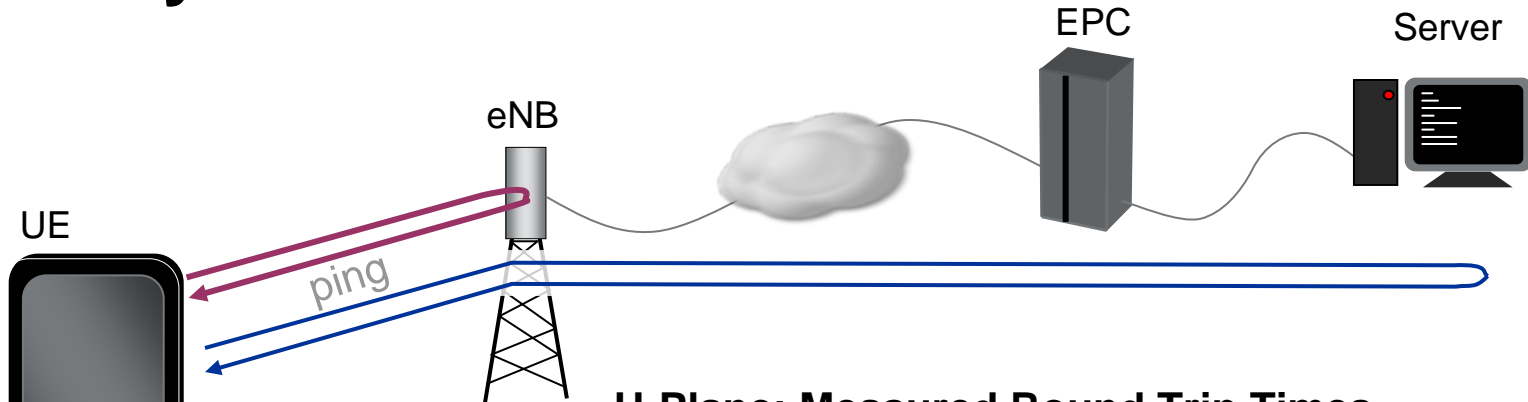
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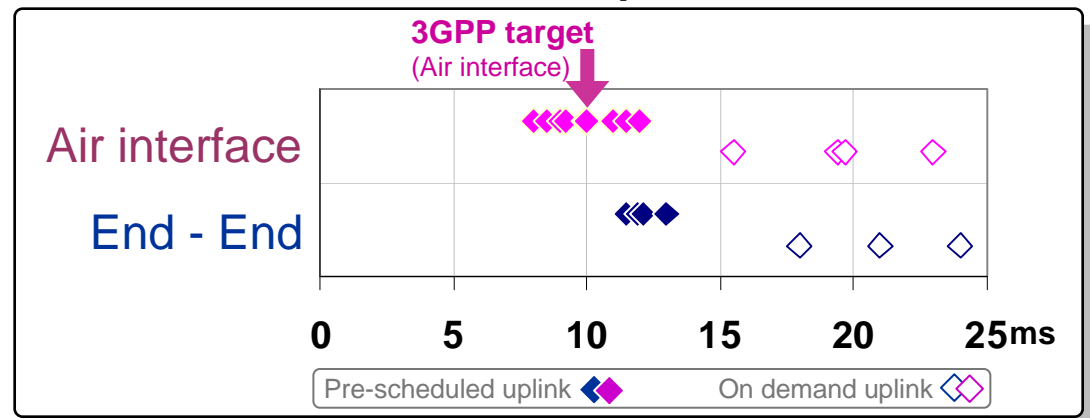
**Predicted end user Tputs from LSTI lab measurements align with 3GPP's Performance Verification for NGMN**

**Helps Operators understand what can be offered to consumers**

# Latency



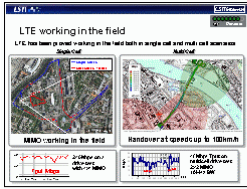
**U-Plane: Measured Round Trip Times**



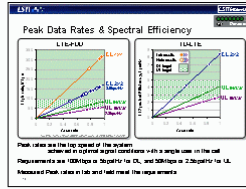
**Low latency is essential interactive services, like gaming and VoIP**  
**The air interface target of 10ms has been achieved for FDD and TDD**  
**'Real World' Latency is the end-end with an on-demand uplink**

# Proof of Concept Other Proof points

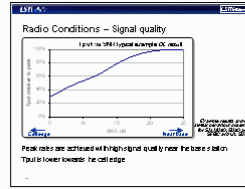
Live-Air  
LTE



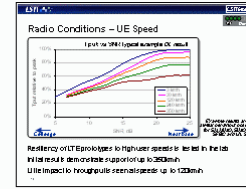
Peak data rates



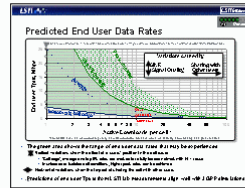
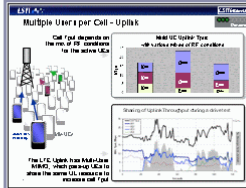
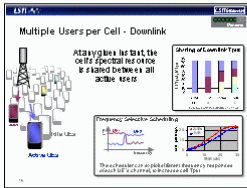
End user data rates



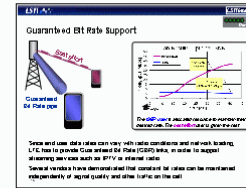
Vehicle  
speeds



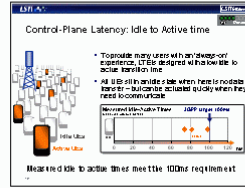
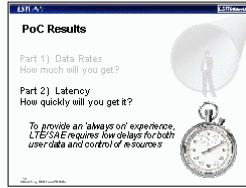
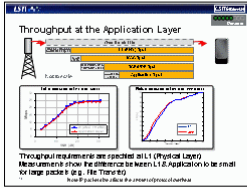
Multi user  
scheduling



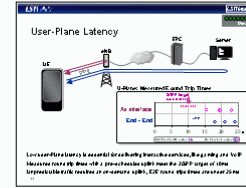
QoS



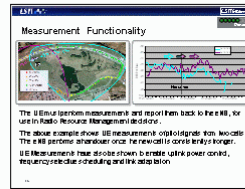
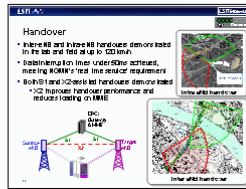
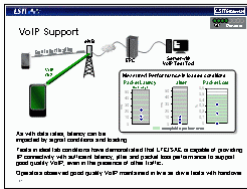
Protocol  
overheads



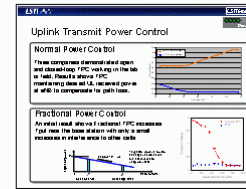
Radio  
latency



VoIP



Connection  
Setup time



Handover

Measurements

Power Control

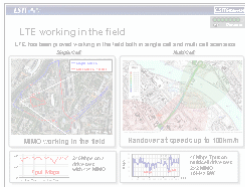
Over 80 sets of tests from 8 vendors consolidated into 16 proofpoints, demonstrating feasibility of key LTE/SAE functionality and performance

# Proof of Concept Other Proof points

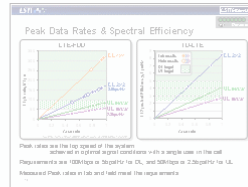
Peak data rates

End user data rates

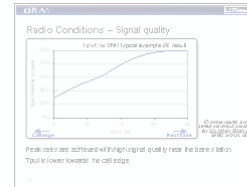
Live-Air  
LTE



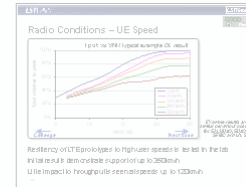
9



10



11



12

Vehicle  
speeds

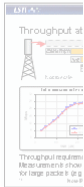
Multi user  
scheduling



## The full set of results is now downloadable from

QoS

Protocol  
overheads



[www.LSTIforum.com](http://www.LSTIforum.com)

Radio  
latency

VoIP



[http://www.lstiforum.org/file/news/Latest\\_LSTI\\_Results\\_Feb09\\_v1.pdf](http://www.lstiforum.org/file/news/Latest_LSTI_Results_Feb09_v1.pdf)

Connection  
Setup time

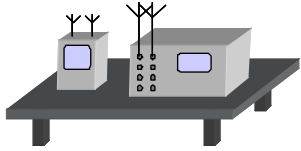
Handover

Measurements

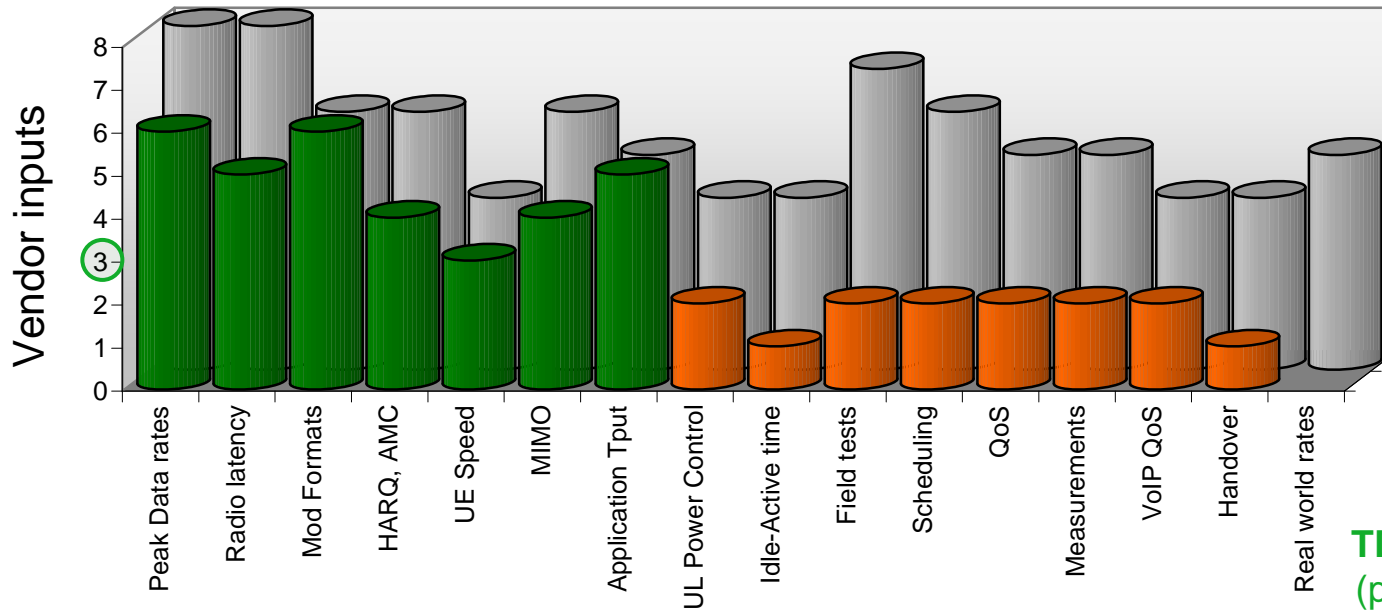
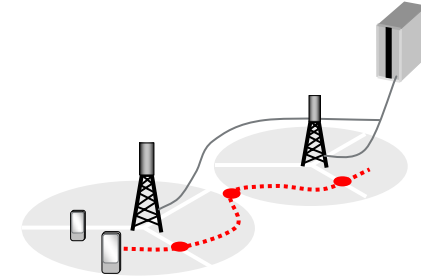
Power Control

Over 80 sets of tests from 8 vendors consolidated into 14 proofpoints, demonstrating feasibility of key LTE/SAE functionality and performance

# PoC Progress for FDD and TD-LTE



maturity



Key:



TD-LTE (proven) TD-LTE (preliminary)

- Similar number of vendors providing results from both FDD and TDD
- FDD completed Feb 09
- TD-LTE Physical layer aspects proven. Preliminary results for other areas.
- TD-LTE on target for completion mid 09



**T R I A L                      I N I T I A T I V E**  
LONG TERM EVOLUTION                      SYSTEM ARCHITECT EVOLUTION

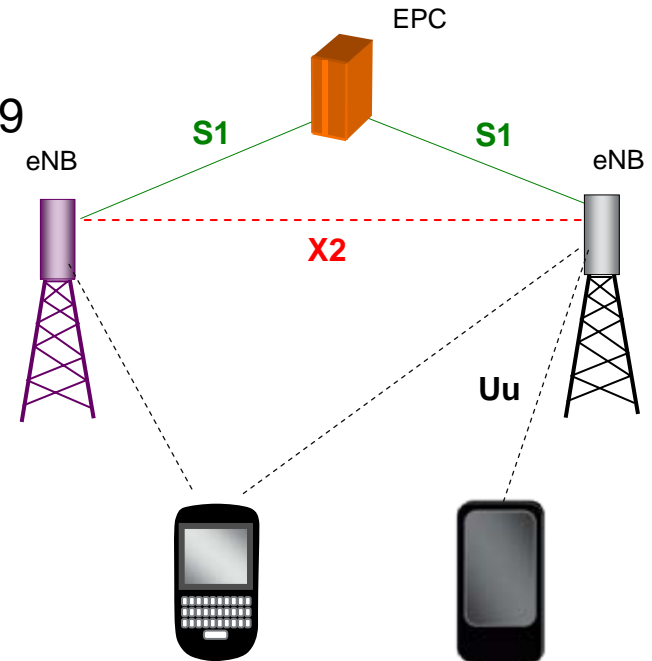
## Inter-Operability Testing

*What is being done to make sure that equipment works together?*

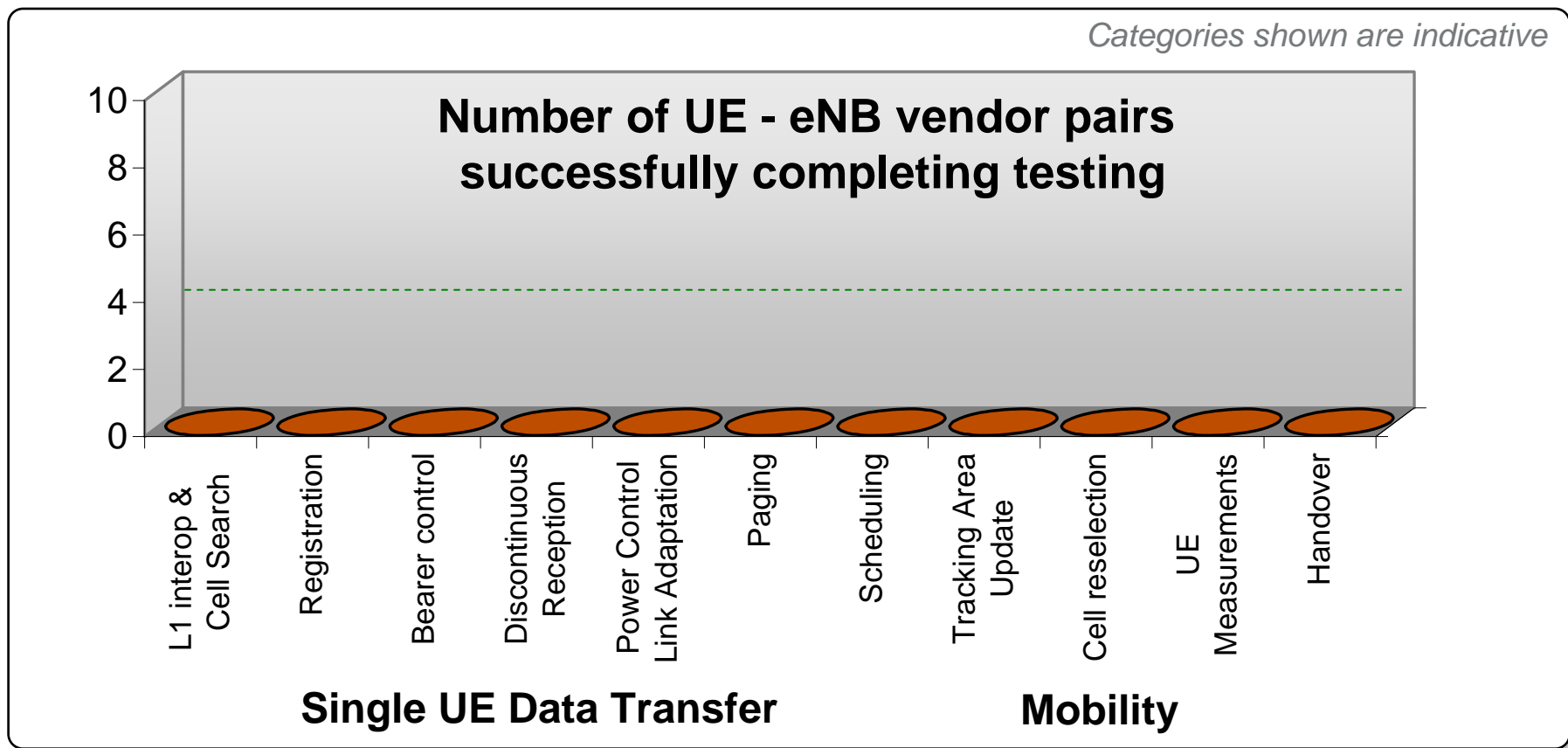


# Interoperability Testing

- **Successful interoperability shows that everybody has the same interpretation of the standard, implying a level of maturity**
- **LSTI agrees and recommends a core set of features for interoperability testing on the LTE/SAE interfaces**
- **First phase**
  - Focus on the Air interface: Testing between UEs and eNBs
  - Feature set and standards baselines agreed
  - Testing underway, reporting during Q2-Q4 2009
- **Second phase**
  - Extra features and multiple partners for the Air Interface
  - S1 and X2 testing, requiring multiple RAN and EPC vendors
  - Expected to complete mid 2010



# IODT Progress Reporting



- LSTI will report consolidated progress on testing in the coming months
  - Several hundred air interface feature tests will be grouped into categories

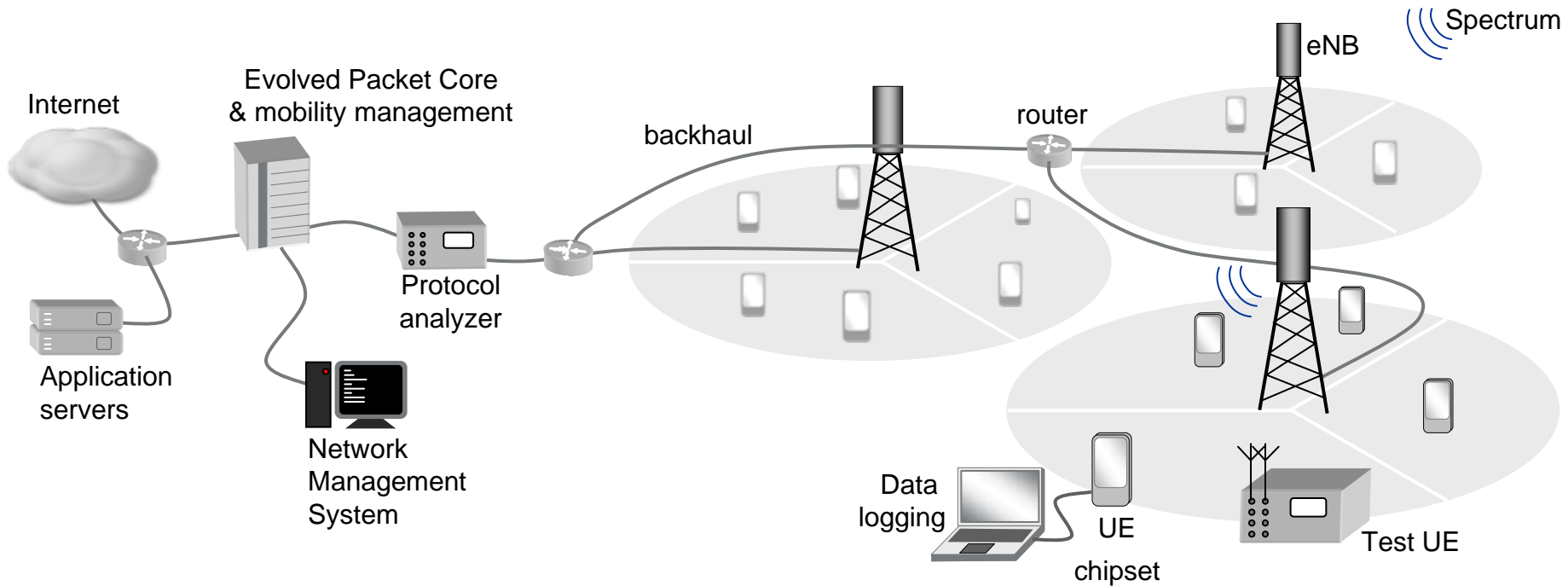


**T R I A L**      **INITIATIVE**  
LONG TERM EVOLUTION      SYSTEM ARCHITECT EVOLUTION

## **Friendly Customer Trials**

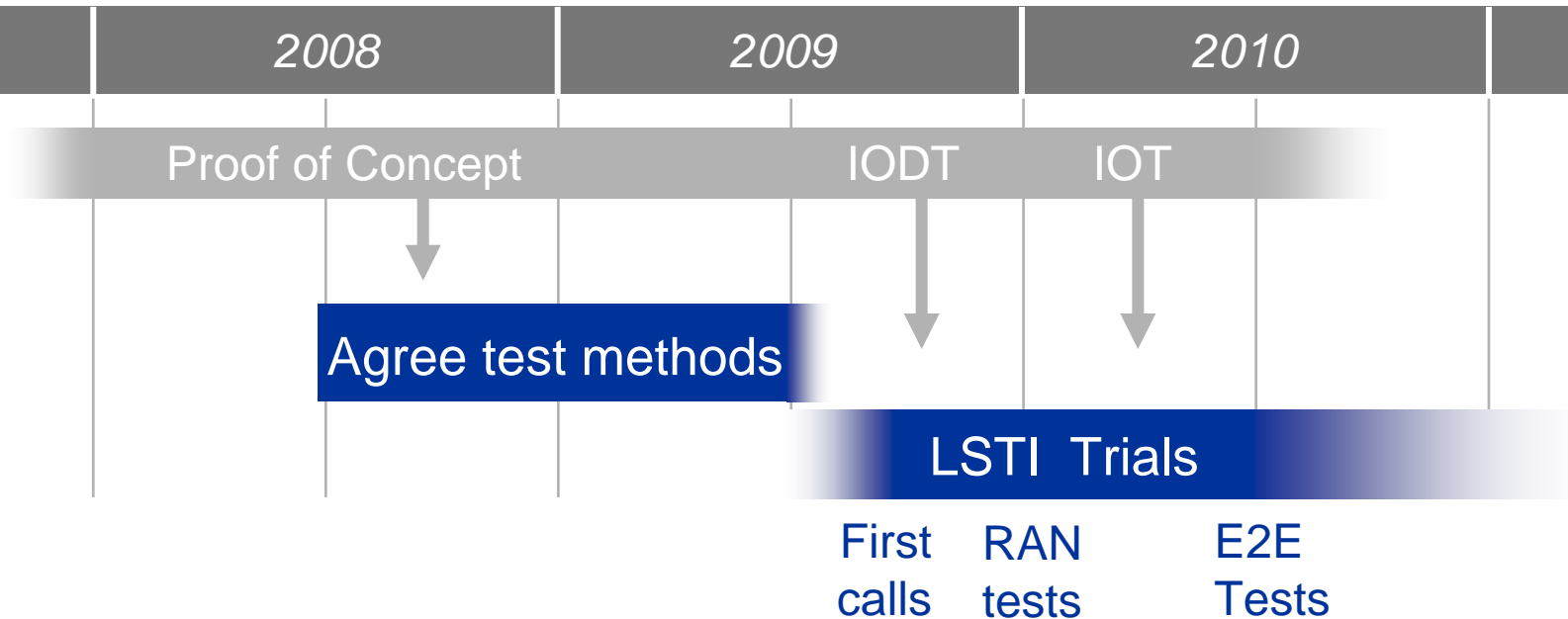
***What are the capabilities of LTE/SAE  
in near commercial conditions?***

# The Trial Ecosystem



- A field trial brings together key ecosystem elements to operate an LTE/SAE network in near-commercial conditions
- It enables operators to decide for themselves what the technology is capable of, and when it is ready for commercial rollout

# LSTI Friendly Customer Trials Activity



- **Recommend common test methods to enable consolidation, sanity checking and sharing of results**
- **Continue to increase industry understanding of the capabilities and maturity of LTE equipment**

# LSTI Activities - Progress

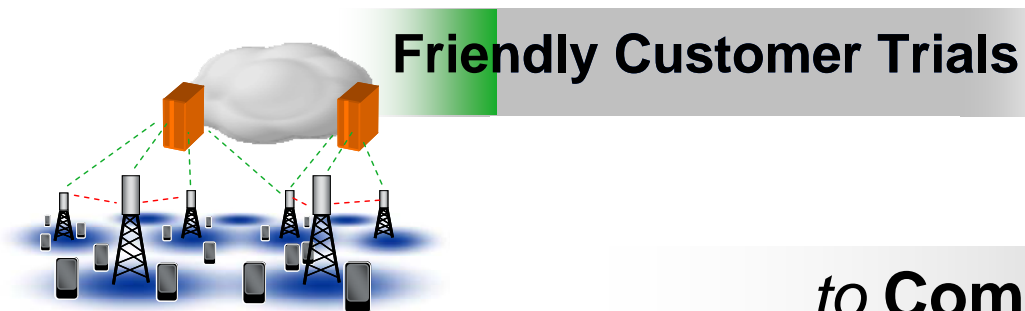
*From* **Standardisation...**



FDD Completed Feb09  
TD-LTE Final consolidation mid 09



Feature set & baseline agreed  
Awaiting first results....



Tests based on NGMN  
drafted & under review

*...to* **Commercial Rollout**

## In Summary, The LTE/SAE Trial Initiative....

- ...is an open initiative of vendors and operators working together to nurture a healthy ecosystem for LTE
- ...achieves this through cross-industry co-ordination of prototyping, interoperability testing and field trials

## The Proof of Concept Activity...

- ...has shown that it is feasible to make LTE/SAE equipment that can meet industry targets for peak performance

***“LTE does exactly what it says on the tin”***

- ...is also revealing the real world performance that operators will be able to offer to end users



**T R I A L                      I N I T I A T I V E**  
LONG TERM EVOLUTION                      SYSTEM ARCHITECT EVOLUTION

**Thank You**



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