

Corporate **R&D**

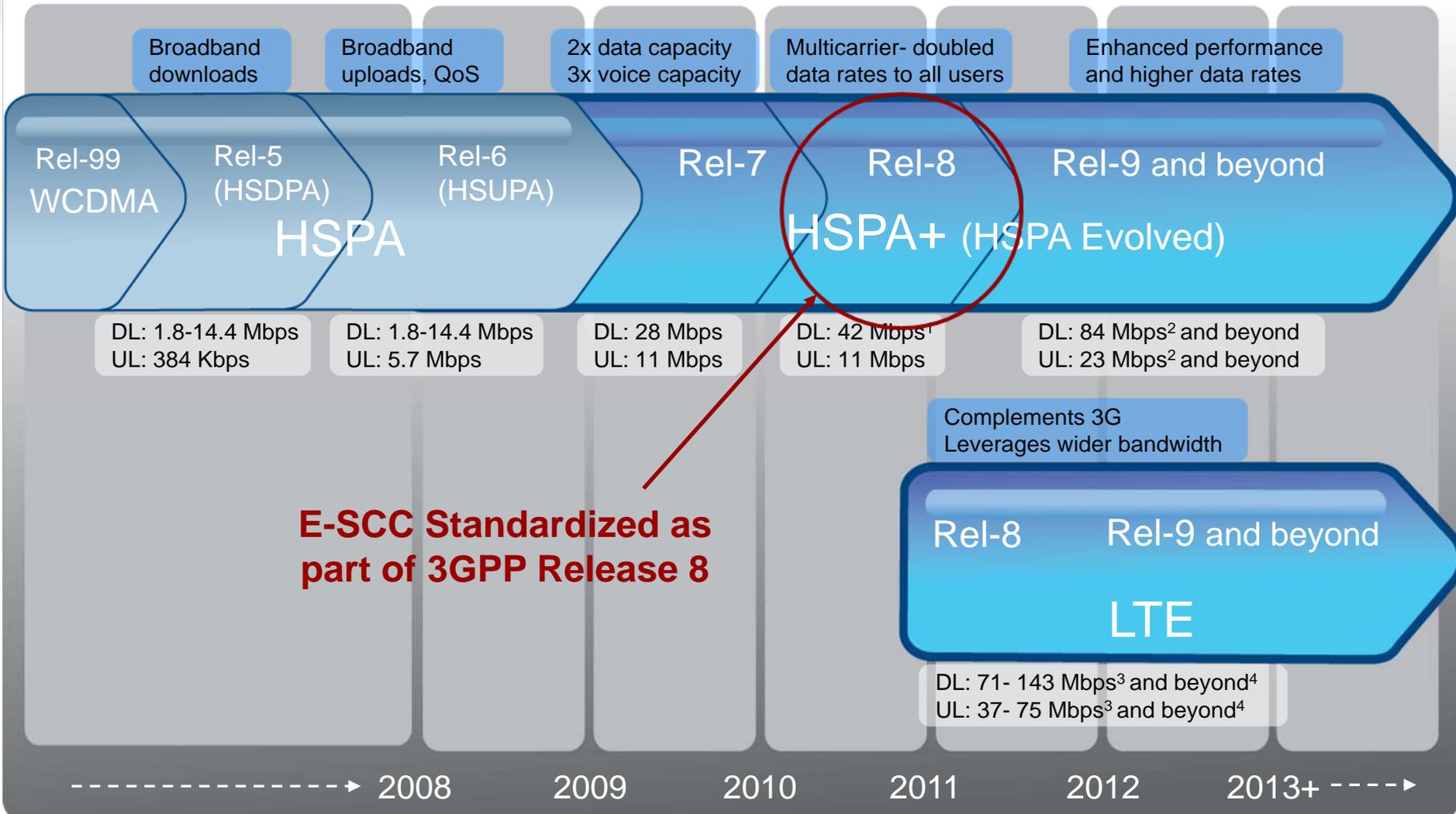
***HSPA+ R8 Enhanced Serving Cell Change  
Performance Evaluation***

***March 2009***

# *Enhanced Serving Cell Change (E-SCC)*

- *Overview*
- *In Lab Performance Evaluation*
- *Field Trials of VoIP using E-SCC*
- *Conclusions*

# 3GPP: A Strong Evolution Path



<sup>1</sup> R8 will reach 42 Mbps by combining 2x2 MIMO and HOM (64QAM) in 5MHz, or by utilizing HOM (64QAM) and multi carrier in 10 MHz.  
<sup>2</sup> R9 and beyond may utilize combinations of multi carrier and MIMO to reach 84 Mbps peak rates. Similarly, uplink multi carrier can double the uplink data rates.  
<sup>3</sup> Peak rates for 10 and 20 MHz FDD using 2x2 MIMO, the standard supports 4x4 MIMO enabling peak rates of 278 Mbps. TDD rates are a function of up/downlink asymmetry  
<sup>4</sup>Peak rates can reach or exceed 278 Mbps by aggregating multiple 20 MHz carriers as proposed for LTE Advanced (LTE Rel-10)  
 Note: Estimated commercial dates

# *E-SCC Motivation: Efficient Support For Real Time Services*

- ***High Capacity VoIP and CS over HSPA require signaling to be carried over the high speed HSPA channel***
  - The alternative is to carry signaling on DCH but this reduces capacity by ~40%
- ***Today's networks typically implement synchronized SCC that is optimized for best effort data services***
  - Interruption time and reliability is unsuitable for real-time services like VoIP and CS over HSPA
- ***Optimized Unsynchronized SCC works reasonably well for real-time services such as VoIP in most environments***
  - Reliability cannot be ensured in dense urban environments where signal variations are steep
  - Unsynchronized SCC has not been commercially deployed

*E-SCC is optimized for Real-Time traffic like VoIP and CS over HSPA*

# Enhanced Serving Cell Change (E-SCC)

***E-SCC dramatically increases cell change reliability and reduces interruption time in demanding propagation environments***

***E-SCC enables high capacity Voice over HSPA under all radio conditions***

## *Improved reliability*

- Fast and reliable layer 1 signaling
- Does not require layer 3 messages
- Receive cell change indication on target cell instead of source cell
- Reduced transition time minimizes risk of dropping calls

## *Reduced Interruption*

- Fast layer 1 signaling
- Faster reconfiguration to target cell
- Reduced transition time minimizes interruption
- Additional reduction of interruption time by use of data bi-casting to Node Bs

***E-SCC improves VoIP and CS over HSPA handover reliability in demanding propagation environments***

# Current Serving Cell Change Failure In Actual Field Deployment

## Serving Cell Change failure observed in an actual urban deployment

Target Cell Better than Serving by  $> 2$  dB

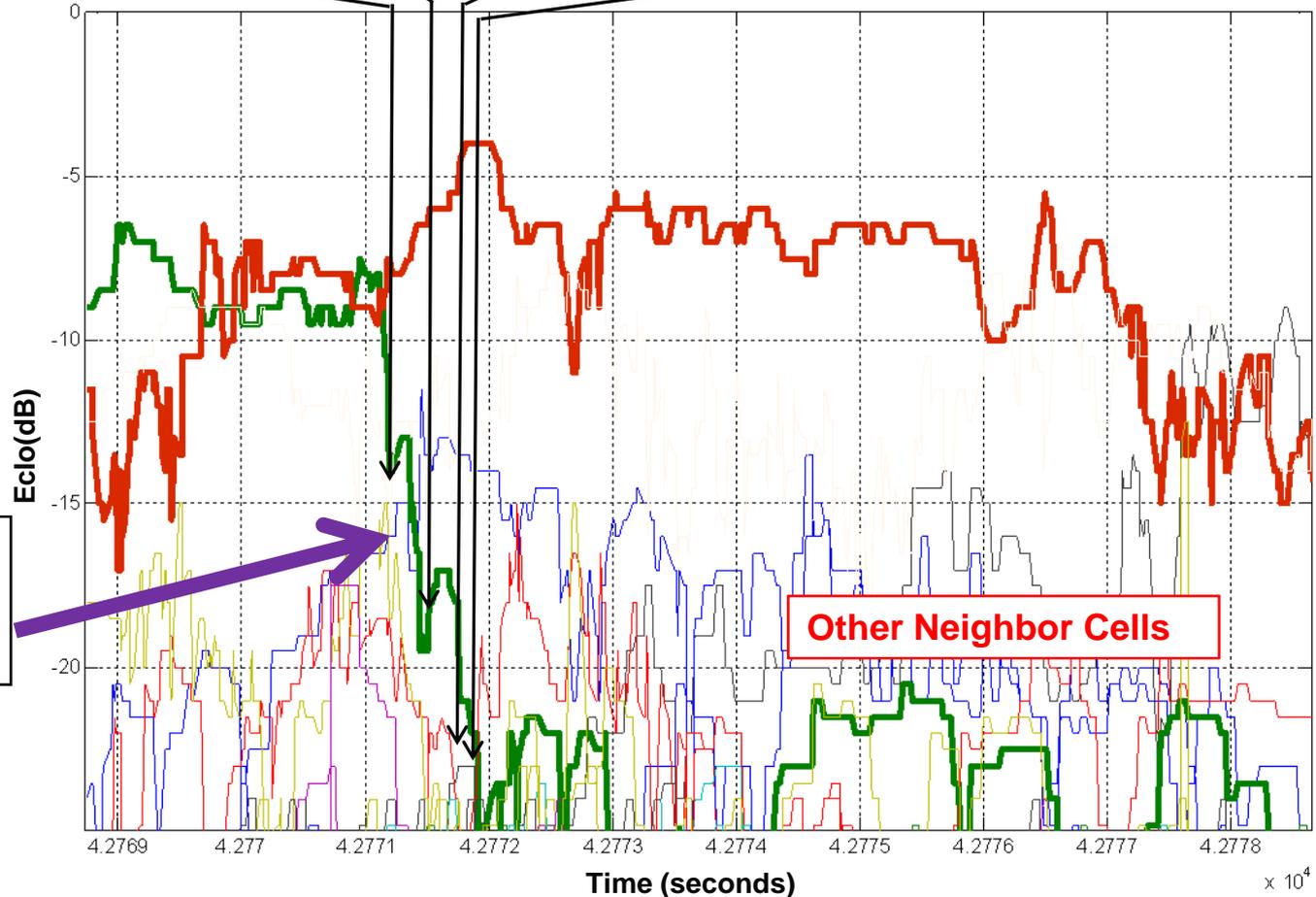
1d Triggered (TTT = 320 msec)

RBR Arrives at Node B (Network Delay = 200 msec)

RBR Dropped After Maximum H-ARQ Transmissions

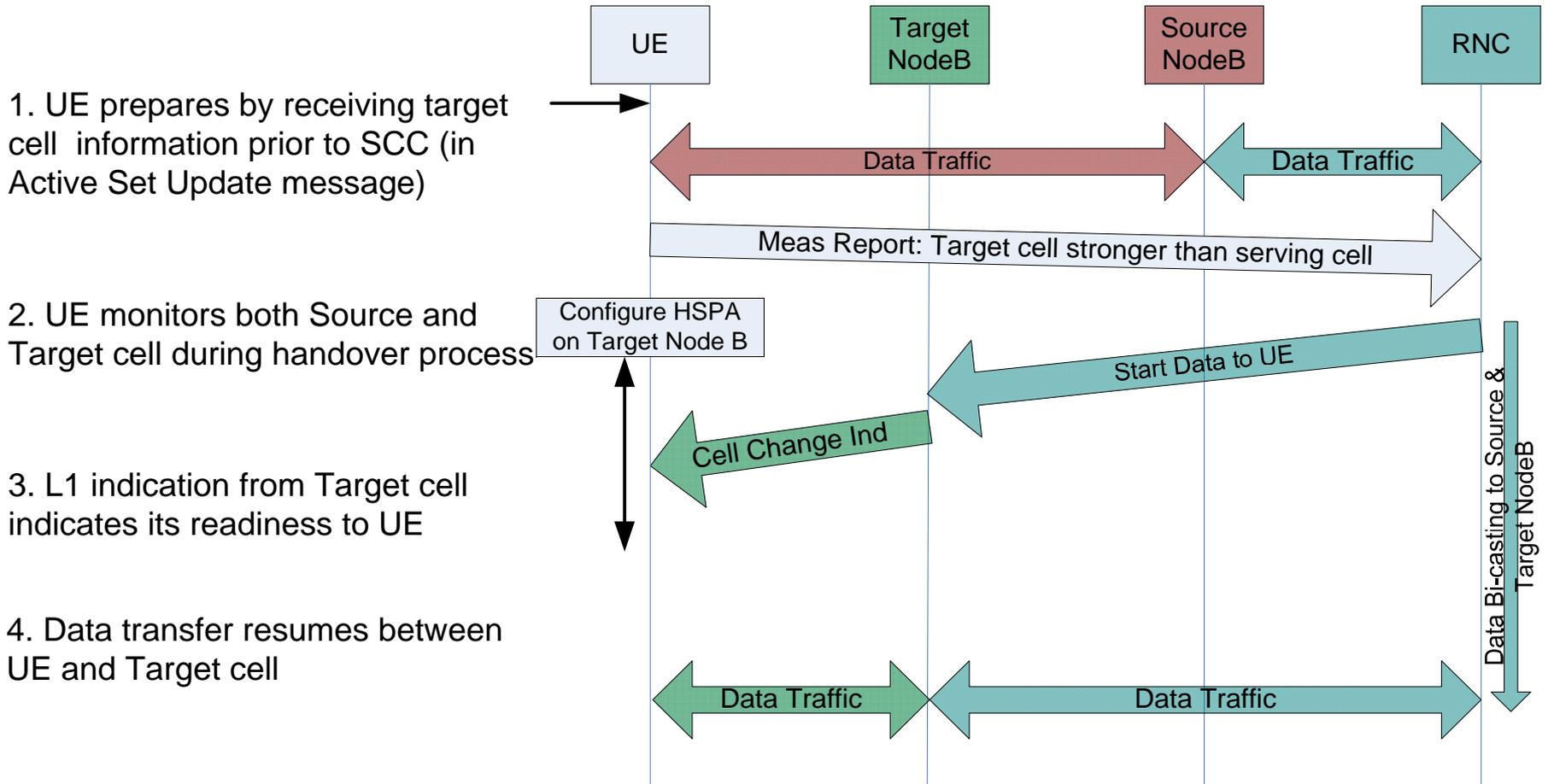
Serving cell change fails due to weak downlink source cell

Slope of serving cell Ec/No degradation is  $\sim 25$ dB/sec



Note: On field traces, SCC failure was detected in simulations assuming signaling is carried on HSPA channels

# E-SCC Procedure



# Simulation - Reduced Number Of Call Drops With E-SCC

Current unsynchronized SCC procedure results in unacceptably high call drop rates in dense urban areas

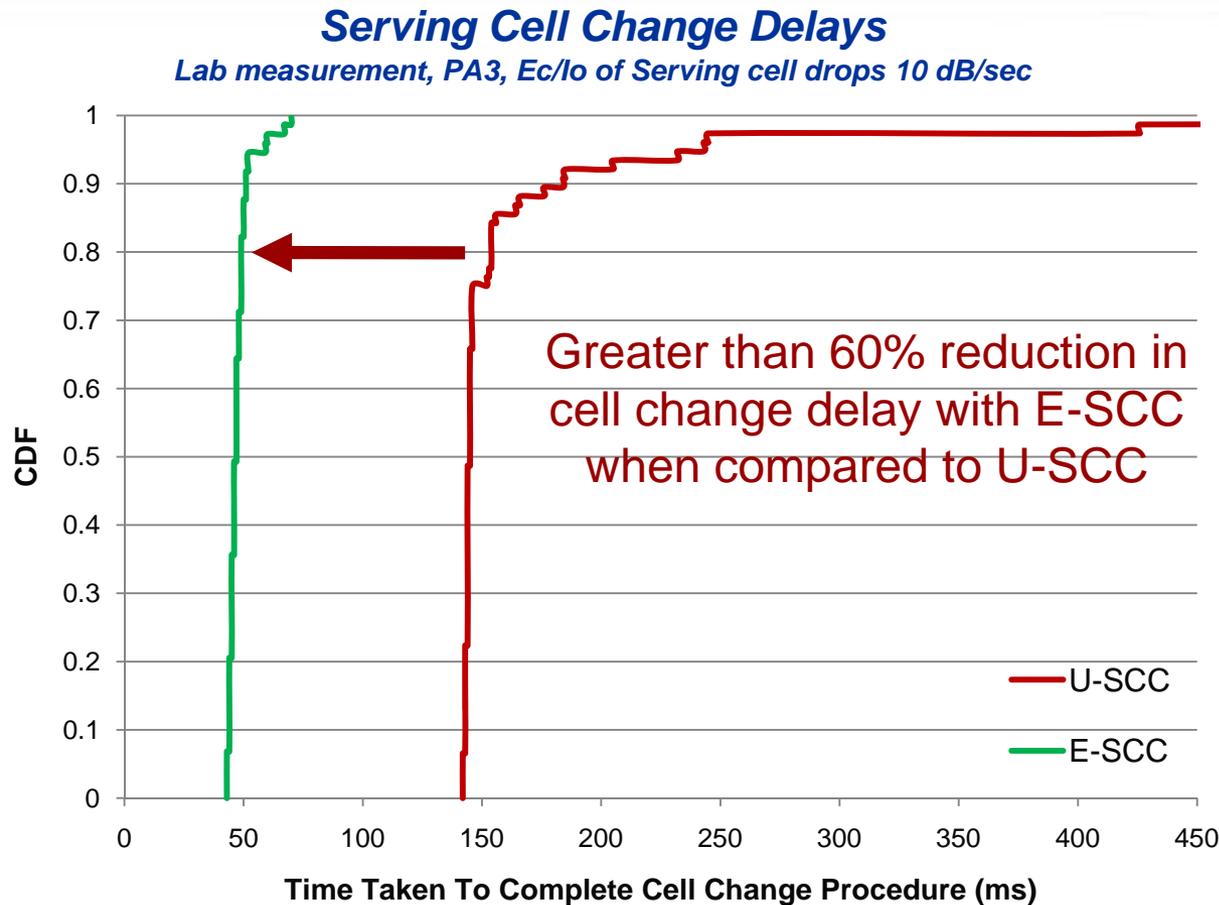
E-SCC significantly improves reliability and reduces call drop rates

**Performance for Unsynchronized SCC and E-SCC simulated by using actual field traces from two cities**

<i>Environment</i>	<i>UTRAN Processing Delay</i>	<i>SCC</i>	<i>E-SCC</i>
		<i>Call Drops</i>	<i>Call Drops</i>
<i>Traces from City 1</i>	<i>80 ms</i>	<i>3 – 7 %</i>	<i>0%</i>
	<i>280 ms</i>	<i>8 – 10%</i>	<i>0%</i>
<i>Traces from City 2</i>	<i>80 ms</i>	<i>2.5 – 5 %</i>	<i>0%</i>
	<i>280 ms</i>	<i>7 – 10%</i>	<i>0%</i>



# Lab Test – Dramatic Reduction In Cell Change Delay

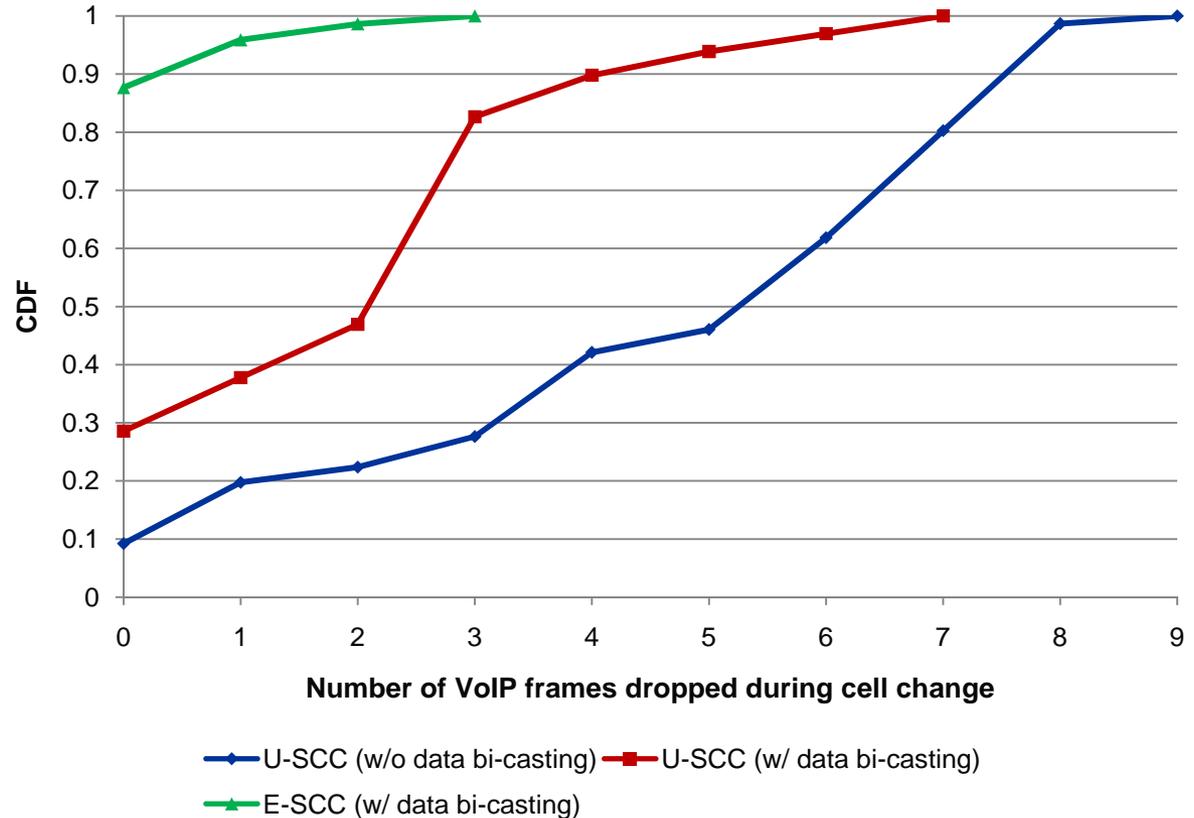


Significant reduction in delay improves user experience for all services

# Lab Test –Significant Reduction In Packet Drops

## VoIP Packet Drops During Serving Cell Change

Lab measurement, PA3, Ec/Io of Serving cell drops 10 dB/sec



60% more users experience zero packet drops during cell change



Significant reduction in packet drops ensures un-interrupted high quality real-time services like VoIP and CS over HSPA



# QUALCOMM E-SCC Field Trials

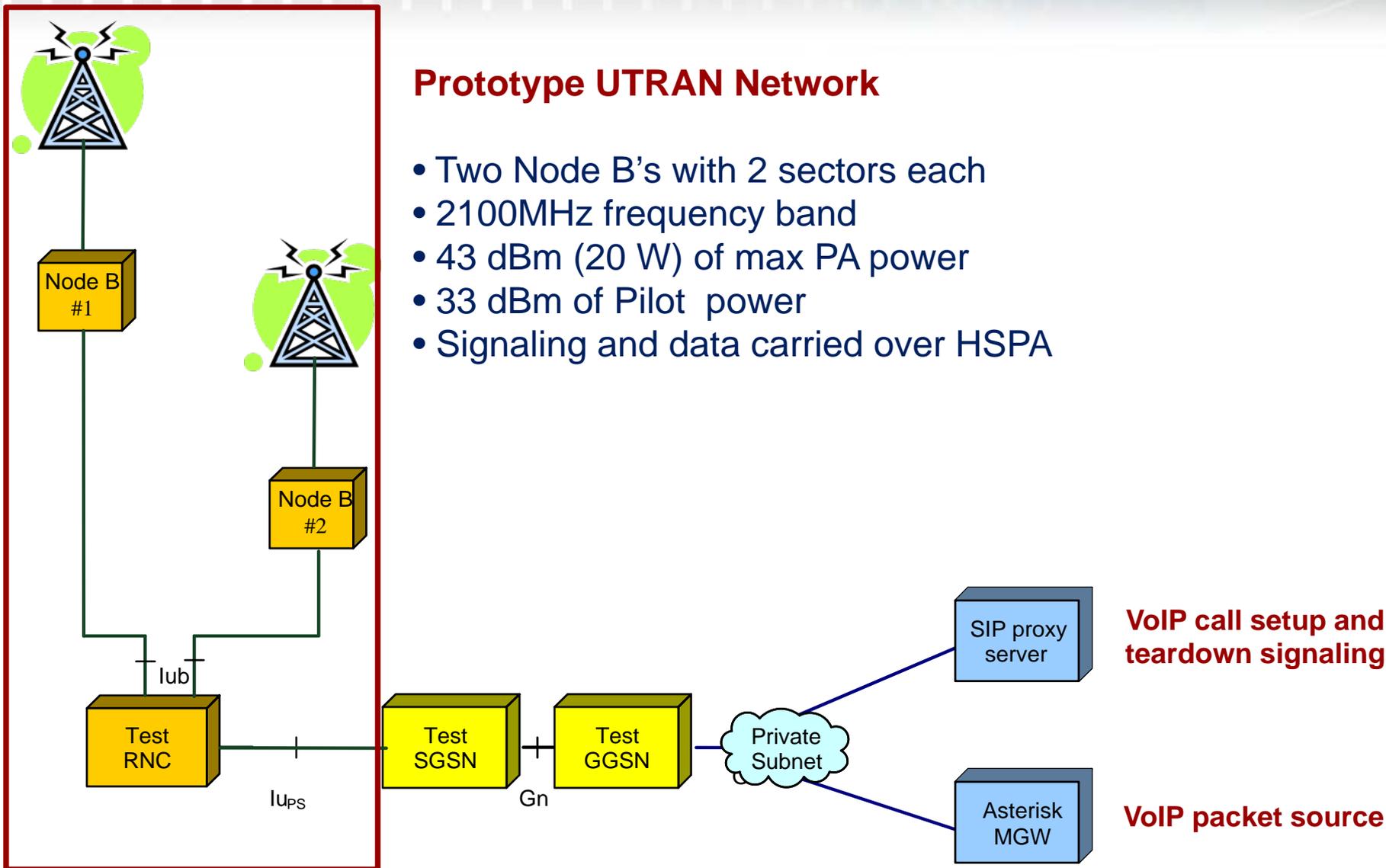
# Prototype System for Support of Legacy SCC and E-SCC

- ***The prototype system consists of UE, Node B, RNC, SGSN and GGSN along with a Media Server that sends VoIP data***
- ***The prototype system supports***
  - Legacy SCC (Unsynchronized and Synchronized) as well as E-SCC
  - Bi-casting of VoIP packets starting from reception of E1d at the RNC to end of SCC procedure
  - Load emulation to emulate load due to multiple VoIP users
  - Generation of interference on neighboring cells
- ***The Activation Time for S-SCC is set to 500 msec***
  - This is the minimum setting seen in commercial networks today

# Test Network Architecture

## Prototype UTRAN Network

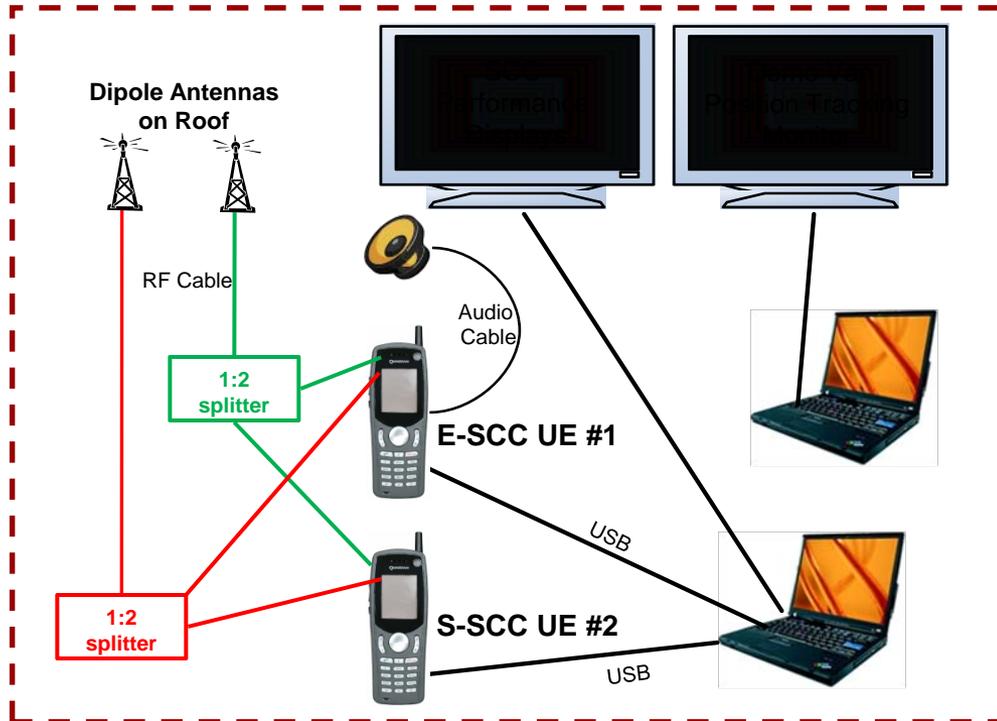
- Two Node B's with 2 sectors each
- 2100MHz frequency band
- 43 dBm (20 W) of max PA power
- 33 dBm of Pilot power
- Signaling and data carried over HSPA



# Key Network Parameters

Parameter	Value
Maximum Cell Power	43 dBm
CPICH Ec/Ior	-10 dB
Total % Fixed Power for Overhead Channels (including C-PICH)	~25%
Event 1D: Filter Coefficient K	3 (458 msec)
Event 1D: Hysteresis	3 dB
Event 1D: Time to trigger TTT	320 msec
RBR (Radio Bearer Reconfiguration)/ASU (Active Set Update) Message Size	~300 bits
Maximum H-ARQ transmissions for RBR/ASU	4

# Drive Test Van Setup



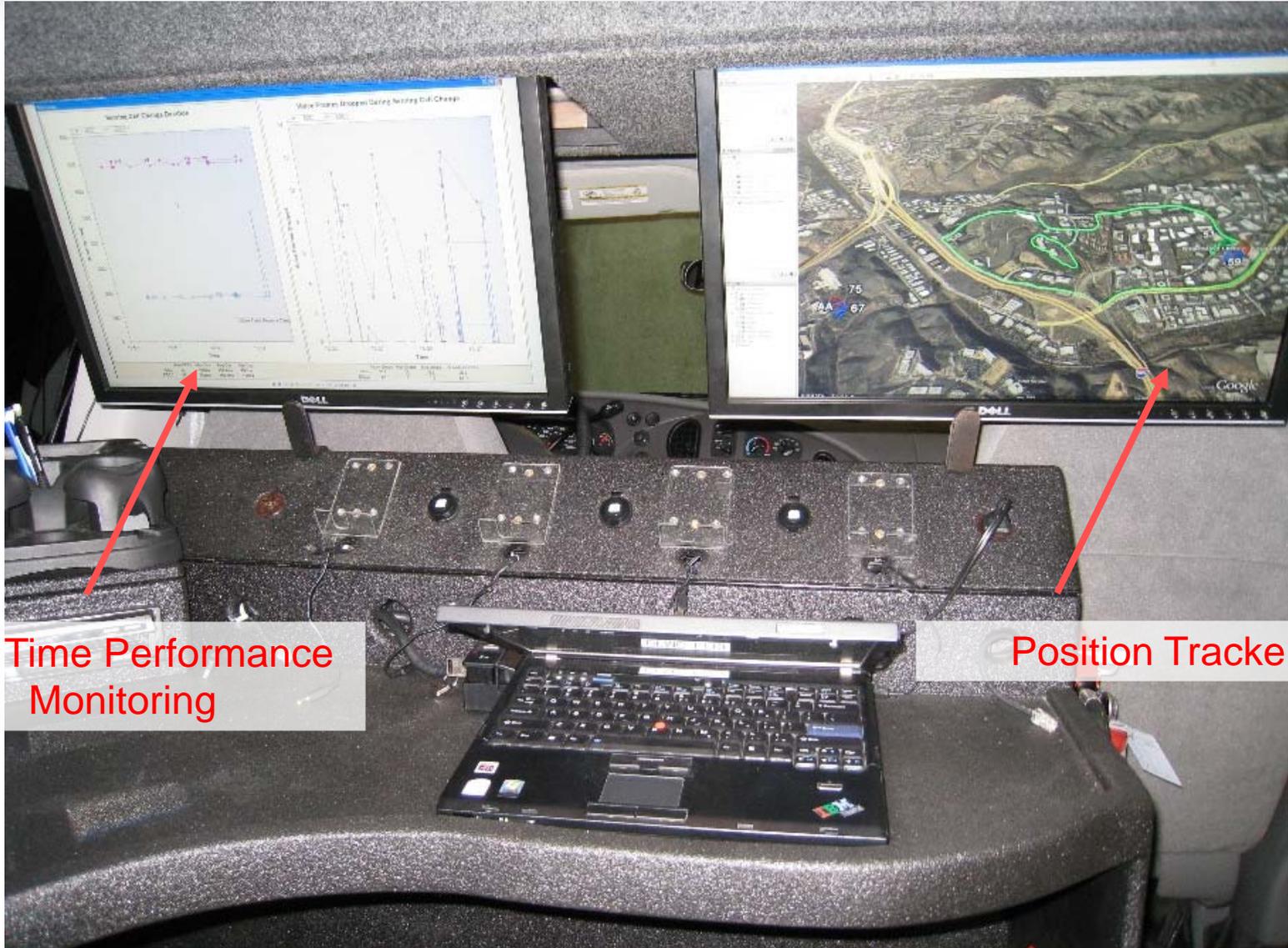
**E-SCC and SCC UE Use Same Antennas**



**E-SCC UE#1**

**SCC UE#2**

# Drive Test Van – Inside View



Real Time Performance  
Monitoring

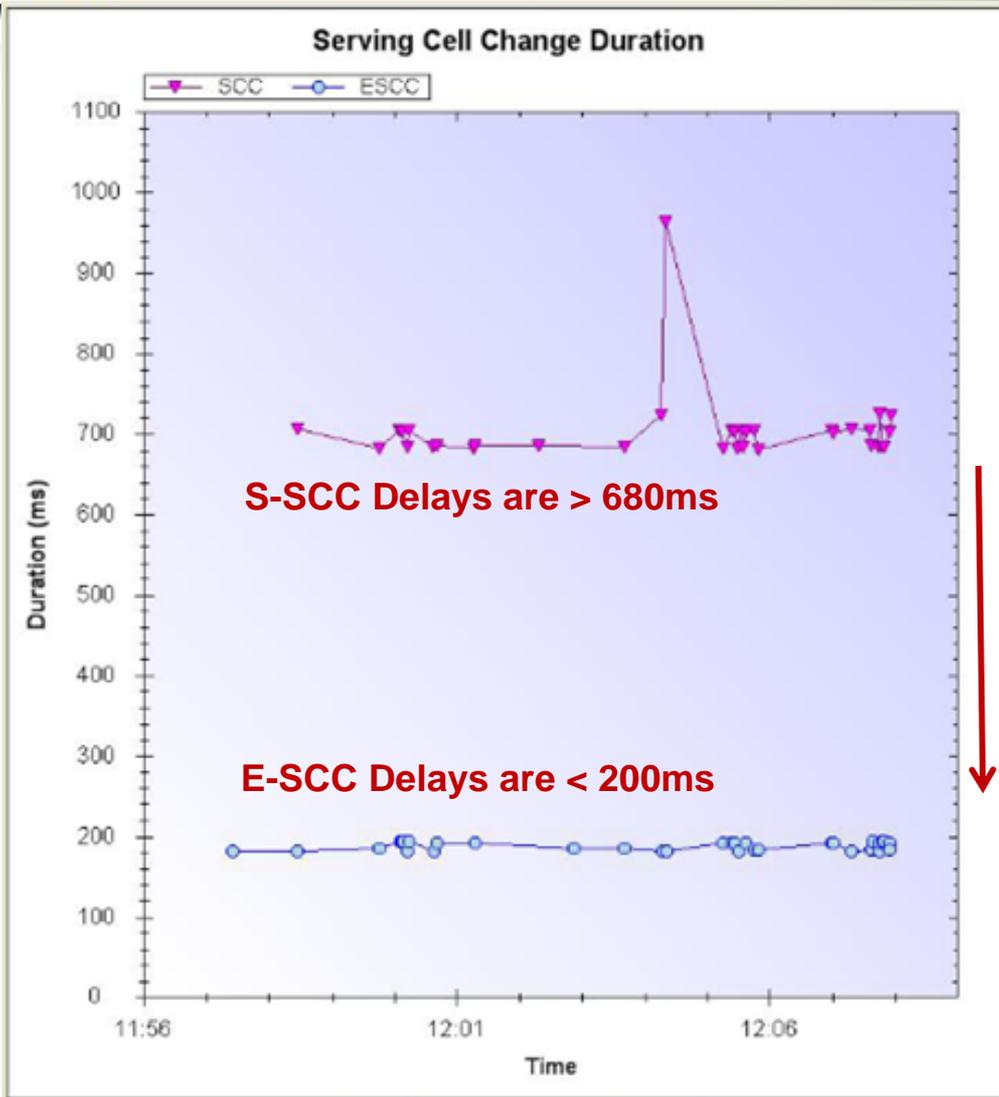
Position Tracker

# HSPA Serving Cell Coverage





# Field Test : E-SCC Reduces Cell Change Delay



**E-SCC reduces cell change delay by more than 70%**

**Cumulative statistics**

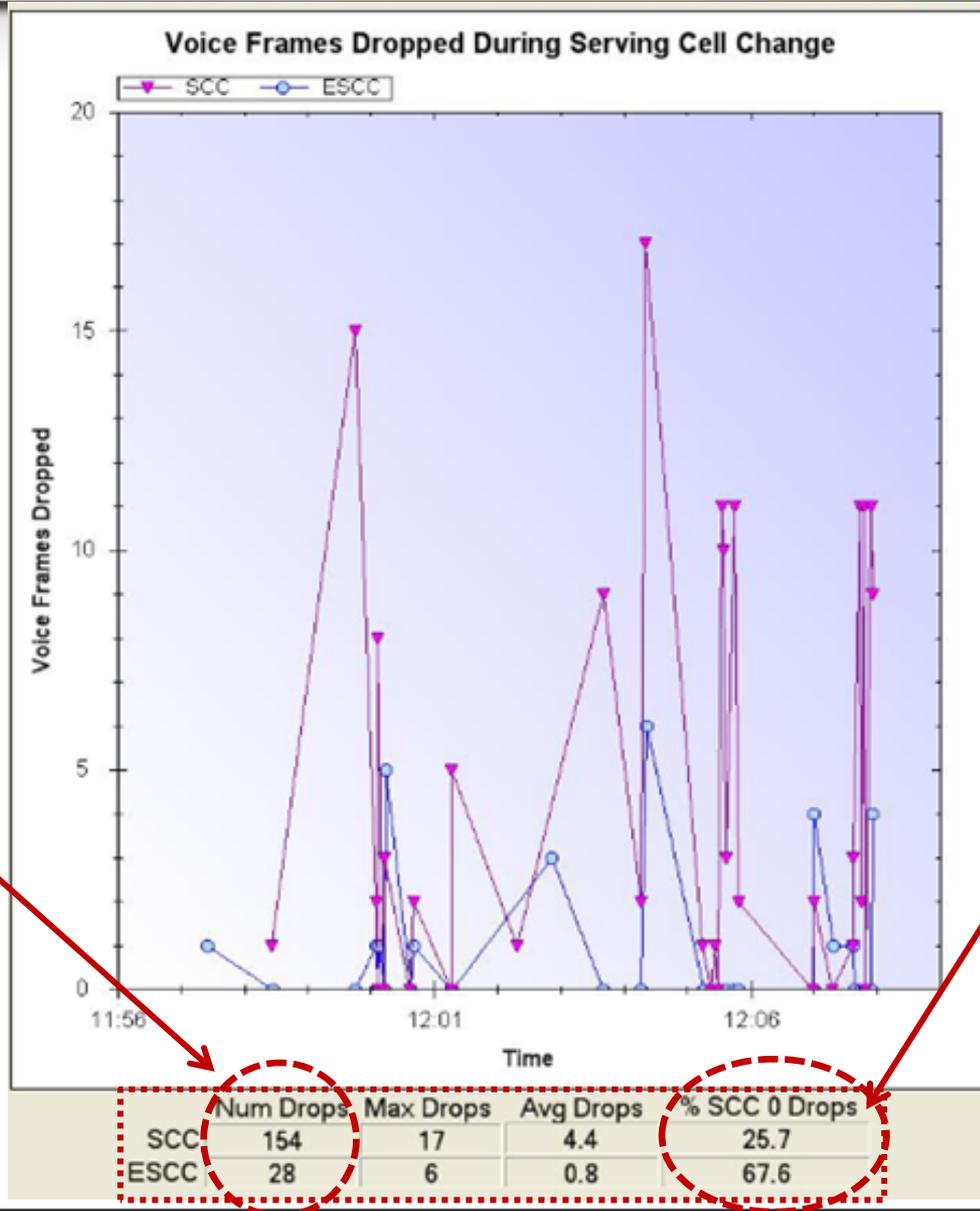
	Num SCCs	Max Dur.	Avg Dur.	Min Dur.
SCC	35	964ms	703.6ms	681ms
ESCC	34	193ms	187.6ms	181ms

**Note:**  
All delays include 100ms UTRAN processing delay

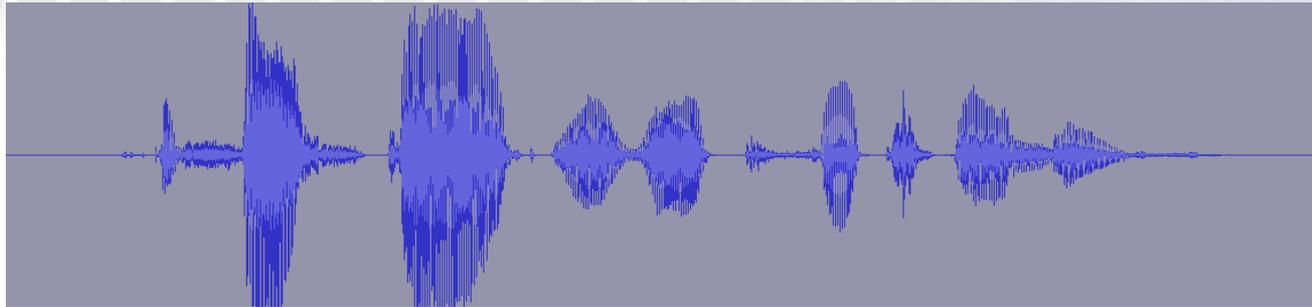
# Field Test: E-SCC Reduces VoIP Packet Drops

**E-SCC reduces packet drops by more than 80%**

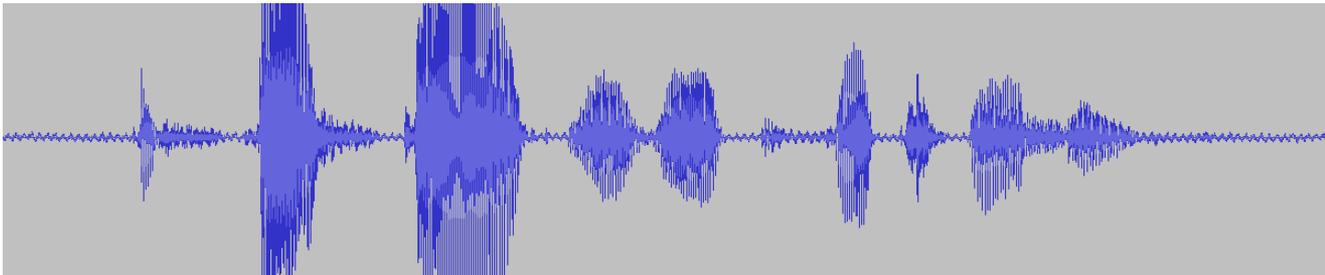
**67% of the VoIP calls have no packet drops with E-SCC**



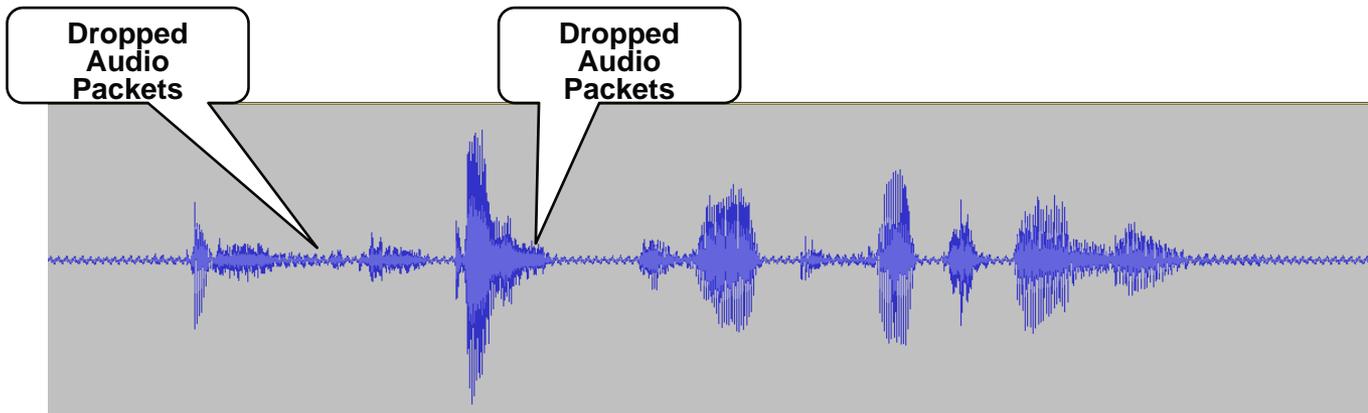
# Audio Comparing S-SCC and E-SCC Performance in Field



  
Audio  
(Source)



  
E-SCC Audio  
quality log



  
S-SCC Audio  
quality log

# Conclusions

- *E-SCC significantly improves performance of serving cell change procedure by reducing cell change delay*
- *E-SCC and data bi-casting ensure uninterrupted data transfer by minimizing packet loss during cell change procedure*
- *E-SCC increases reliability of cell change and minimizes dropped calls*
- *E-SCC enables fast cell changes required to deliver un-interrupted high quality real-time services like VoIP and CS over HSPA*

**To learn more about HSPA+ and E-SCC please visit:**

- Qualcomm HSPA+ Corporate R&D Research Page
  - [http://www.qualcomm.com/innovation/research/feature\\_project/hspa\\_plus.html](http://www.qualcomm.com/innovation/research/feature_project/hspa_plus.html)
- E-SCC Whitepaper:
  - [http://www.qualcomm.com/common/documents/white\\_papers/ESCC\\_White\\_Paper-v4.pdf](http://www.qualcomm.com/common/documents/white_papers/ESCC_White_Paper-v4.pdf)



***Thank You***