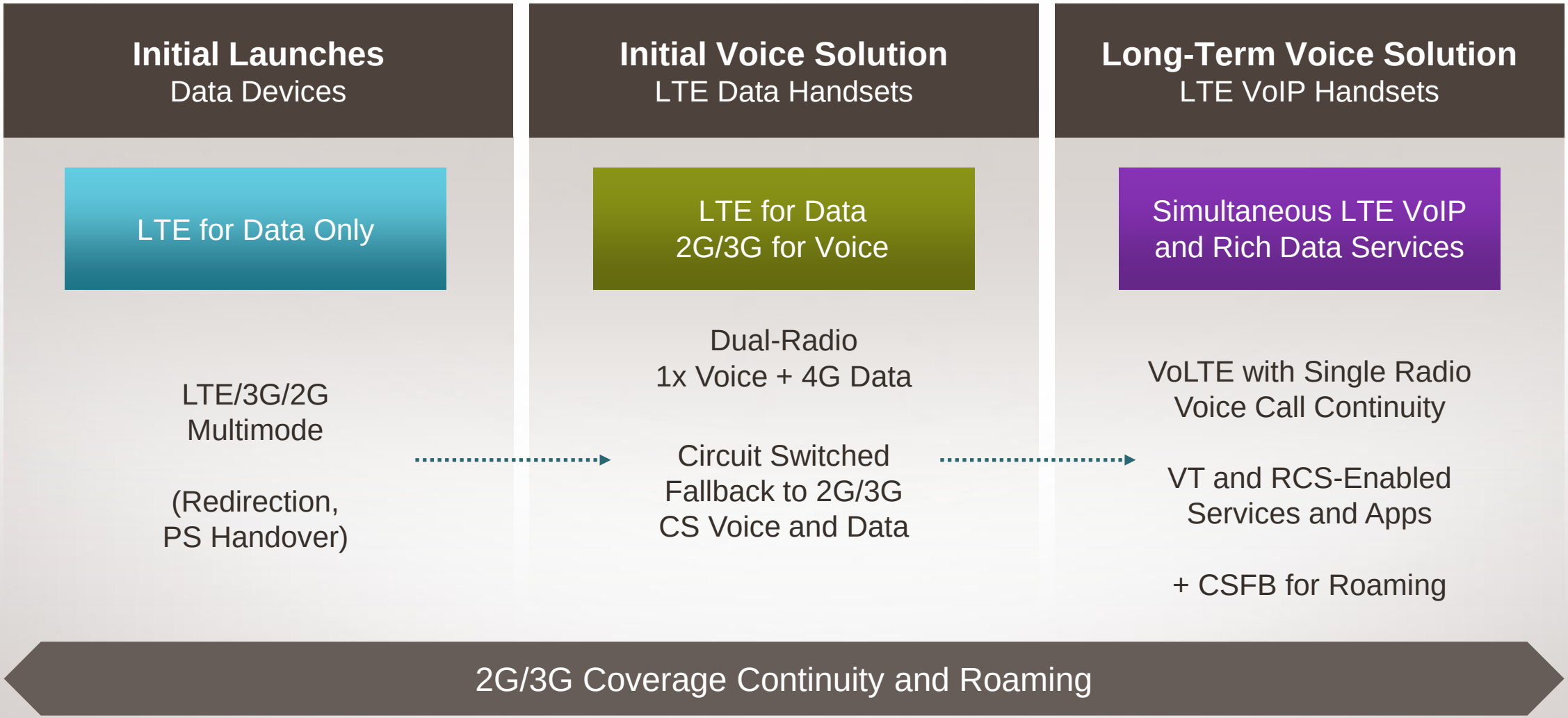
CSFB Performance

October 2012

High-Level Multimode Options for LTE Voice



First Step for LTE Voice Support

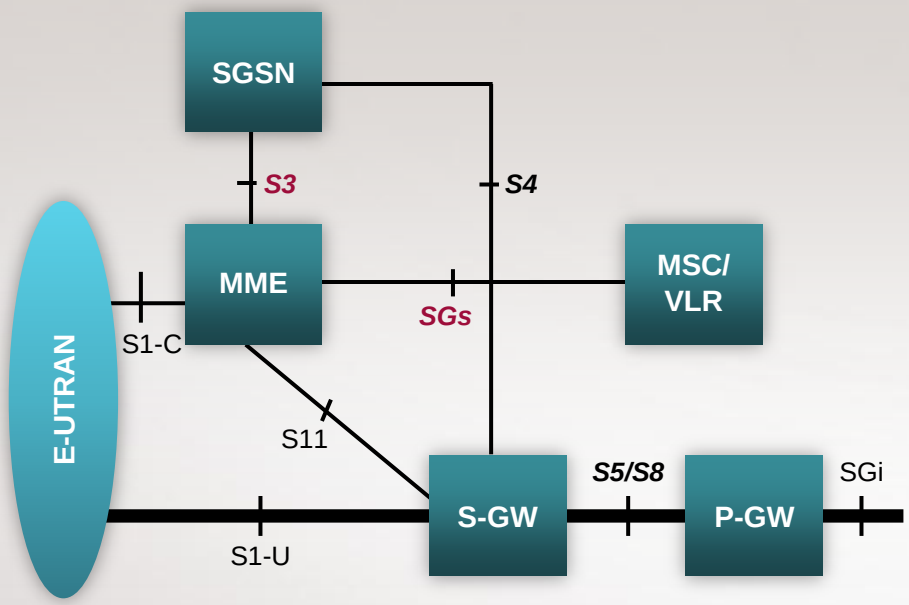
Circuit Switched Fallback (CSFB)

- Enables global voice/SMS roaming and interworking for LTE devices
- Fully standardized for 2G and 3G
- Utilizes mature/ubiquitous 2G/3G networks for voice
- Commercially launched across all LTE regions
- Strong global ecosystem
- Reliability comparable to native CS calls
- Subsecond incremental call setup time in live networks

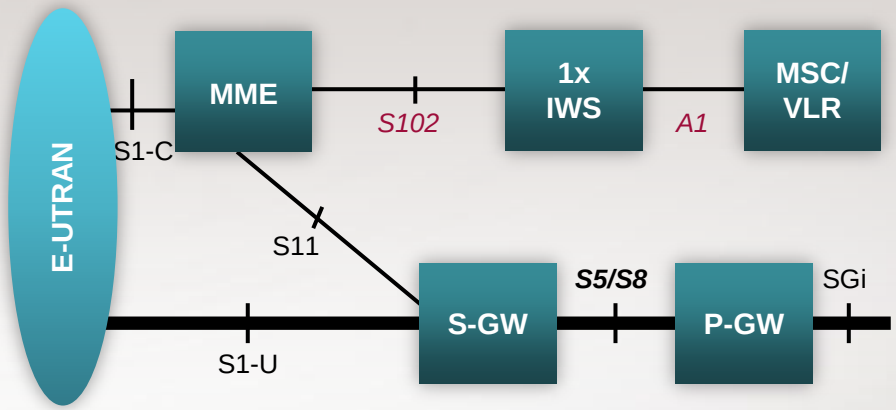
CSFB Enables Single Radio Device Architecture with Better Cost, Power, and Form Factor

CSFB Network Architecture

3GPP CSFB Network



3GPP2 CSFB Network

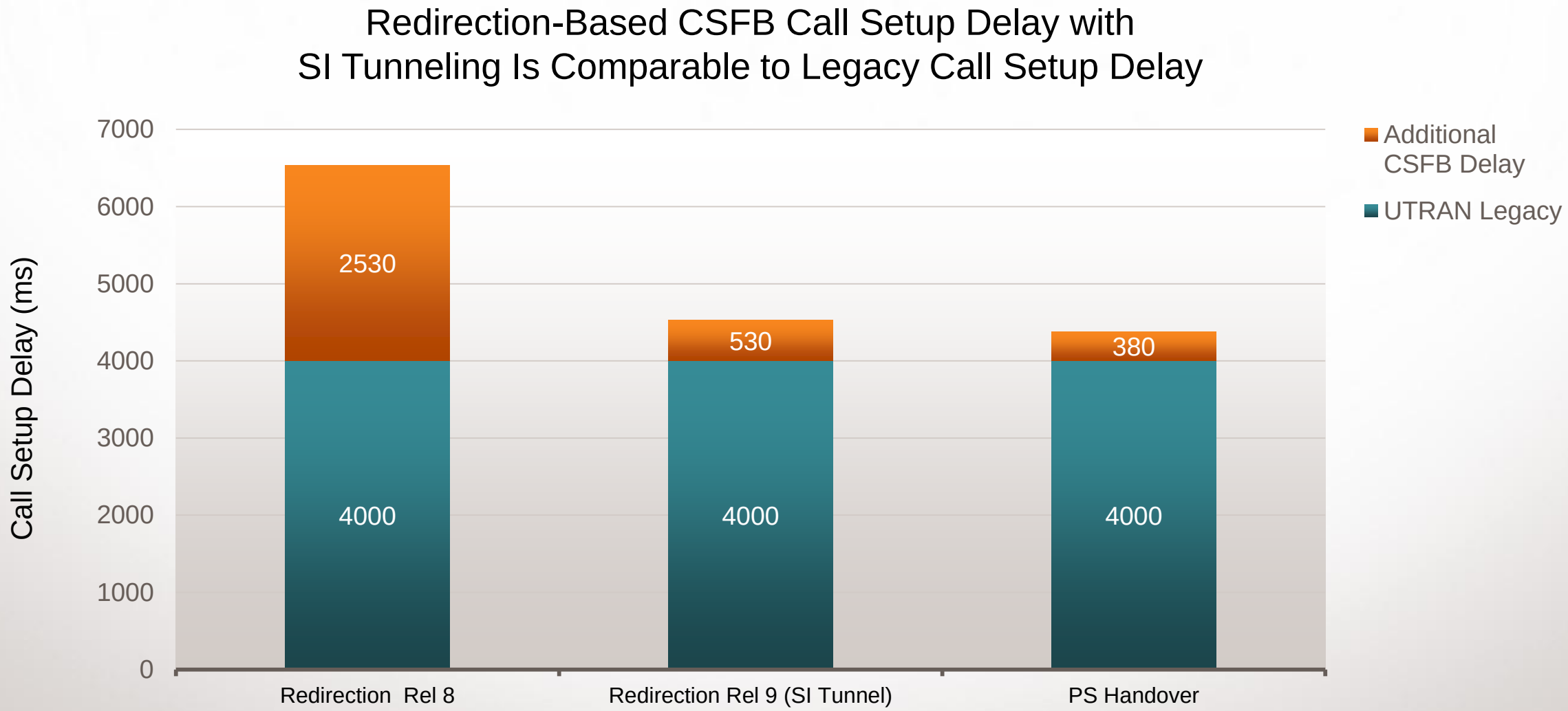


CSFB Summary

- Device is registered for both CS and PS services via LTE
- CS voice pages are delivered over LTE
- Device remains on LTE except for voice calls
- SMS can be received over LTE
- For voice calls, UE falls back to UMTS/GSM/C2K
- Mobility methods supported:

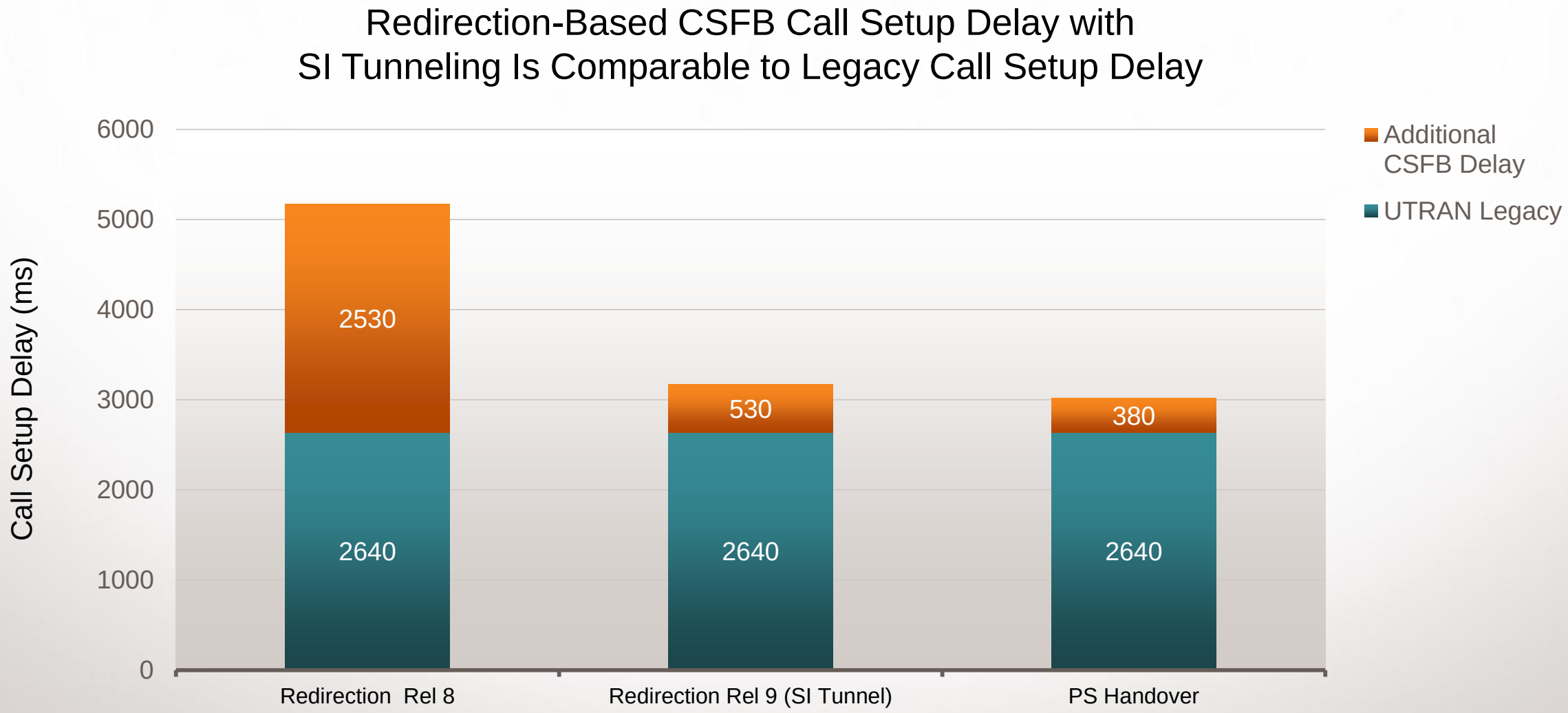
Method	Target Info	Target Prepared	Measurements	LTE → W	LTE → G	LTE → C2K
Redirection	Target Frequency	No	Optional	Yes	Yes	Yes
Cell Change Order	Target Cell	No	Required	No	Yes	No
Handover-Based	Target Cell	Yes	Required	Yes	Yes	Yes

CSFB to UTRAN Call Setup Delay (Mobile-Originated)



Data shown redirection scenarios is based on results from LAB and field testing. Data shown for handover scenario is based on internal Qualcomm Technologies testing.

CSFB to UTRAN Call Setup Delay (Mobile-Terminated)



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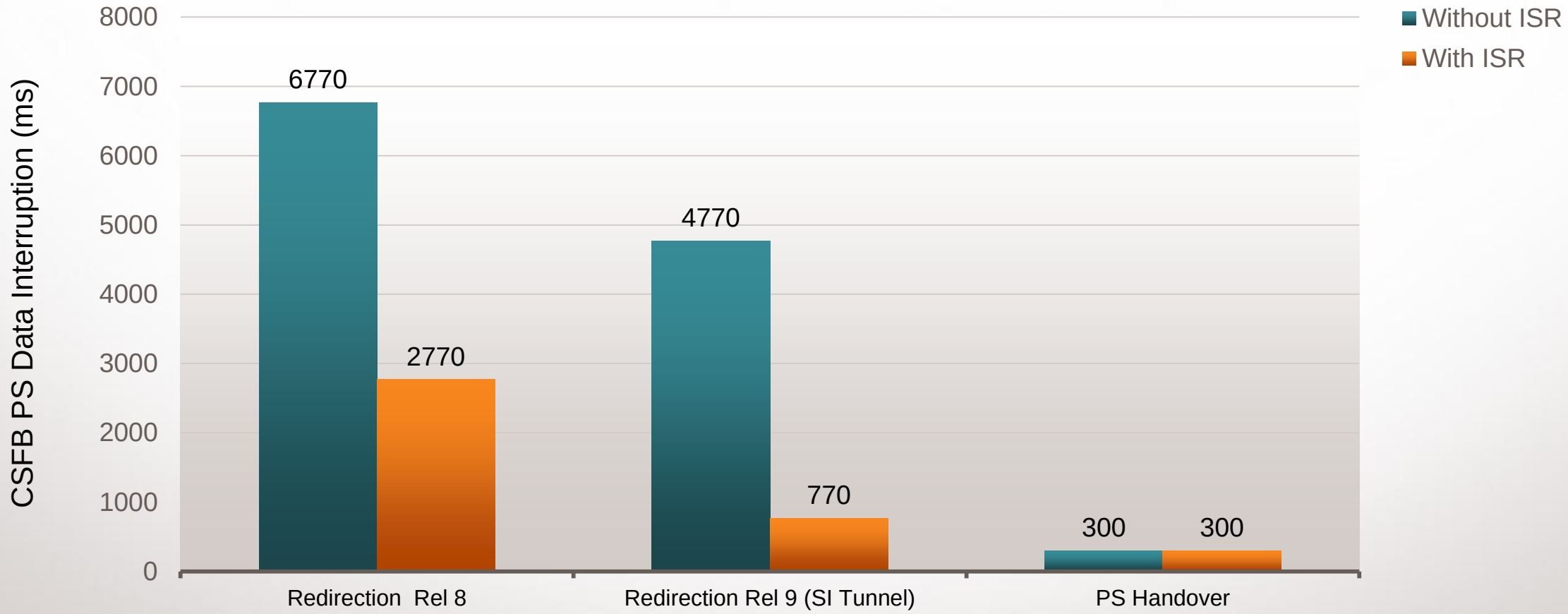
CSFB PS Data Interruption

The Handover Option Provides the Lowest Data Interruption Time;
For the Redirection Options, ISR Can Significantly Reduce Data Interruption Time



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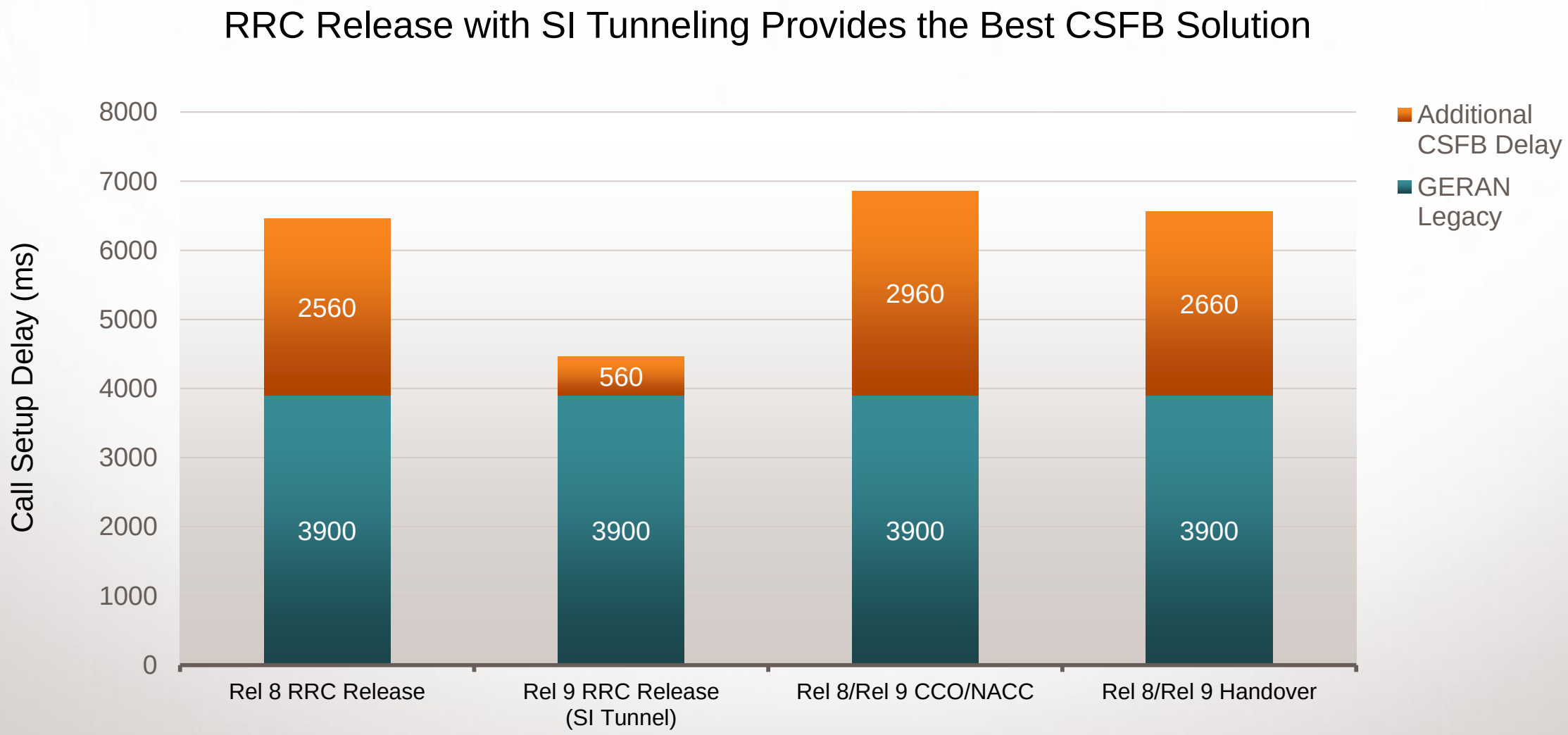
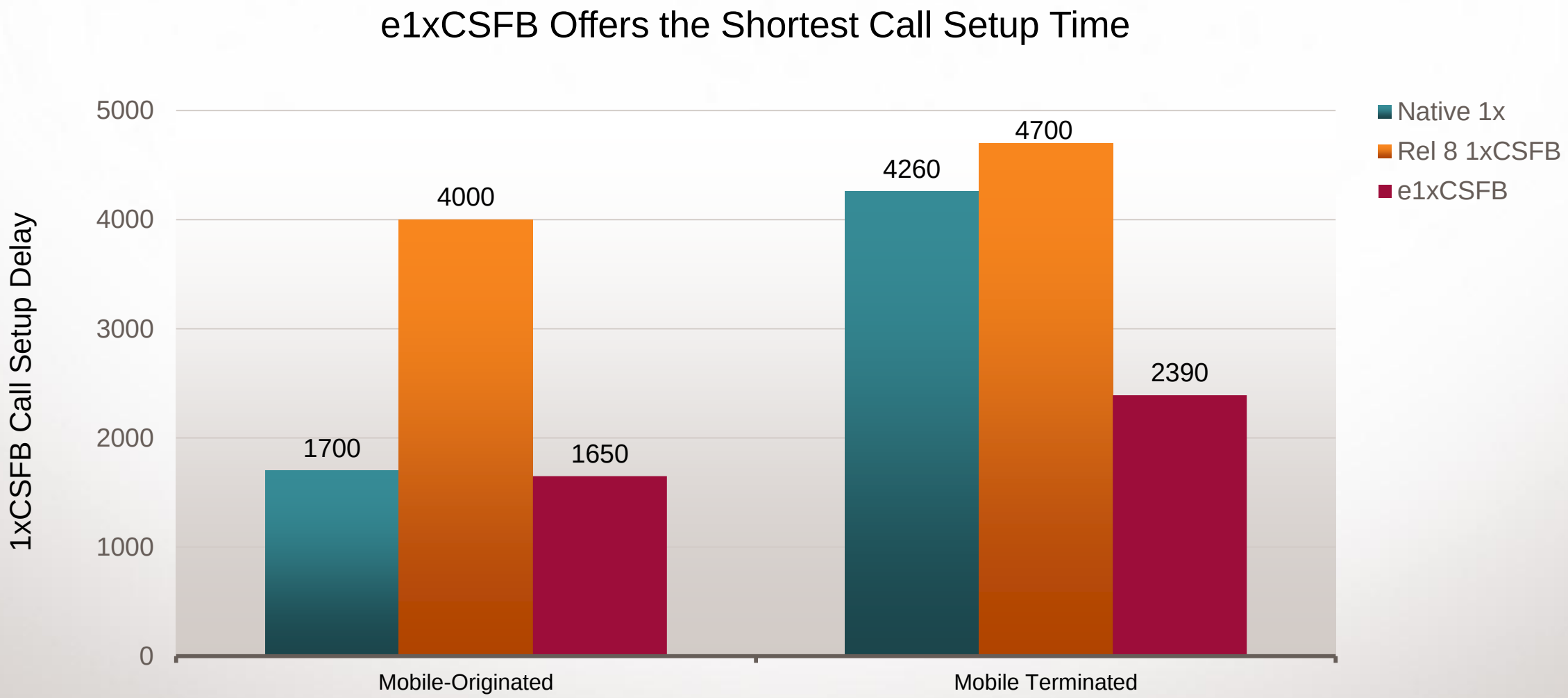
CSFB to GERAN Call Setup Delay (Mobile-Originated)



Data shown is based on internal Qualcomm Technologies testing.

1xCSFB Call Setup Delay



Dual Radio vs. e1xCSFB

Metric	Dual Radio Solution	e1xCSFB
Estimated MO Call Setup Delay	50ms+e1xCSFB	Best
Estimated MT Call Setup Delay	1870ms+e1xCSFB	Best
Standby Power Consumption	1x+LTE Idle Standby	Best (LT-Only Standby)
User Experience	Best (Simultaneous Voice and Data [SVD])	No SVD
Device Cost	Higher	Lower
Network Cost	Lower (No Network Impact)	Higher
Outbound Roaming	No Network Impact*	Needs LTE Roaming to Support e1xCSFB**
Inbound Roaming	1x voice, Data on EV-DO***	All Inbound Roamers Allowed
SMS	Need IMS to Offload from 1x Network	Reuse S102 to Offload from 1x n/w
Future Considerations	VoLTE Will Require Nationwide LTE	S102 Can Be Reused for SRVCC

*Some 1x and LTE band combinations may need special attention. **If LTE roaming is not in place then the device will camp on 1x network, provided 1x roaming agreement is in place. *** Dependency on PRL configuration

In Conclusion

- CSFB offers a solution with the cost, size, and battery life advantages of single-radio solutions, LTE data speeds, and reliability/ubiquity of 2G/3G voice
- Redirection-based CSFB using Release 9 SI Tunneling, for both 3G and 2G offer call delays within subseconds of legacy call setup delay
- Redirection-based CSFB offers call reliability on par with legacy call setup reliability
- Compared to dual radio solution, e1xCSFB offers more cost effective device solution and also with shorter call setup delay
- Additional details on CSFB are also available at: http://www.qualcomm.com/media/documents/circuit-switched-fallback-first-phase-voice-evolution-mobile-lte-devices

Thank You

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Agenda

4G World Wednesday October 31st 1:30pm to 4:30pm

- **1:30 pm The 1000x mobile data challenge**
  - 1:30 How do we enable 1000x? — Rasmus Hellberg, Sr Director, Tech Marketing,
  - 1:45 How do we get access to new spectrum to reach 1000x? — Prakash Sangam Director, Tech Marketing
  - 2:00 Taking HetNets to the next level for 1000x — Rasmus Hellberg Sr Director, Tech Marketing
  - 2:15 The small cell products to power 1000x (3G/4G small cells, Wi-Fi) — Prakash Sangam Director, Tech Marketing
- **2:45pm The Chipset evolution and multimode challenges**
  - 2:45 Smartphone signaling and power enhancements — Sunil Patil, Director, Product Management
  - 3:05 Solving the global multimode and carrier aggregation challenges — Peter Carson ,Sr Director Marketing
  - 3:25 Circuit switched fallback, performance and interworking (LTE FDD/TDD GSM, UMTS, TD-SCDMA, 1X) — Sunil Patil, Director, Product Management
- **3:45pm The Voice and data Service evolution—together with Ericsson**
  - 3:45 The latest on VoLTE (RCS, SRVCC VoLTE, VoIP over other accesses), — Eric Parsons, Strategic Product Manager, LTE, Ericsson
  - 4:00 How do we achieve the Smart Pipe? (QoS and more) — Peter Carson, Sr Director Marketing
  - 4:10 LTE Broadcast services and opportunities — Mazen Chmaytelli, Sr Dir, Business Dev.