Push to Talk over Cellular (PoC) - Ensuring the User Experience through Lab-Based Testing
• Introduction
• Why PoC?
• PoC Performance
• Performance Testing
• Functional Testing
• A Lab-based Test Approach
• Conclusions
Why PoC?

• The successful deployment of CDMA2000 is enabling new, data-oriented services to be reliably launched

• CDMA carriers are looking to maximize the return on their deployment investment

• Push to Talk over Cellular (PoC) is being widely touted as the next Killer Application
  ➢ Already shown to increase ARPU and reduce churn
Why evaluate PoC performance?

• Several PoC deployments have been throttled back after rapid subscriber adoption identified performance issues

• Subscribers expect the *End User Experience* to be comparable to existing analogous services:
  - CDMA circuit-switched voice
  - Existing PoC implementations (ex: Nextel)

Carriers’ return on their PoC deployment investment will depend on meeting End User expectations
Key PoC performance issues

- Timing
- Speech Quality
- Robustness of Service
  - Availability
  - Interoperability
How are performance issues analyzed?

- **Performance Tests**
  - Delay Measurements – *What delays are important to the End User?*
    - Call Set Up, Audio, and Floor Availability
  - Voice Quality Measurements – *What Voice Quality metrics capture the End User Experience?*
    - PESQ, Jitter, Hold-Over-Time, Front End Clipping

- **Functional Tests**
  - Protocol Testing – *How will the Handset respond to Network Interoperability Issues?*
    - Retry Timer Evaluation, Error Handling Processing, etc.
  - User Interface Testing – *How do we verify that Accurate Information is conveyed to the End User?*
    - Presence (A Chargeable Feature), Data Network Availability
Test Opportunities on a typical PoC Call

PoC Control Server

CDMA 2000
RAN

User 1 Registers
CS Sends Buddies
User 1 Pushes Talk
Network Free
User 1 Talks
Network Free
User 2 Pushes Talk
User 2 Talks
Network Free
New Call Attempt
SIP Error Message

Audio Voice Quality

Call Setup or Floor Availability Delay

User Interface Verification

Protocol / Messaging Error
The following delays are easily detectable by the End User and directly impact his/her perception of service quality:

- **Power-Up Delay** - How long from Power On until the Handset is Registered?

- **Call Setup Delay** – How long for the User to be Granted the Floor or How long does it take for the call to actually be configured (from a SIP Messaging Perspective)?

- **Audio Delay** – How long does take from the time that the transmitter speaks to the time that the receiver hears?

- **Floor Availability Delay** - How long does it take from the time the floor is released until the other user is granted the floor?
The following voice quality metrics impact perception of service quality on all Handset Audio Interfaces (Speakerphone, Headset, etc):

- **PESQ - Perceptual Evaluation of Speech Quality**
  - An **objective** and automated method used to measure Voice Quality
  - “Ship the Enron Documents to the Feds” might sound like “Rip the Enron Documents to Shreds”

- **Jitter – Variable Transmission Delays inherent to a Packet Network**
  - “I didn’t get a keyboard with my PC” might sound like “I didn’t get a key”…“bored with my PC”

- **FEC – Front End Clipping**
  - “Don’t Shoot” might become “Shoot”

*It is essential to have objective metrics for characterizing these performance issues*
Functional Testing: Protocol

- How does the handset respond to following interoperability issues, which could impact the robustness of PoC service:
  - Network Element Failure Scenarios
    - Release Order Message (Traffic or Paging Channel)
      - Retry Timer Impacts
    - ReOrder Order Message
    - CHAP/PAP Authentication Failure
  - PoC Error Code Responses
    - SIP Error 404 (HS Not Authorized), 480 (PoC Service Temporarily Not Available), 500 (Internal Server Error), etc.
  - No Response at All – Network Element Out of Service

Verification of interoperability is critical to ensuring robust service
Functional Testing: User Interface

• The user interface must correctly represent service status. The following tests can be used to establish this:
  
  ➢ Icon Verification Testing
    • Network Availability (Data Service Available or Not?)
    • Icon Message Indicators (Correct Meaning Presented?)
  
  ➢ Presence Verification Testing
    • Online vs. Offline Buddy / Group Information
    • Inclusion or Blocking of Presence Information
  
  ➢ Group List Management
    • Adding / Deleting / Renaming / etc.

Accuracy of the User Interface is essential when End Users are paying for these additional features (Presence / Group Management)
Why lab-based PoC testing is the best approach

- **Repeatable**
  - eliminates the performance variability of live networks to obtain accurate handset metrics

- **Programmable**
  - enables definition of network and radio channel characteristics in any desired combination to characterize handset performance over a wide range of operating conditions

- **Enables Adversarial Test**
  - provides the handset with on-demand error scenarios which cannot be easily introduced into live networks

- **Test efficiency**
  - network is always accessible and test procedures / results analysis can be fully automated

Lab Based Testing will reduce the number of issues that escape to the field and adversely impact the End User Experience!
PoC Lab-Based Test Solution

Wireless Channel Emulator

RF

CDMA Network Emulator

IP

Mobile Under Test

Analog Audio

PoC Test Packs

Diagnostic Monitor

CDMA Network SW

Voice Quality Analysis SW

Voice Xmit

Emulated “Golden” Mobile

Analog Audio

PoC Switch Emulator

VoIP EVRC Speech

PTT Test Path

Note: Traffic shown in one direction, but can be bi-directional.
Conclusions

• The success of PoC depends on End User Satisfaction with the deployed service

• End User Satisfaction is highly sensitive to handset performance issues

• PoC service can be optimized through comprehensive evaluation of timing delays, speech quality and service robustness

• Lab-based testing provides
  - The widest range of test coverage
  - Isolation of handset performance to obtain accurate metrics
  - Improved test efficiency through automated test execution and results analysis