



The Impact of Smartphones on 3G Network Performance

May 20, 2010

Presentation Outline

- What is the real issue with smartphones?
- Quantifying the problem
- Proving that the problem exists (network test results)
- Solving the problem

A brief introduction to Signals Research Group LLC

- Signals Research Group, LLC offers thought-leading field research and proprietary consulting services on the wireless telecommunications industry.
- Our flagship research product, a research newsletter entitled *Signals Ahead*, includes subscribers on five continents across the entire wireless ecosystem.
- Publisher of *The Dollars and Sense of Broadband Wireless*, <http://www.signalsresearch.com>.



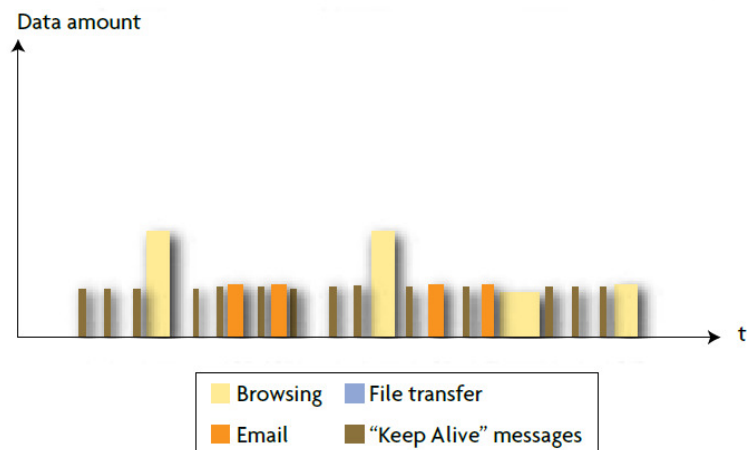
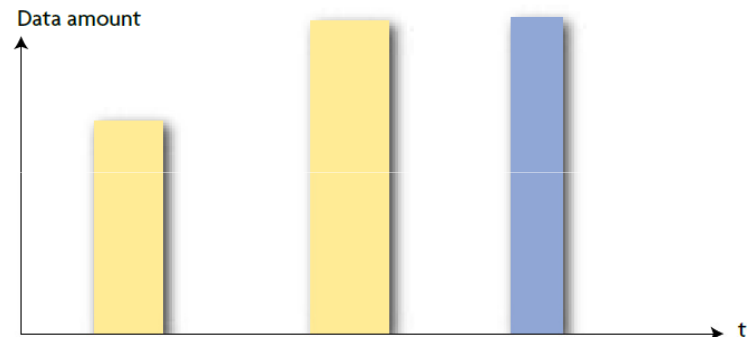
What is the real issue with smartphones?

- Congestion is problematic on many 3G networks in a number of markets throughout the US and the world.
 - Dropped calls/failed call attempts
 - Low data rates and/or slow response times
- Concurrent with this growing problem there has been a rapid uptake in the adoption of usage of smartphones.
 - ~13-15% of the handset market
 - The iPhone/AT&T connection is the most evident and widely-discussed
 - Highest usage, widest adoption, biggest problem
- Smartphones are the problem, but it isn't the data usage.

Key Observations

- Operators always prioritize real-time voice traffic over data traffic
 - Capacity held in reserve for circuit-switched voice traffic
 - Additional capacity made available when necessary
- High data usage is concentrated among a small group of subscribers, yet the network congestion blankets entire markets.
- The problems are real, the culprit is the smartphone, but not the data usage, per se.

Quantifying the Problem

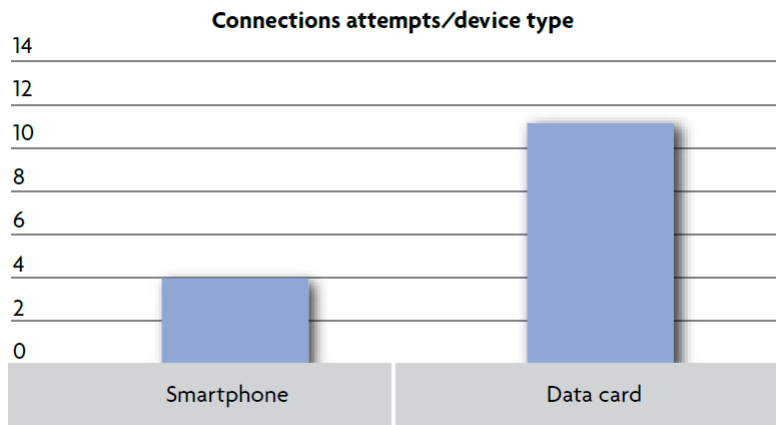
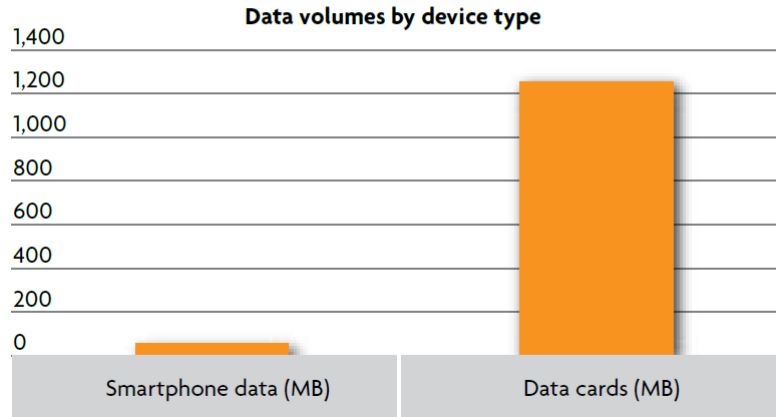


Source: Nokia (recreated by SRG)

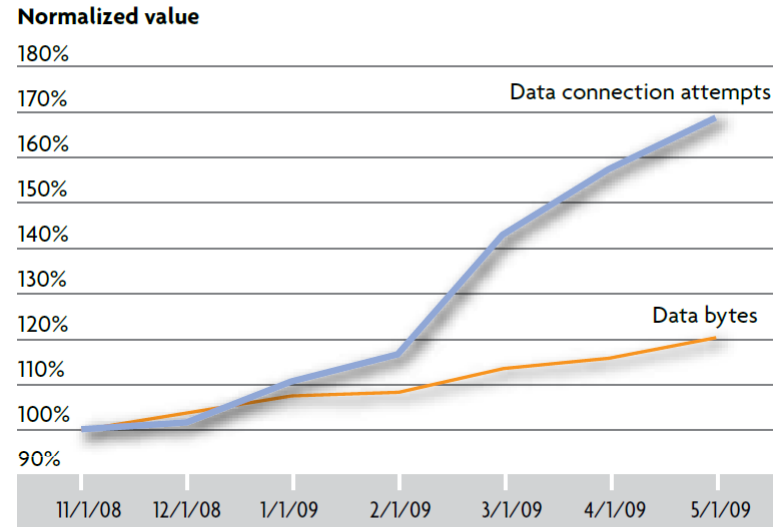
- 3G was designed and implemented to support large amounts of data traffic.
 - Long, uninterrupted data sessions (video conferencing, etc)
 - Focus on bandwidth and throughput
- The reality is that signaling traffic is outpacing data traffic by 30-50%, if not higher.

Quantifying the Problem

Amount of Transmitted Data per Connection – smartphones versus data cards



The Growth of Mobile Data Traffic Versus Data Connection Attempts



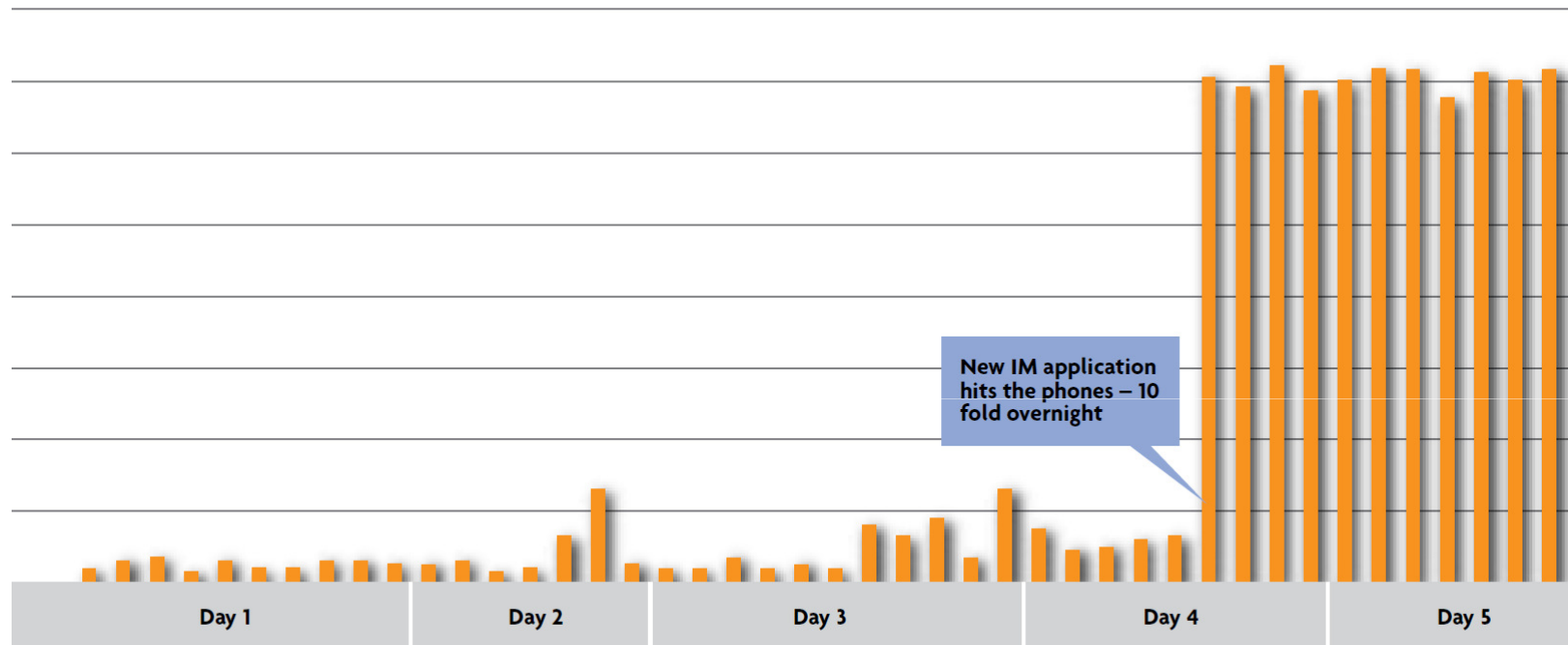
Source: Airvana (recreated by SRG)

- Data collected over a six-month period.
- The growth of signaling traffic outpaced data traffic
 - 70% versus 20%

Quantifying the Problem

The Impact of Instant Messaging on a 3G Network

RAB Completions



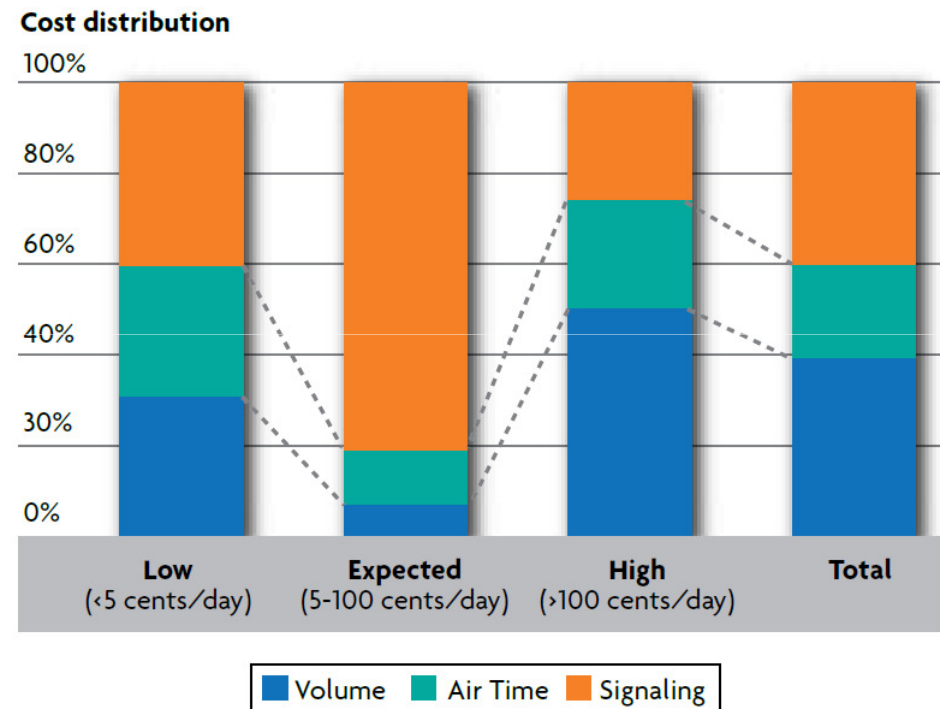
Source: Industry Sources (recreated by SRG)

- Figure shows the dramatic spike in signaling traffic, not data traffic
 - chattiness of application, “keep alive” messages, and fast dormancy

Quantifying the Problem

- The amount of data traffic sent on a network only has a modest impact on network delivery costs.
- Signaling traffic can account for as much as 70% of a subscriber's contribution to network costs.
- On average, airtime + signaling account for 60% of the cost.

Distribution of Network Delivery Costs – per subscriber based on usage levels

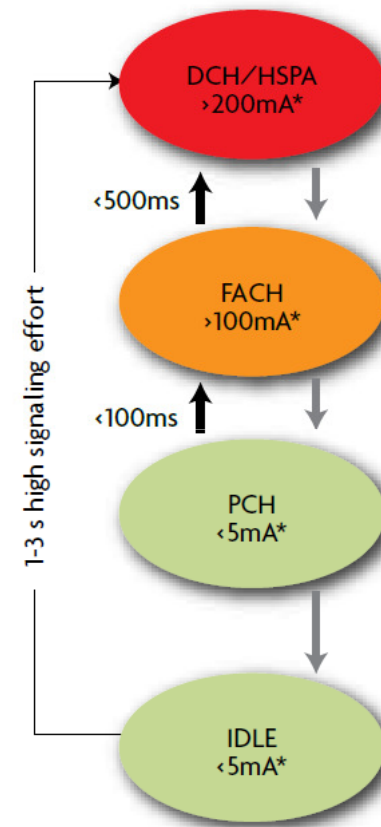


Source: Alcatel Lucent (recreated by SRG)

A Technical Sidebar Discussion

- Cell_DCH (Dedicated Channel) is what is commonly used to send/receive data or make a phone call.
- Cell_FACH (Forward Access Channel) is used to send/receive some data in a shared channel.
- Cell_PCH (Paging Channel) – mobile device monitors network for activity/messages

Mobile Phone State Transitions



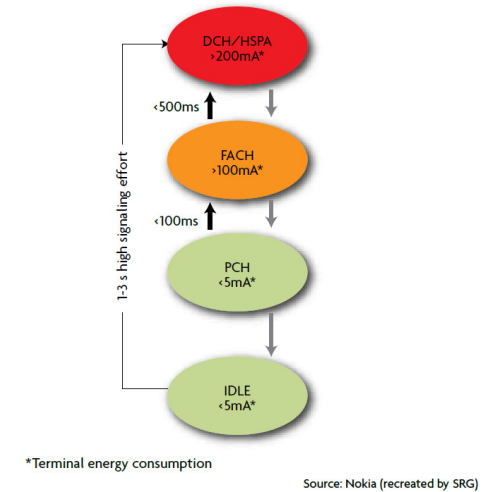
*Terminal energy consumption

Source: Nokia (recreated by SRG)

A Technical Sidebar Discussion – Part II

- Each time a mobile phone makes a state transition change it generates signaling traffic.
 - ~30 messages to go between Idle and DCH
 - ~7 messages between Cell_PCH and Cell_DCH
 - ~2 messages between Cell_PCH and Cell_FACH

Mobile Phone State Transitions



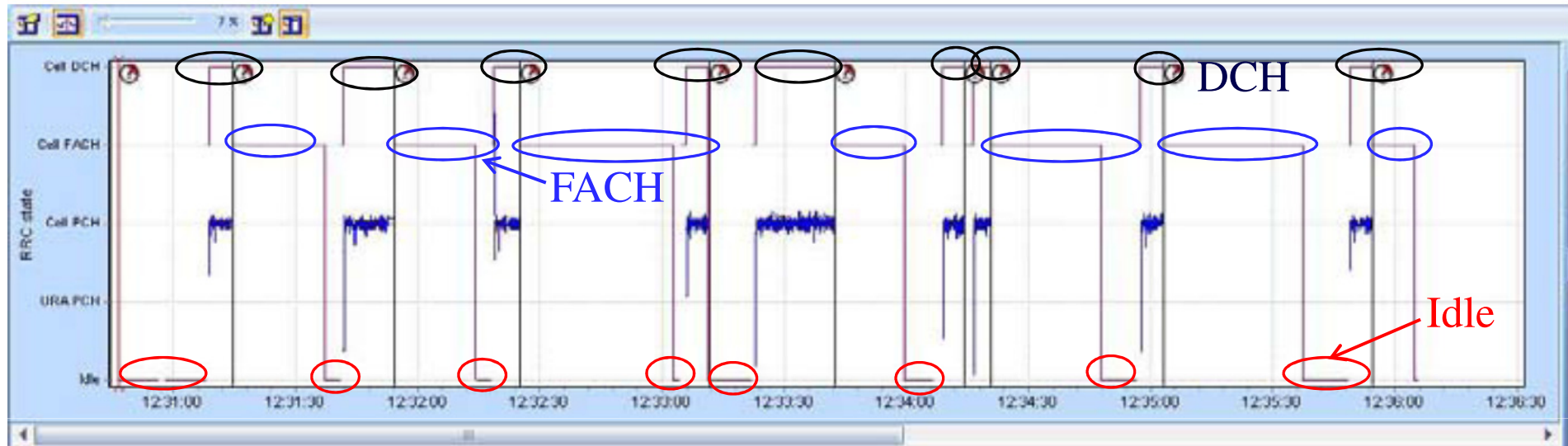
- The number of messages for setting up a voice call versus a data session are largely comparable, although different network elements could be impacted.
- Herein lies the problem: Network elements are over-burdened with processing signaling messages that they lack sufficient resources to handle the data traffic.

Proving the Problem Exists – Test Methodology

- We leveraged two smartphones along with sophisticated test equipment to log the data and signaling traffic.
 - Nokia N85 and N97 handsets
 - Anite Nemo Handy drive test solution and Anite Nemo Outdoor post-processing tool
- We loaded several typical smartphone applications on the N97 and then proceeded to log the underlying phone interactions with the network. The remaining [unaltered] handset was used as a reference.
 - Fring application (Yahoo IM, Facebook, Skype, etc)
 - Web surfing, POP3 email, FindMe, FTP, YouTube

Proving the Problem Exists

RRC State Transition Changes – N97 while using Yahoo IM with the fring application

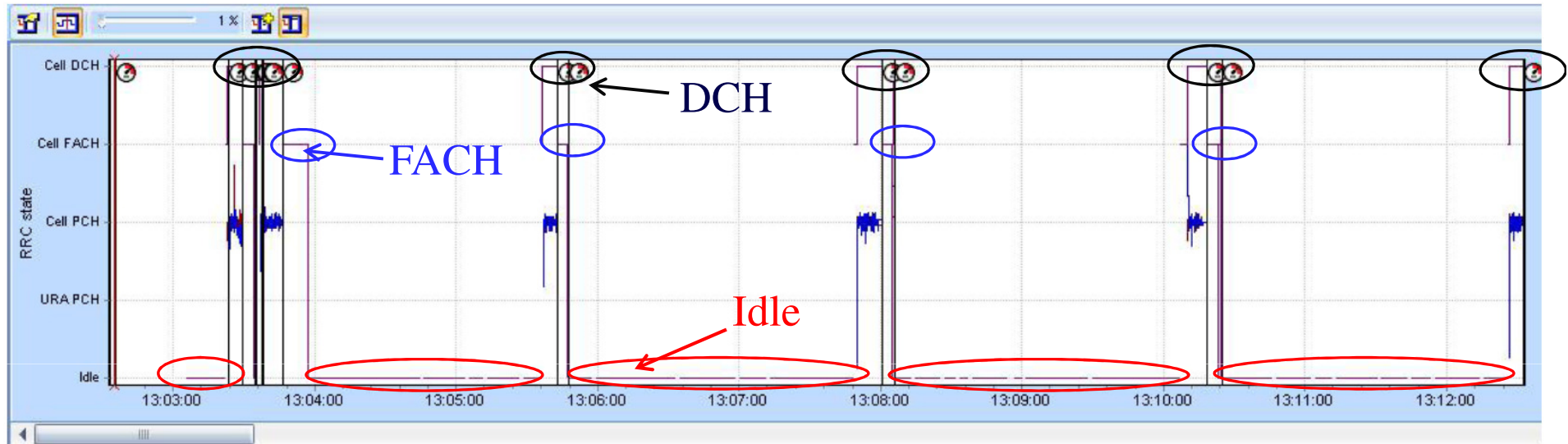


Source: Signals Research Group, LLC

- Test scenario involves sending/receiving 9 Yahoo IM messages.
 - 5 min test period
 - 320 RRC messages
 - A single IM requires 26-43.5 seconds of network resources
 - Average payload = 325-575 bytes or the equivalent of ~2-3 SMS messages
- From a signaling perspective, each Yahoo IM is roughly the equivalent of placing a voice call.

Proving the Problem Exists

RRC State Transition Changes – N97 with active background applications running over an extended period



Source: Signals Research Group, LLC

- Test scenario involves the smartphone in “idle” mode and demonstrates the impact of unnecessary signaling traffic.
 - 68.3 minute test
 - Yahoo IM “Keep Alive” messages every 130-140 seconds (150 bytes of data)
 - 13-15 seconds per activity
 - 148 cell reselections

Proving the Problem Exists – battery life implications

The Impact of “Keep Alive” Messages on Battery Life

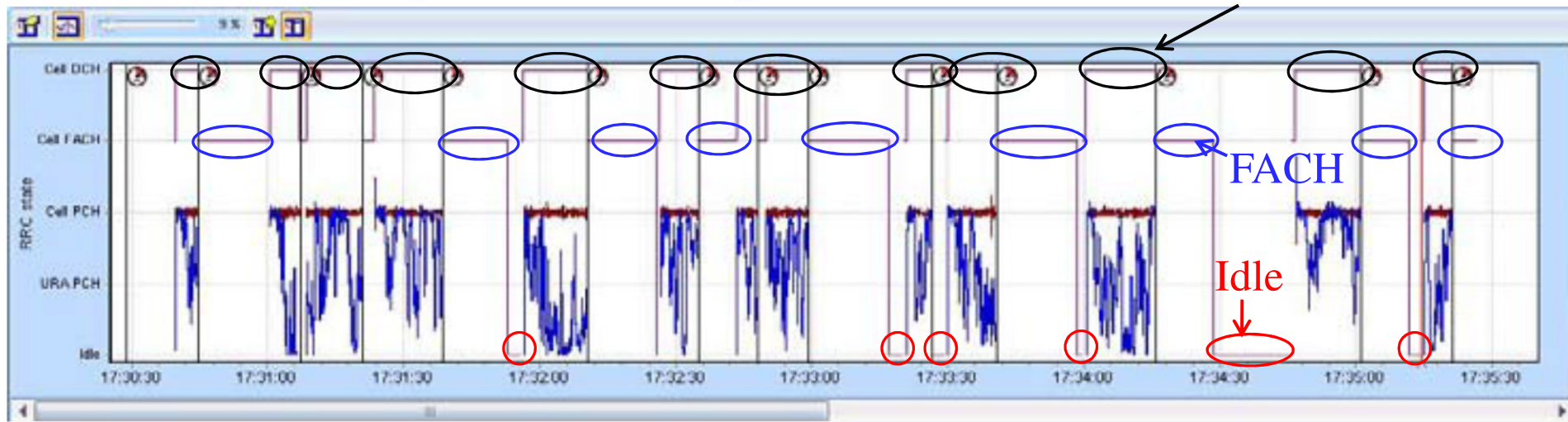
| “Keep Alive” Message Frequency (minutes) | Time Required to Equate to a Full Hour of the Backlight Turned On (hours) |
|--|---|
| 1 | 7.53 |
| 2 | 15.06 |
| 3 | 22.59 |
| 4 | 30.12 |

Source: Signals Research Group, LLC

- 8 hours of keep alive messages = 1 hour with the backlight turned on.

Proving the Problem Exists

RRC State Transition Changes – N97 while surfing the Internet



Source: Signals Research Group, LLC

- Test scenario involves using the browser to surf the CNN mobile website
 - 3 min 40 sec test
 - 12 transitions to Cell_DCH = 344 RRC messages
 - Average DCH payload = 38-48kB

Solving the Problem

- Implement Enhanced Cell_FACH (a Release 7 “HSPA+” feature).
 - FACH behaves like a DCH channel
 - No need to use DCH under many scenarios
 - improved latency
 - reduced signaling
 - improved battery life
- Implement Cell_PCH.
 - 4x less signaling traffic when moving to DCH versus Idle
 - Only 2 signaling messages required when combined with Enhanced_FACH to send an IM (versus 30 today without PCH implemented)
 - Equivalent power consumption requirements versus Idle

Solving the Problem

- Work with the vendor community and application developers.
 - Educate
 - Battery saving features like “fast dormancy” have a detrimental impact if not implemented correctly
- Network Architecture Enhancements.
 - Femtocells – offload data and signaling traffic from the macro network
 - Enterprise “mini-RAN” solutions, based on Wi-Fi and/or 3G
 - Intelligent offloading of data/signaling traffic onto other networks, such as Wi-Fi
- Intelligent Network Monitoring, such as deep packet inspection.