The Impact of Smartphones on 3G Network Performance

April 14, 2010

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Presentation Outline

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

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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.

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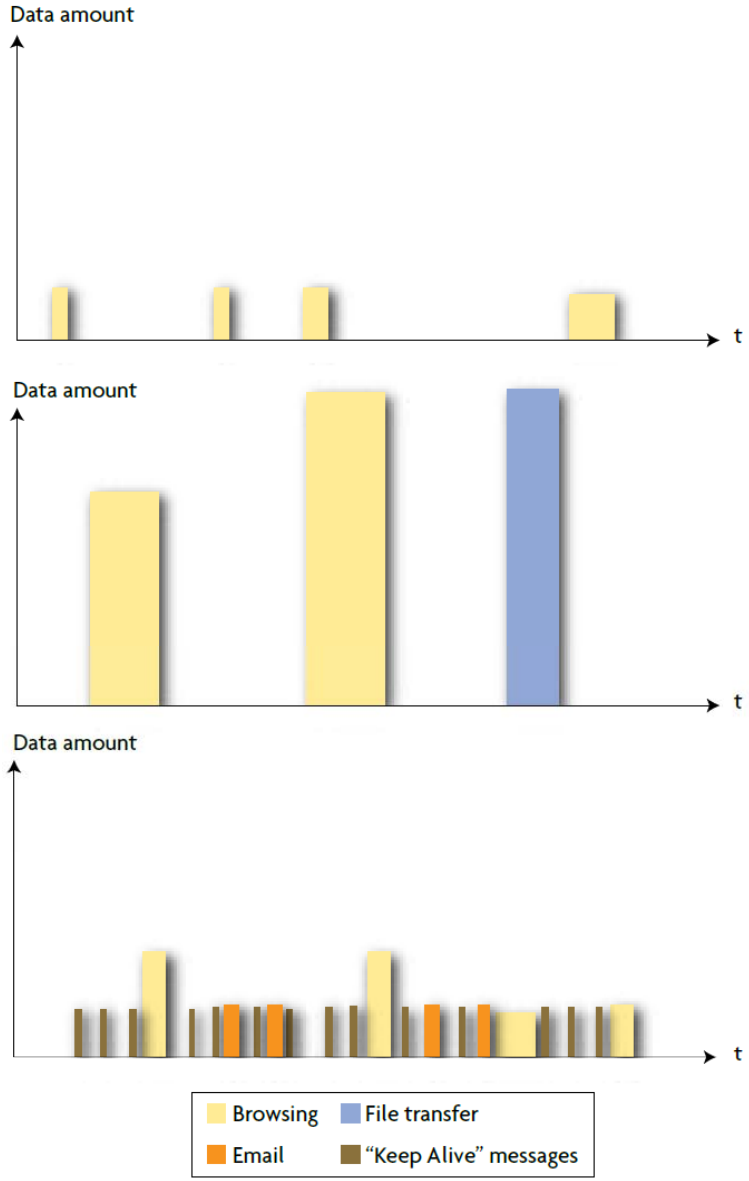
Key Observations

- 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.

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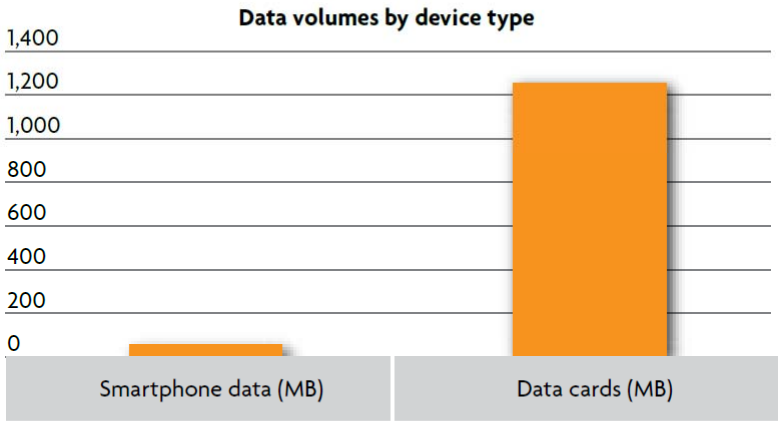
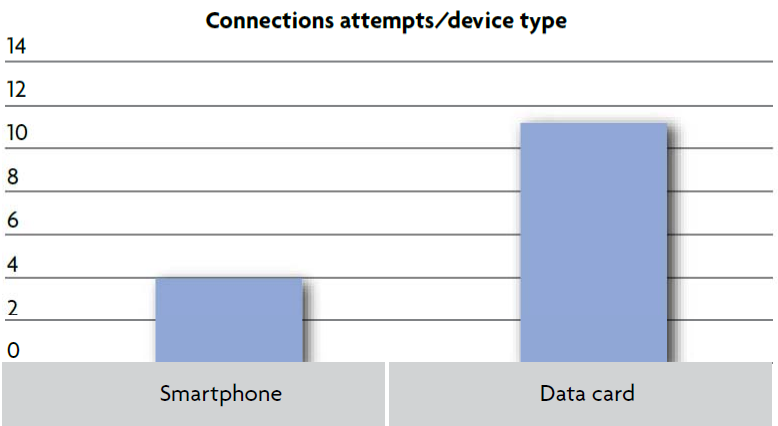
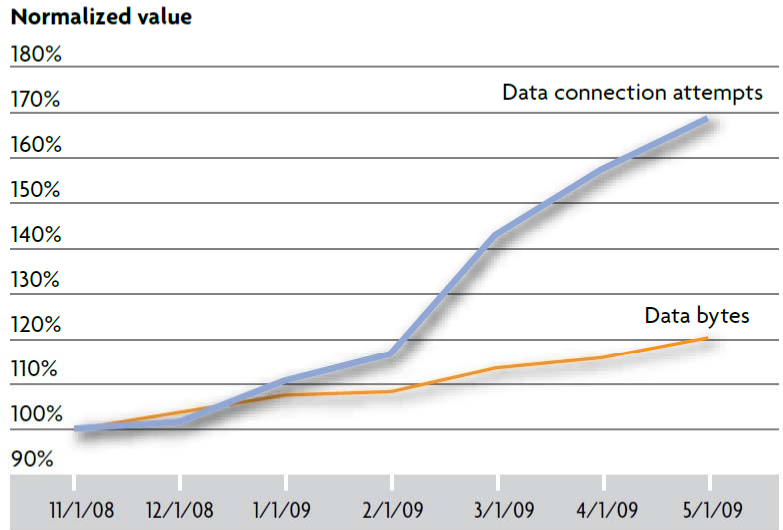
Quantifying the Problem

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%

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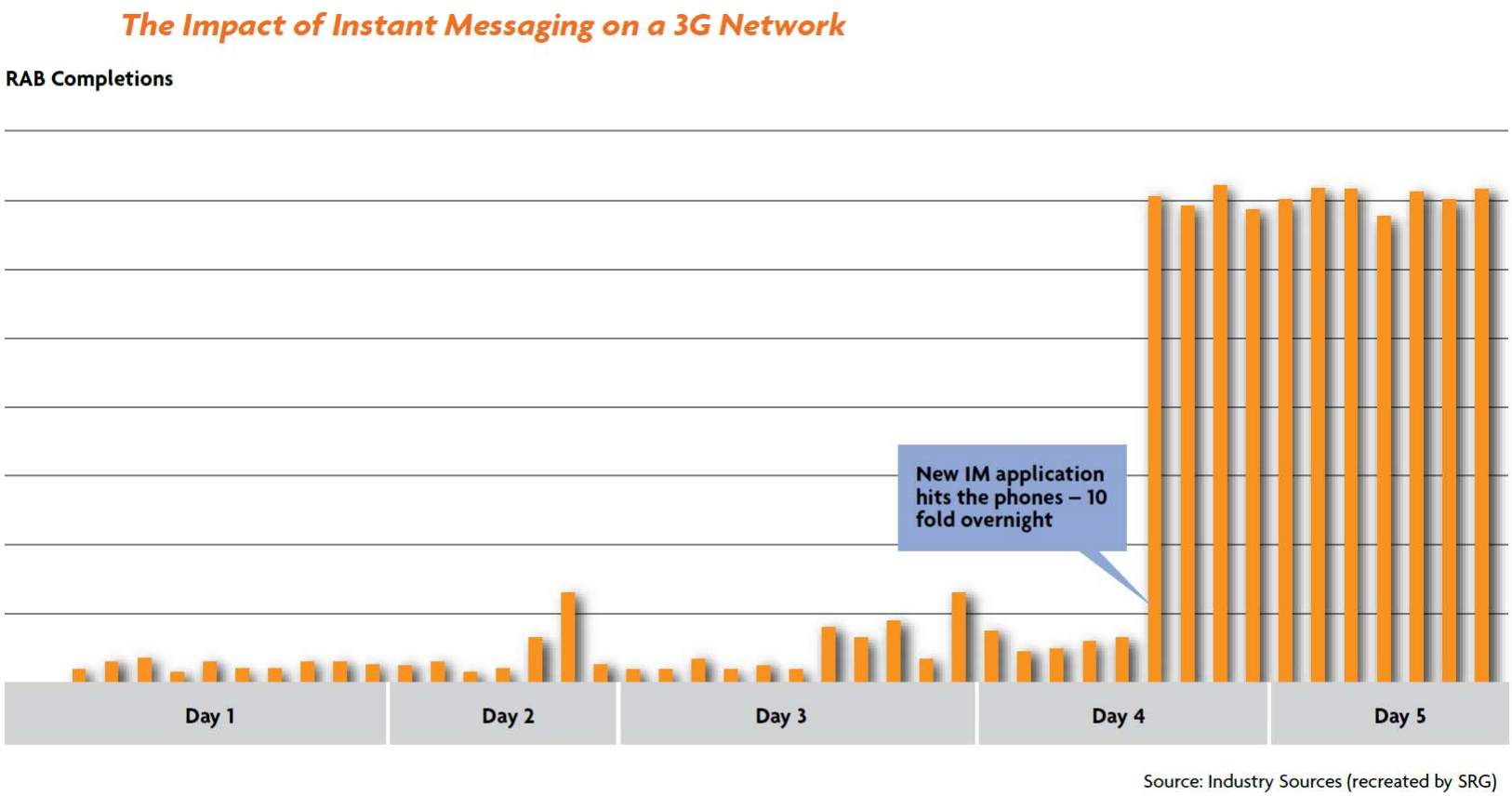
Quantifying the Problem



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

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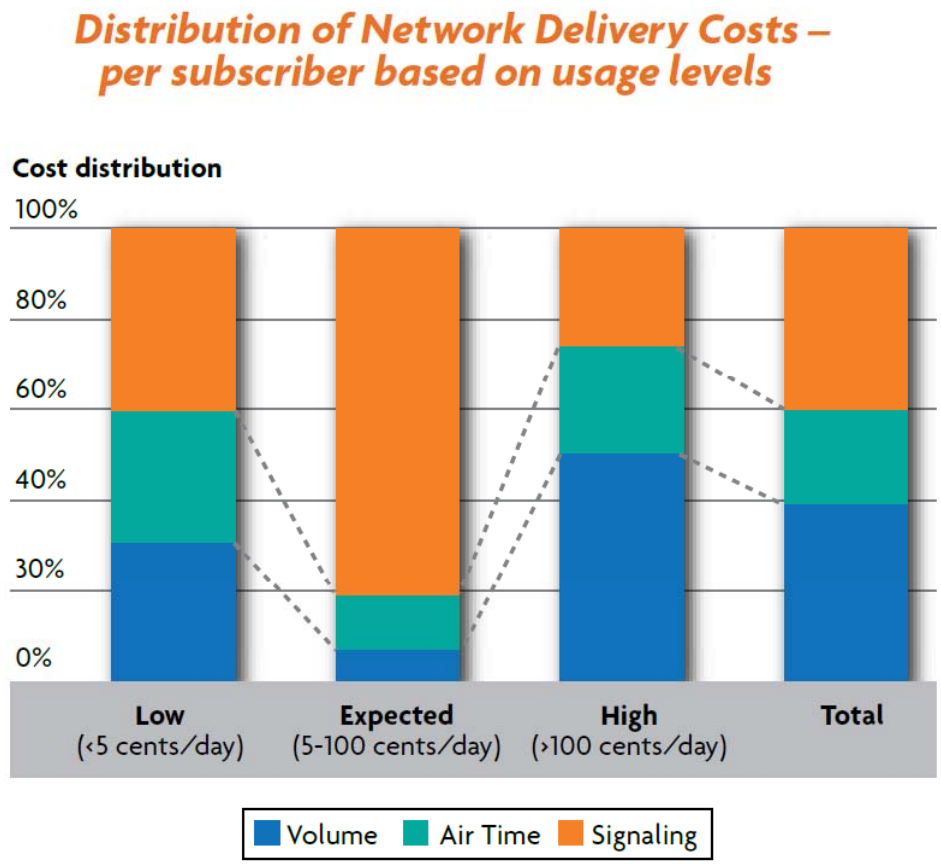
Quantifying the Problem

- 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.



Source: Alcatel Lucent (recreated by SRG)

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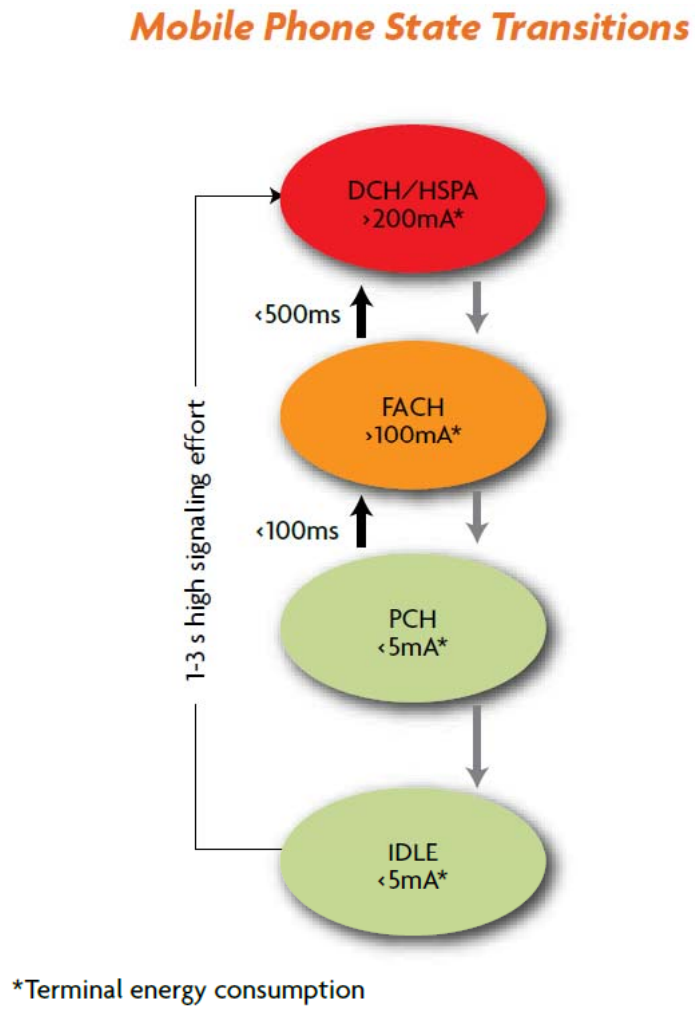
A Technical Sidebar Discussion

- 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



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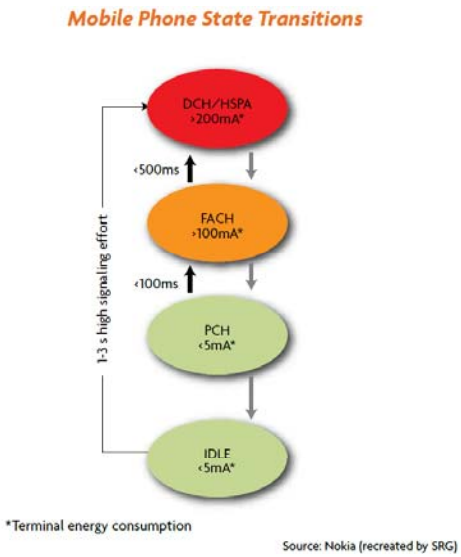
A Technical Sidebar Discussion – Part II



- 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
- 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.

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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

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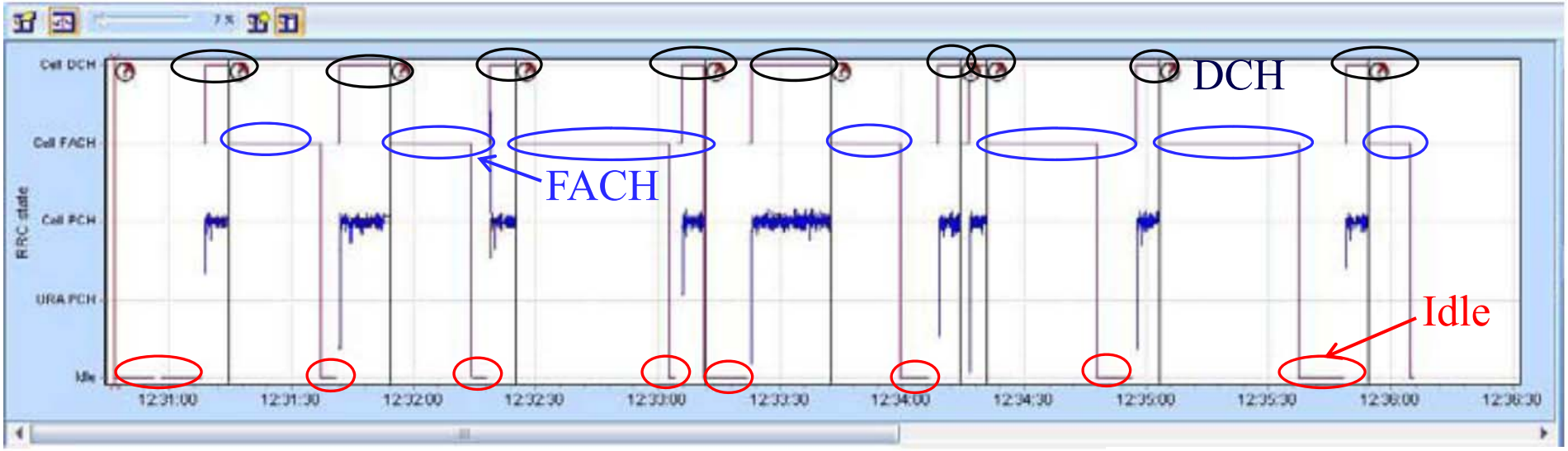
Proving the Problem Exists

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.

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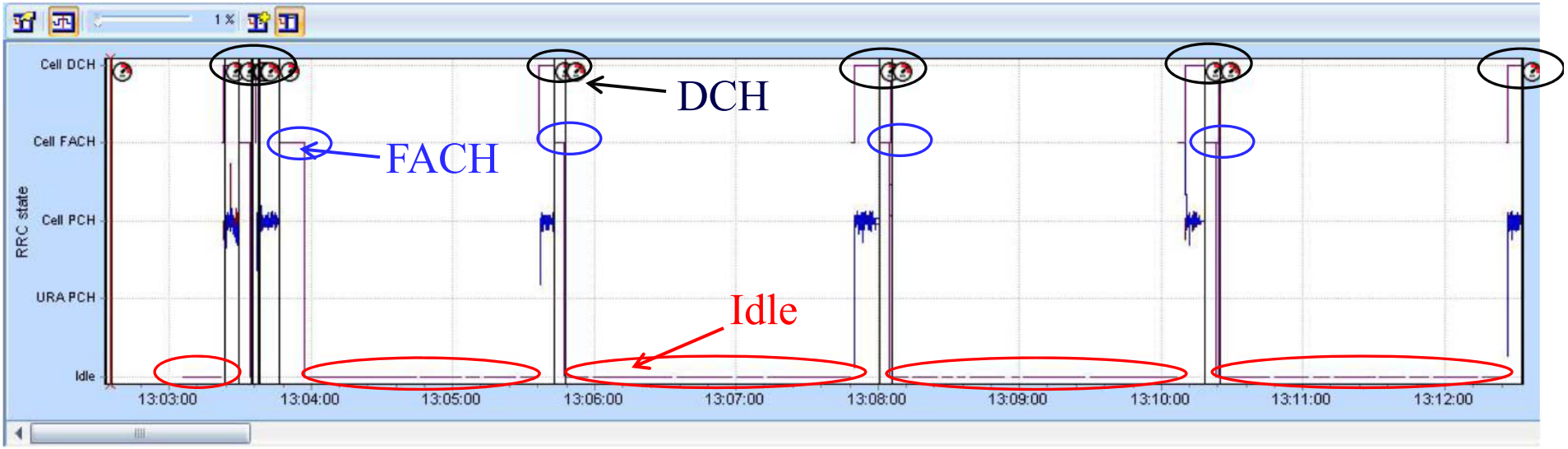
Proving the Problem Exists

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

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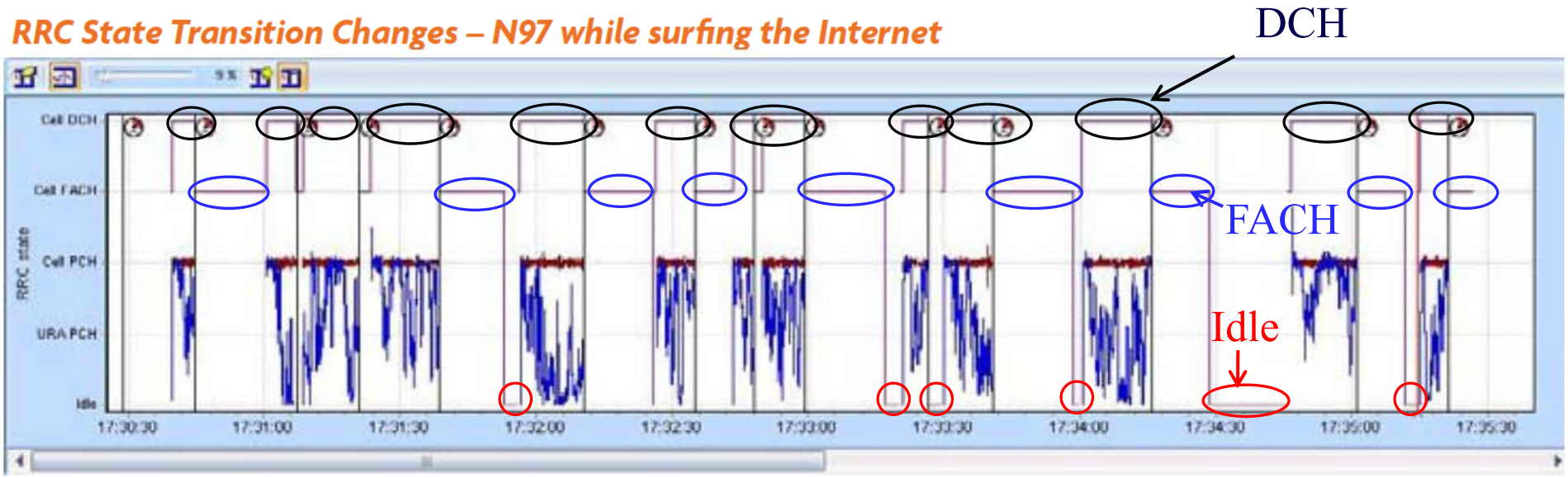
Proving the Problem Exists



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

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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

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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.

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