

WLAN/Cellular Convergence

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What Will Be Covered

Market Overview

WLAN Infrastructure Issues

Potential Configurations

- Non-Integrated Solutions
- PBX Controlled Solutions
- Carrier Controlled Solutions

Cellular Carriers Views on WLAN Integration

Overview

- The general interest in IP Voice and Wireless LAN makes their combination almost inevitable
- A mobile VoIP solution that incorporated cellular service would offer far more functionality
- Unfortunately, WLANs were not designed for voice, so special care must be taken in the network design to meet the users' expectations for performance, security, and reliability
- There are available "work-around" solutions for WLAN/cellular convergence, however, providing the desired functionality requires a full buy-in by the cellular carrier.

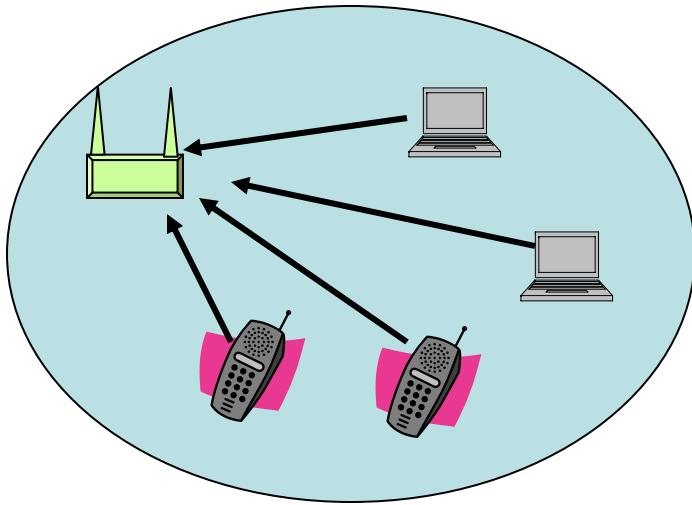
The Big Picture...

- WLAN Telephony of "Vo-Fi" is in its infancy
 - Fewer than 1% of WLAN stations
 - Small number of handset products to compare
 - Developing Standards
- WLAN/Cellular convergence is "pre-natal!"
 - Few installations worldwide
 - Some integrated handsets, but no commitment from any US cellular carriers

Part 1: WLAN Infrastructure

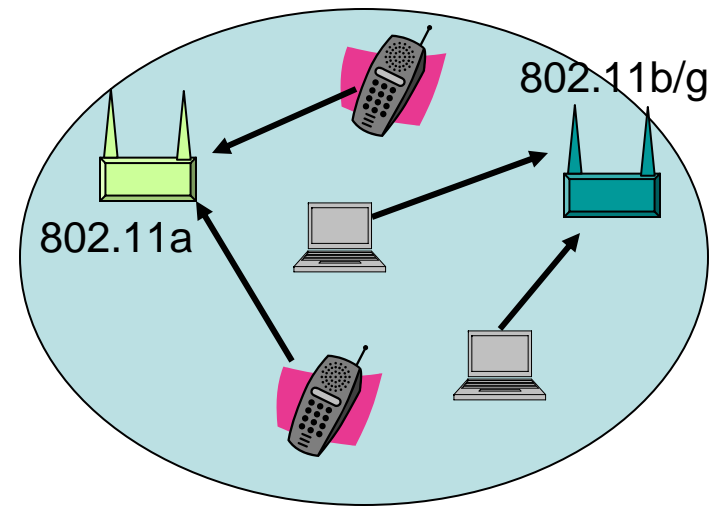
Potential WLAN Configurations

Integrated Voice/Data
WLAN



QoS Required to Prioritize Voice

Dual Overlay Network



- 802.11a has more channels (23)
- 802.11b provides longer battery life

WLAN Infrastructure Issues

- WLAN Switch Recommended
- Pervasive Coverage Required
- Voice Signaling
 - Proprietary
 - SIP
- Capacity Issues
 - Radio Link (802.11a, b, g, or n)
 - Quality of Service (802.11e/WMM, SVP, Meru)
 - Call Access Control/Load Balancing
 - Network Management, Monitoring, Troubleshooting
- Security (WPA or 802.11i/WPA2)
- Handoff Capability (802.11r or Proprietary)

Battery Issue

- Battery life for Wi-Fi Phones is roughly half of cellular battery life
- Most Wi-Fi phones use 802.11b
 - Lower network capacity
 - Longer battery life than 802.11a or g!

IEEE 802.11 Radio Links

Interface	Max. Bit Rate	Independent Channels	Frequency Band	Radio Technique
802.11b	11 Mbps	3	2.4 GHz	DSSS
802.11a	54 Mbps	23	5 GHz	OFDM
802.11g	54 Mbps	3	2.4 GHz	OFDM
802.11n	289 Mbps (20 MHz) 600 Mbps (40 MHz)	26 (20 MHz)	2.4 or 5 GHz	OFDM/MIMO

Part 2: WLAN/Cellular Integration Options

Current Environment

- Cellular telephones are an anomaly in modern business communications
- Not connected to any other part of the organizations' network infrastructure, they are costly, stand-alone personal communicators
- Roughly 50% are employee-owned and charges are expensed
 - No cost tracking
 - No corporate discount
 - No separation of personal/business calls
- With cellular costs rising, enterprise customers are looking for more functional cost-effective solutions for mobile communications

Cell Phone vs. WLAN Phone

Cellular Technology

- Switching: Circuit-based
- Frequency Band (Licensed)
 - 824-890MHz/1.8-1.9GHz
- Frequency Division Duplex
- Radio Technology
 - GSM: TMDA (8), 200 KHz channel
 - CDMA: DSSS, 1.25 MHz channel
- Voice Coding
 - GSM: RPE-LTP (13 Kbps)
 - CDMA: QCELP (1.2 -9.6 Kbps)
- Encryption: Standard
- Hand-off Mechanism: Standard

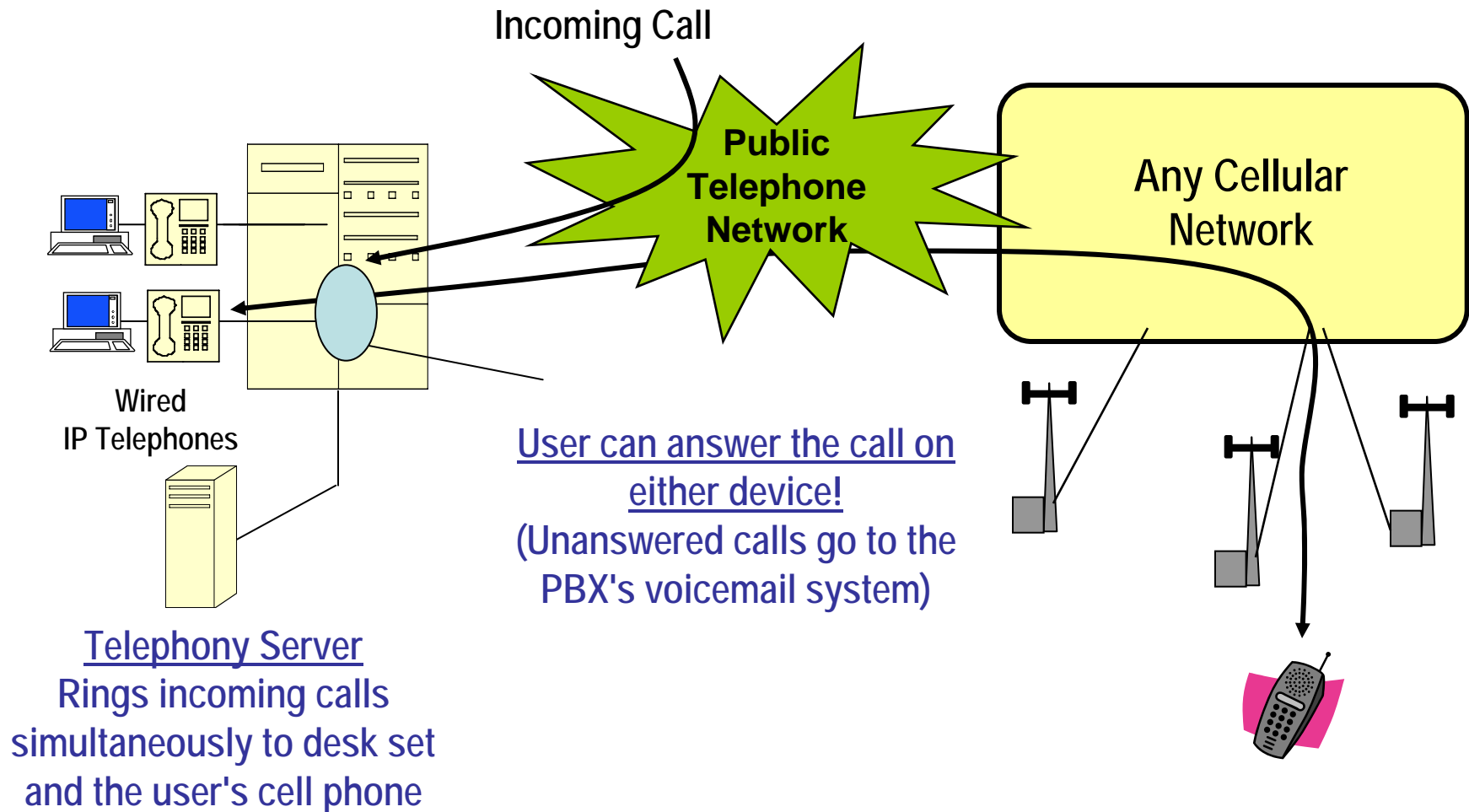
WLAN Voice Technology

- Switching: Packet-based
- Frequency Band (Unlicensed)
 - 2.4GHz/5GHz
- Time Division Duplex
- Radio Technology
 - 802.11b DSSS, 22 MHz channel
 - 802.11a/g: OFDM 20 MHz channel
- Voice Coding
 - G.711 (64 Kbps)
 - G.729a (8 Kbps)
- Encryption : User Specified
 - WEP, WPA, WPA2/802.11i
- Hand-off: Vendor Proprietary
 - 802.11r Planned (2007?)

Integration Options

- Non-Integrated Solutions
 - Extension to Cellular
 - Dual Mode Handsets
- PBX Controlled Solution
- Carrier Controlled Solution

Extension to Cellular



WLAN/Cellular Handsets

- The Wi-Fi Alliance lists 26 Certified Models (7/06)
 - D-Link: 1 model
 - Motorola: 2 models
 - Nokia: 10 models
 - Phillips: 1 model
 - Samsung: 10 models
 - Sanyo: 1 model
 - Sony: 1 model
- Most are not available in the US

Integrated Handset Solution

- Solution Elements:
 - WLAN/Cellular Handset
 - Cellular Service
 - Wireless LAN
 - SIP-capable WLAN Voice Infrastructure
 - Public Hot Spot (Signaling: PSipTN)
- Network Integration: None
 - User selects network via the handset
 - No handoff capability
- Advantage: One handset rather than two
 - Wi-Fi Battery life is still an issue

Assessment Non-integrated Solution

- Better than nothing!
- More attractive handsets than Wi-Fi only
- Wi-Fi/Cellular handoff is nice, but how often is it really going to happen?
- The user can have the benefit of a single handset but they have to live with the shortcomings

Integrated Network Solutions

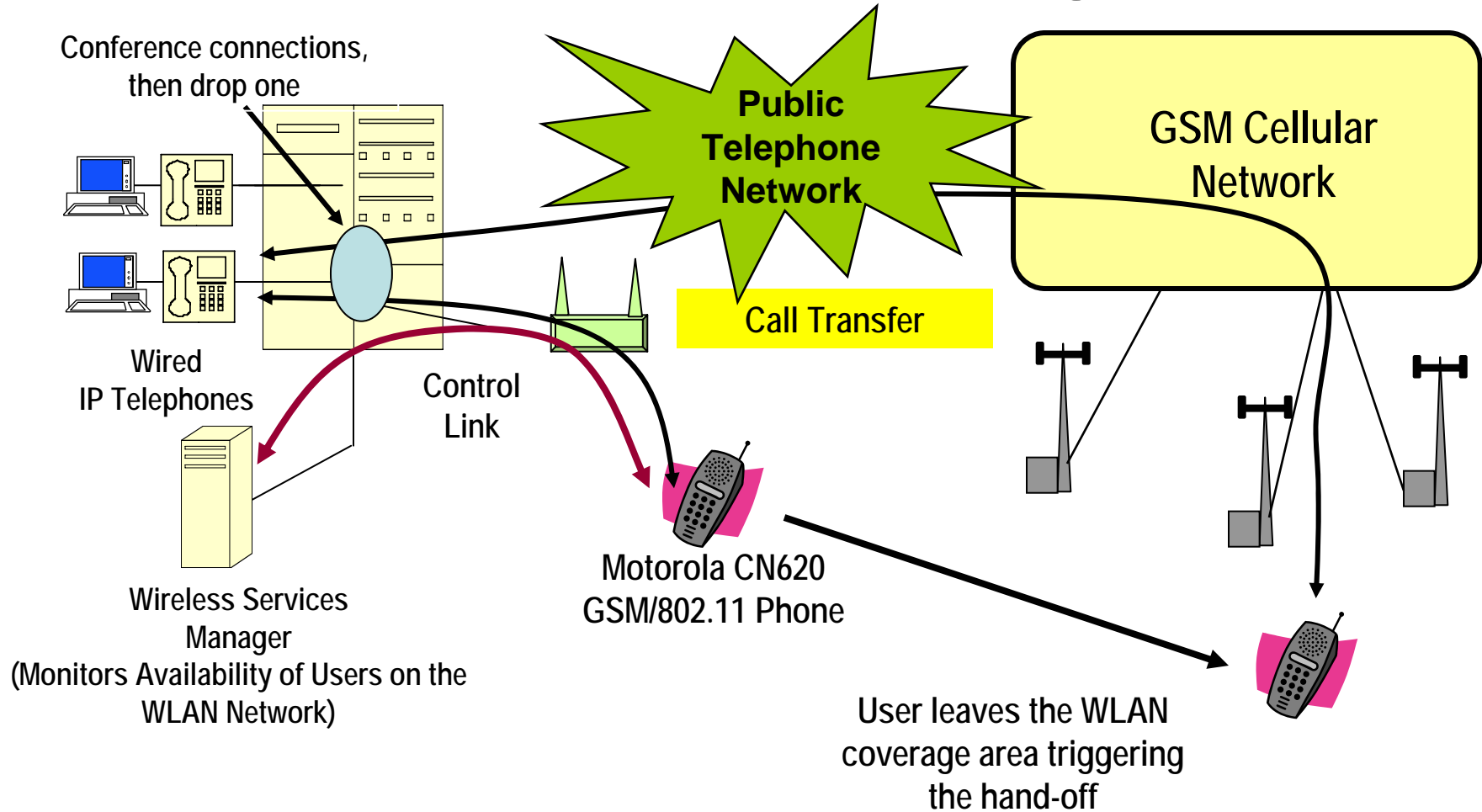
- Two major strategies for integrating WLANs and cellular services:
 - PBX Coordinated Solution
 - The customer installs a server on their private network that coordinates the transfer of calls between the WLAN and the cellular network
 - No physical work is required from the cellular carrier, but they still must certify the handsets (i.e. they can still block the implementation)
 - Carrier Coordinated Solution
 - The carrier installs a special server in their network and essentially treats the WLAN or VoIP network as a peer

Seamless Convergence

First Functional Wi-Fi/Cellular Convergence System

- **Avaya:**
 - IP PBX System
 - The Avaya Communication Manager
- **Proxim (acquired by Terabeam):**
 - Wireless LAN Switching System
- **Motorola:**
 - CN620 WLAN/802.11 Handset
 - Wireless Services Manager

Seamless Convergence



IP-PBX/Cellular "Hand Off"

1. WLAN call in progress and the Wireless Services Manager recognizes the station is moving out of range
2. The PBX places a call on an outbound trunk to the user's cell phone number.
3. The cell phone element of the user's CN620 recognizes that the calling number is the PBX, so it doesn't ring. It answers the call and switches into cellular mode.
4. In the meantime, the Avaya Communication Manager (i.e. telephony server) sets up a three-way conference call between the WLAN connection, the cell phone connection, and the other party in the call.
5. When the server sees it has connected through the cellular network, it drops the WLAN call from the conference, and it continues on the cellular connection (i.e. "make-before-break").

Motorola CN 620

Display in WLAN Mode

Voicemail Menu
Navigation Wheel

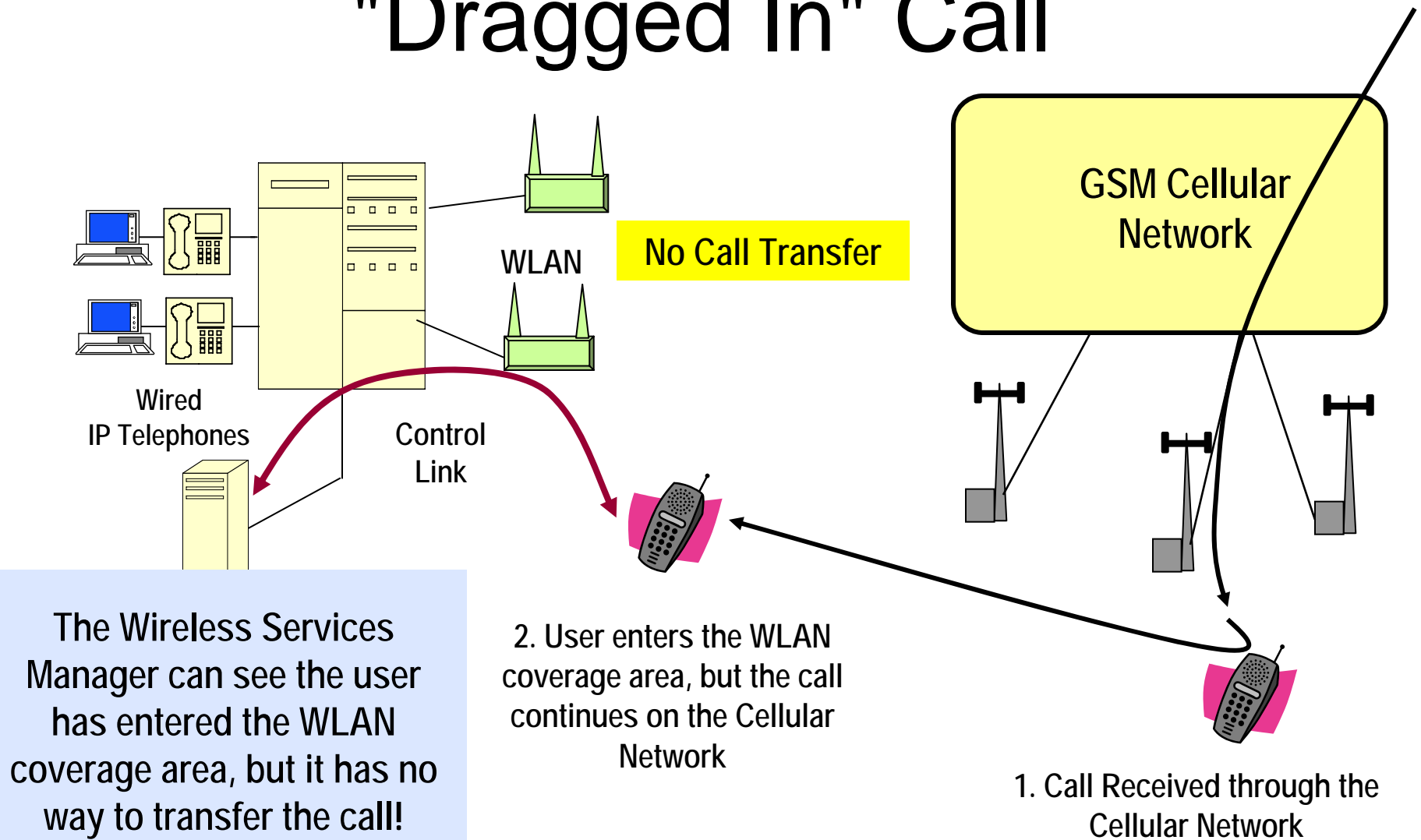
Push-to-Talk Button

Mute, Hold and Speaker Keys

(GSM Cellular/802.11a WLAN)



"Dragged In" Call



Seamless Convergence Status

- The product was never fully delivered
 - Motorola's CN620 was not fully developed
 - Cingular never certified handset for use on their network
- Avaya is now marketing 310 WLAN Gateway (Proxim)
 - WLAN switch with thin access points
 - Provides "handoff" similar to Motorola
 - Working with Nokia on WLAN phones (E60, E61, E70)

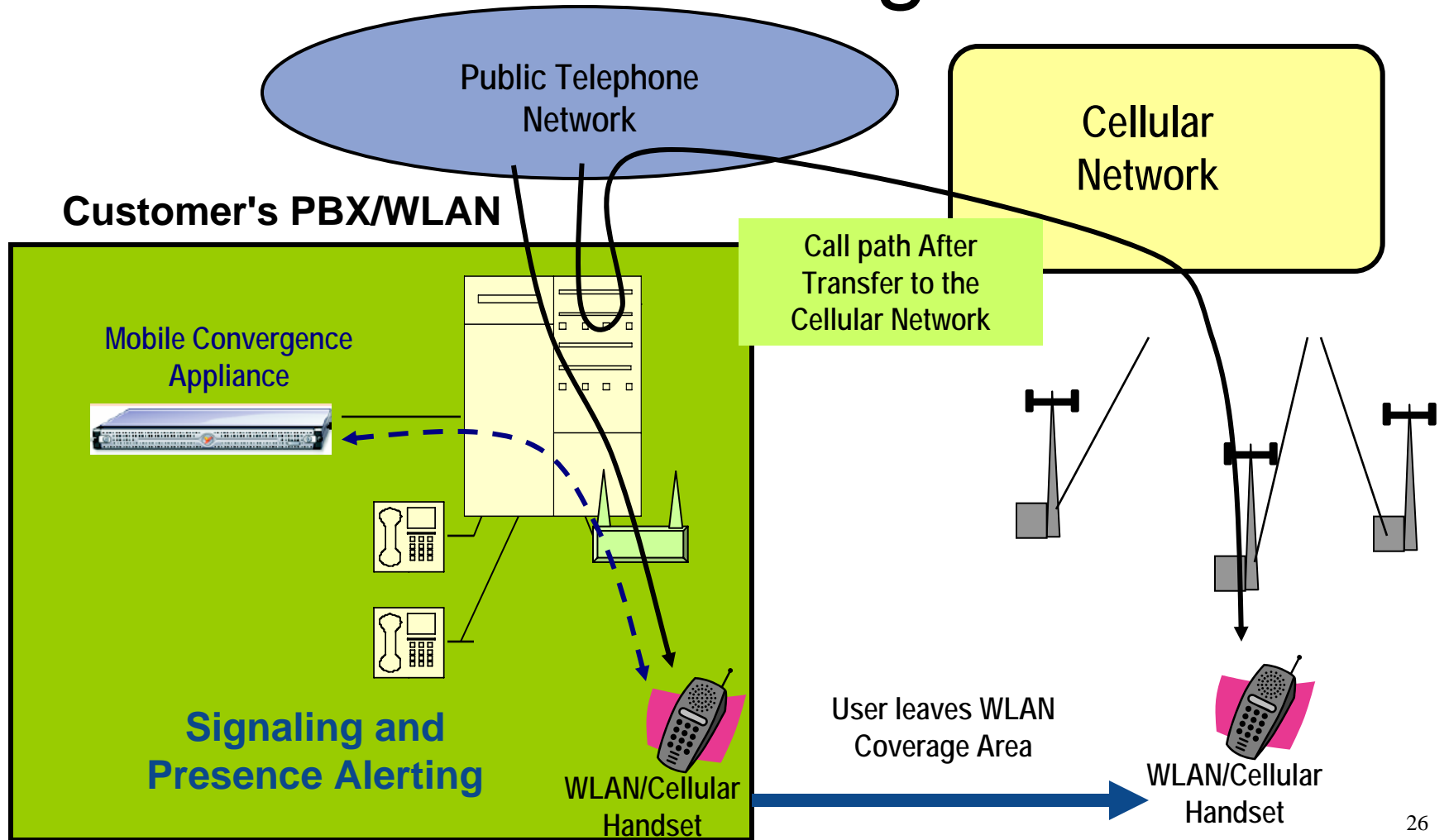
Nokia E70



Divitas Networks

- Similar to the Seamless Convergence concept, but the Divitas solution will work with any PBX, WLAN, and cellular service
- Two Elements:
 - Mobile Convergence Appliance
 - Software client for Wi-Fi/Cellular handset
 - Windows Mobile
 - Linux
 - Symbian
 - Provides presence management with cellular as default

Divitas' Configuration



Netmotion Wireless

- Mobility XE
 - A WLAN/cellular integration solution targeted at data applications
 - Provides security as well as application session persistence
 - Application connection is maintained over multiple networks and potentially for hours

Other Potential Options

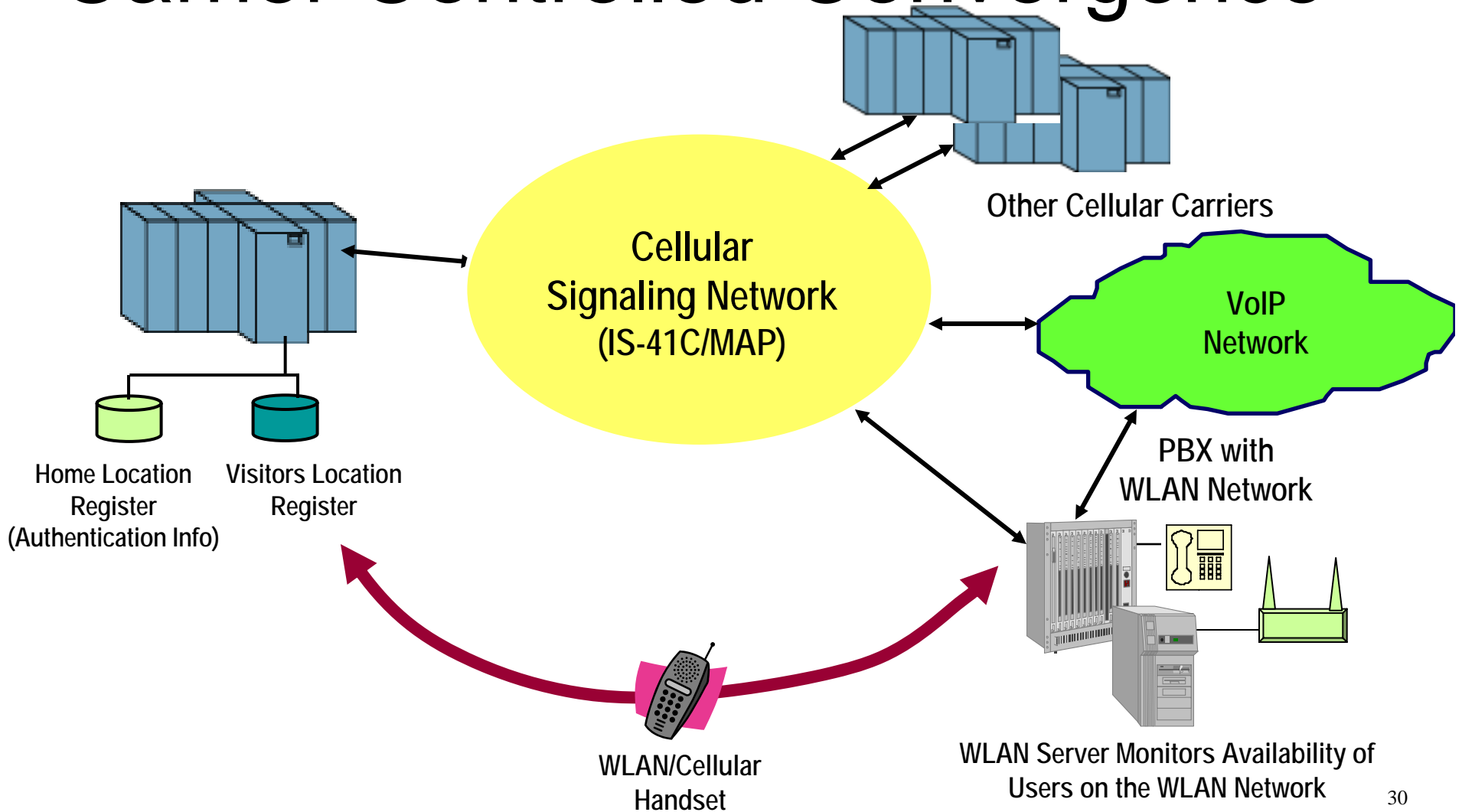
- A number of companies have developing or partial solutions that may hold promise:
 - CounterPath (eyeBeam)
 - Microsoft (Live Communication Server)
 - OnRelay (Mobile Branch eXchange)
 - Orative (Orative Enterprise Software)
 - PadCom (TotalRoam)
 - Telepo (Enterprise Communications Server)
 - Traverse Networks (CallConnect)

Carrier Controlled Convergence

The only truly integrated WLAN/cellular solution would be one where a call could be handed off in either direction!

- The decision to implement that is solely in the hands of the cell carriers
- Thus far, no US carrier has exhibited any real interest
- Optimistic analysts have fueled endless speculation in this area

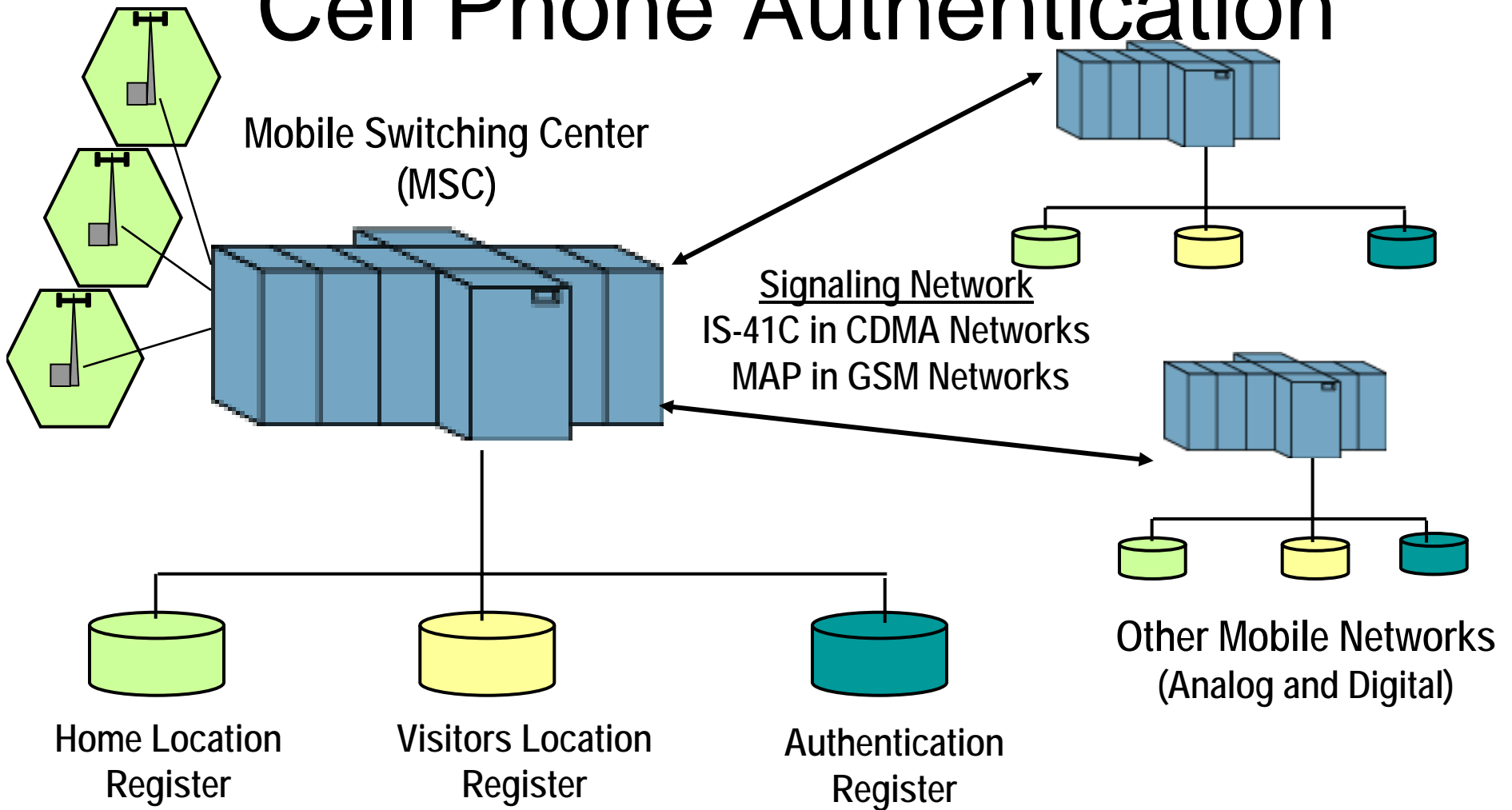
Carrier Controlled Convergence



Cellular Infrastructure

1. **Mobile Switching Centers (MSCs):** The central office switching facilities (typically one per city) that connect to the base stations, establish and maintain cellular calls, and interconnect to the wired telephone network
2. **Base Transceiver Stations (BTS):** These are the antenna structures and associated electronics that decorate the landscape
3. **Signaling System:** The MSCs are interconnected with a common channel signaling network that allows for secure roaming and inter-system handoffs
4. **Subscriber Equipment:** The handsets and other devices used to communicate over the network

Cell Phone Authentication



Carrier Controlled Convergence

- Long Term Solution:
 - IP Multimedia Subsystem (IMS)
- Short Term:
 - Several Proposed Products
 - Kineto Wireless/Unlicensed Mobile Access (UMA)
 - BridgePort: *NomadicOne Network Convergence Gateway*
 - Cicero Networks: *CiceroPhone, CiceroController*
 - NewStep Networks: *Converged Services Node*
 - FirstHand (formerly SIPquest)

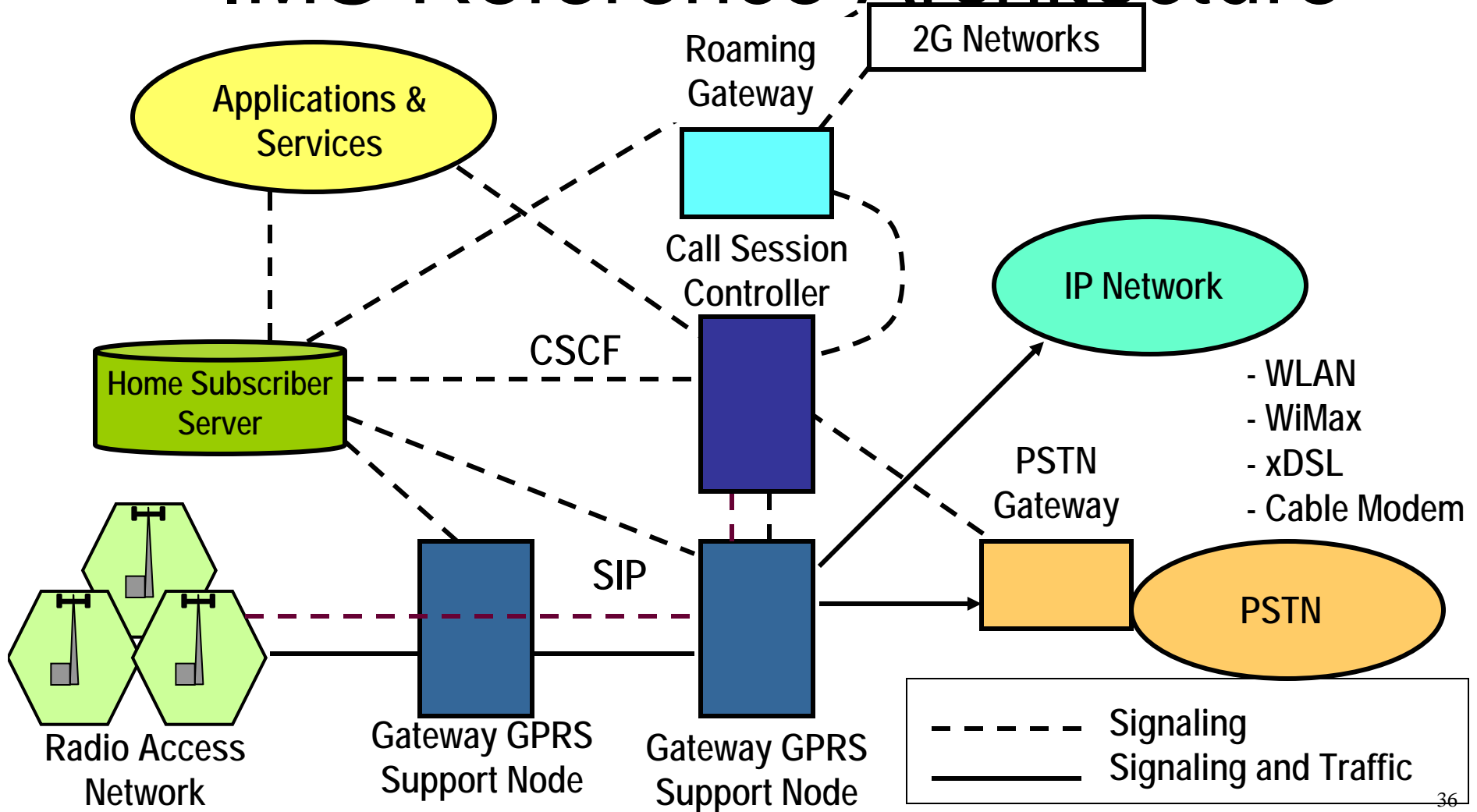
IP Multimedia Subsystem (IMS)

- Major initiative from the 3G Partnership Project (3GPP) for Fixed/Mobile Convergence (FMC)
- A SIP/ IP-based Solution for mobile VoIP
 - Single IP core network with multiple access options including 3G, Wi-Fi, WiMax, and xDSL
- **IMS Vision:**
 - User would have one device, one voicemail, one feature set, and one bill
 - Access agnostic service with consistent look and feel

IMS Implementation Issues

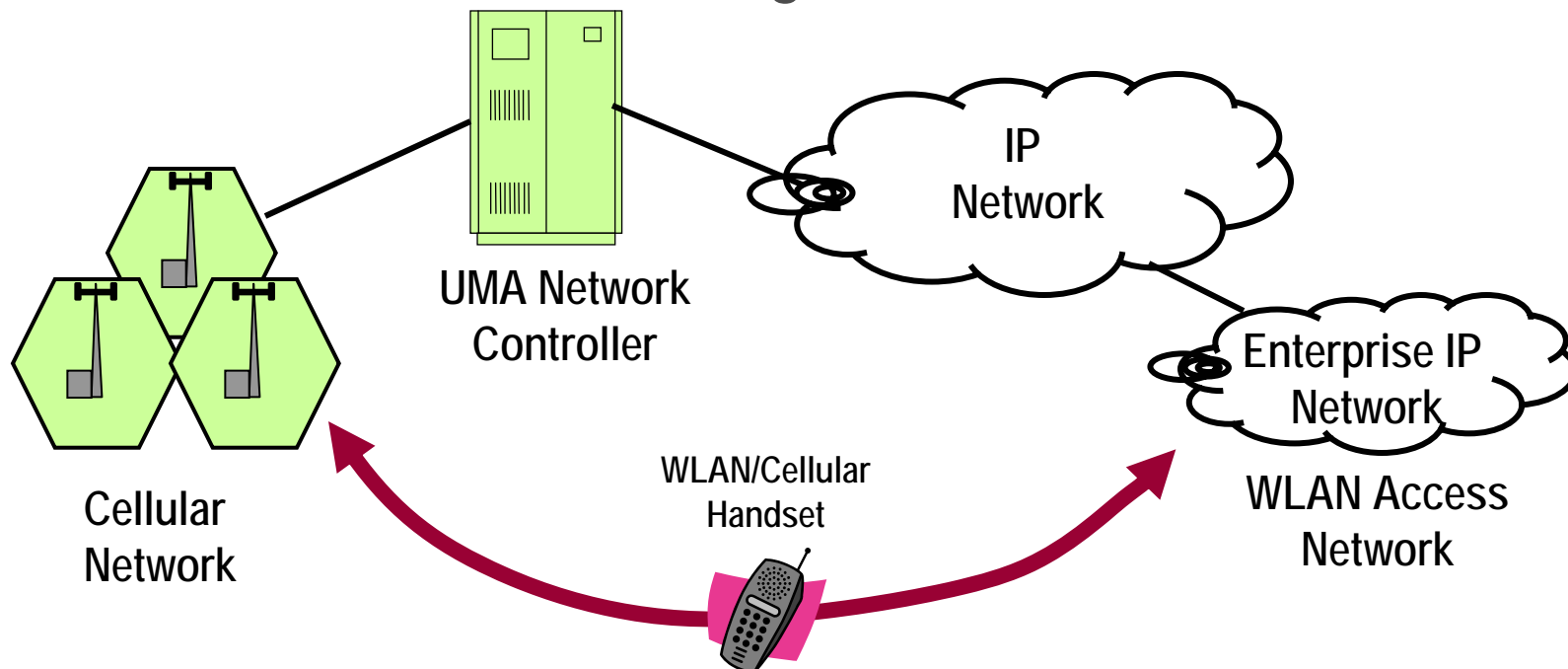
- Requires a full "buy in" by the cellular operators
- Carrier-grade SIP Extensions for
 - Quality of Service
 - Fraud Prevention
 - Privacy/Encryption
 - Billing and Chargeback
 - Voicemail Integration

IMS Reference Architecture



Unlicensed Mobile Access

- Kineto Wireless- UMA Network Controller
 - Hand-off to IP/Enterprise network looks like a cell-to-cell handoff
 - UMA has now been merged into the 3GPP



Bridgeport Networks

- Similar approach to Kineto and UMA
- BridgePort Product:
 - *NomadicONE Network Convergence Gateway*
 - Connects to the cellular carrier's signaling network
 - Handoff looks like a network-to-network handoff (rather than a cell-to-cell handoff)
 - Expects to morph into an Applications Server in an IMS network

FMC Industry Associations

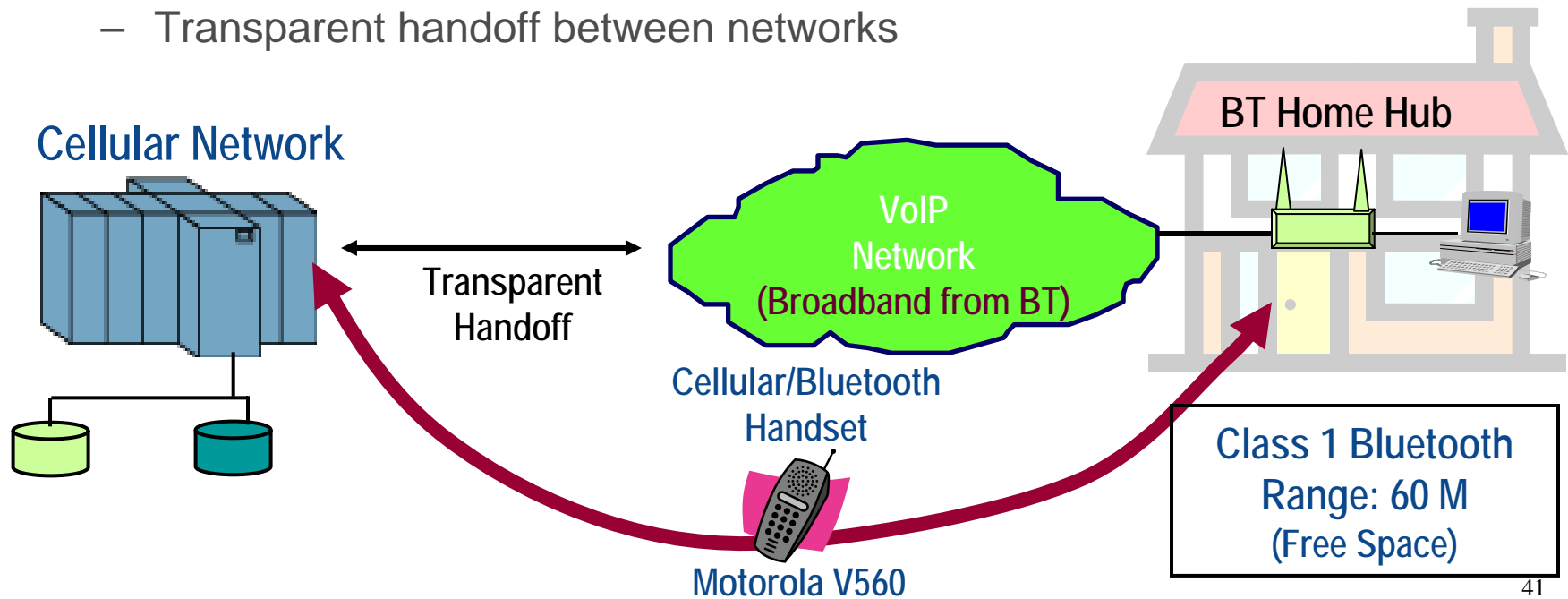
- IEEE 802.11r- WLAN Roaming
- IEEE 802.21- Standard for Local and Metropolitan Area Networks: Media Independent Handover Services
- Open Mobile Alliance (www.openmobilealliance.com)
- MobileIGNITE (Bridgeport Networks)
- Unlicensed Mobile Access- UMA (www.umatechnology.org)
 - Disbanded and incorporate into the 3GPP in May 2005
 - UMA technology incorporated into 3GPP Release 6
- Seamless Converged Communications Across Networks (www.sccan.org)
- Wireless Wireline Convergence Working Group
- Fixed-Mobile Convergence Alliance
 - BT, Swisscom, NTT, Korea Telecom, Rogers Wireless, Brasil Telecom

FMC Around the World

- NTT DoCoMo Passage Duple™
 - Uses N900iL handset from NEC/Panasonic
 - Cellular Capability
 - 802.11b WLAN with SIP Signaling
 - Osaga Gas (Japan)
 - 10,000 WLAN/cellular phones
 - WLAN Network from Meru Networks

BT Fusion or *Bluephone*

- Introduced in mid-2005, the BT Fusion is the world's first carrier-supported fixed/mobile service
 - Uses an integrated GSM cellular/Bluetooth handset (Motorola V560) with a home base station ("BT Home Hub")
 - Inside the home, it transfers to a Class 1 Bluetooth interface that connects through BT's VoIP service
 - Transparent handoff between networks



Part 3: Cellular Carriers' Views on WLAN Integration

Cellular Carriers' Position

- The Critical Issue:
 - Without the cellular carriers' support, any WLAN/cellular capability will have limited functionality
 - To execute a true hand-off, the "other" network must be connected to the cellular carriers' signaling complex
- The carriers' position?
 - No US carrier has endorsed the idea
 - The companies' Web sites have no information
 - Comments by their executives have been so general as to be meaningless!
 - The naïve can read real something into this if they try!

What do the Carriers Have to Gain?

- WLANs can provide better coverage than cellular networks in indoor environments
- Shifting calls to unlicensed WLAN channels would increase the number of calls they could carry on their licensed channels
- Pre-emptive strike: Do it before the customers are screaming for it
- If one carrier does it, they will all have to follow suit.

What do the Carriers Have to Lose?

- **Revenue and Customer Control:**
 - No longer "something special", just another part of the customer's call handling system
- **Pricing Control:**
 - Will the cellular carrier get any revenue for WLAN calls?
 - Will the cellular carrier have to process a signaling request, even if the call stays on the customer's WLAN?
- **Quality Control:**
 - Is the cellular carrier responsible for WLAN screw-ups?
- **Security Control**
 - Will WLAN security flaws open security vulnerabilities in the cellular network?

Cellular Security

- Cellular carriers were burned badly with the weak authentication system in AMPS (i.e. cloned handsets)
- Second generation digital networks (GSM and CDMA) addressed the problem
- Digital cellular transmissions are also encrypted over the air (The North American version of GSM encryption has been cracked, but it is not considered a major exposure)
- Cellular carriers are justifiably concerned about introducing security vulnerabilities into their networks

Handset Challenges

- Potential Problems:
 - **Cost:** As the handsets are not built on software defined radios, there are essentially two sets of phone electronics in one case (they will share the battery, earpiece, and microphone)
 - **Subsidies:** Unless the cellular carrier sees a profit potential, they're not subsidizing Wi-Fi/cellular handsets. WLAN/cellular might drive the bigger issue of “network independent” handsets
 - **Battery Life:** Wi-Fi drains the handset's battery in half the time (better Wi-Fi power saving mechanisms are planned)
 - **Politics:** Will the handset manufacturers push the WLAN/cellular handset idea if it jeopardizes their relationship with their biggest customers, the cellular operators?

Key Points to Take Home

- The participation of the cellular carriers is the key ingredient in meaningful WLAN/Cellular integration
- While the cellular carriers do have advantages to gain from this collaboration, for now they appear to be looking at the issue in the context of maintaining control
- While we don't have the ultimate solution today, we do have some interesting "work arounds"
- WLAN/cellular handsets are one element- maybe that's all we really need?
- We in network design must walk our users through the options and make sure they know what they're getting (Beware of airline in-flight magazine technology!)

QUESTIONS?

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