Wireless Internet Roaming

(WiFi and Cellular integration)

December 7, 2002

Stuart Jeffery
Telecommunications Consultant
1072 Seena Ave
Los Altos, CA 94024
Tel +1 650 966 8199
Fax +1 408 850 1959
E-Mail: stu@seena.net

Problem space

- Wireless Carriers are in the Wireless Data business
  - Yesterday – CDPD
  - Today – GPRS, 1XRTT (2.5G), iMode (in Japan)
  - Tomorrow – 3G
- Public Accss WiFi is developing very rapidly
  - Cheap, High Speed and Convenient
  - Users have device – PDA, Laptop, etc WiFi enabled
  - Ease of use, security all being solved
- **From carrier's perspective, wireless data is their business and these Public WiFi users are their customers!**

“Wireless Customer” wants….

- Ubiquity – wants it to work everywhere
- Same “user experience” - wherever they are
  - Same “procedures”
  - Same “services”
- Economical / Affordable service -
  - In North America – internet data is “flat rate”
  - Data via cellular is $1 to 5 per MB (long term)

Carrier's dilemma:

They must participate in this market

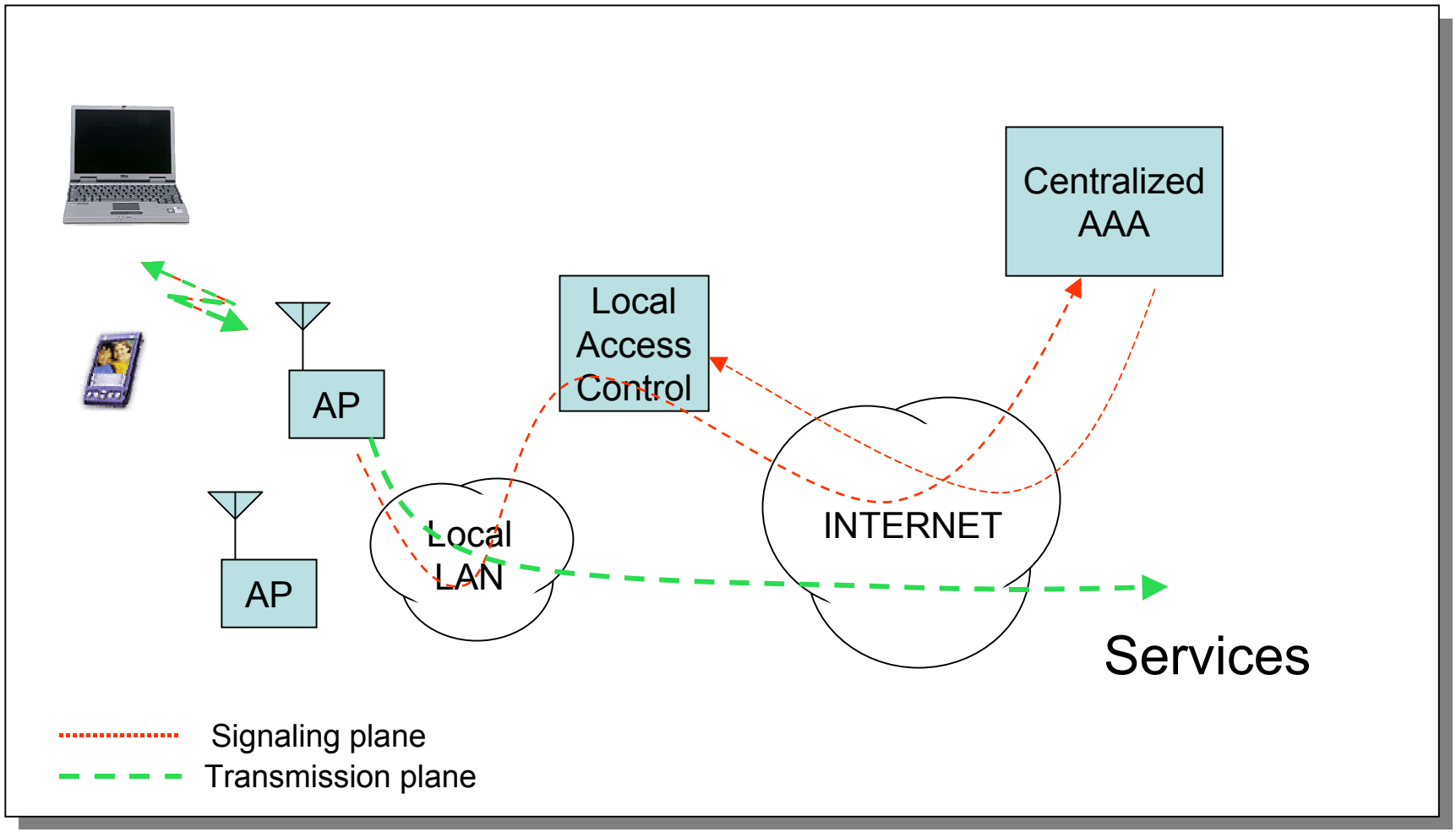
- WiFi is cheap, fast, but has limitation:
  - Cheap – no license fee, commodity equipment, and simple network infrastructure (no central management)
  - Limitation - Short range and inefficient spectrum usage
- Carrier data- expensive, but ubiquitous
  - Expensive – complex infrastructure, QoS, exclusive licenses
  - Slow – related to range and battery life
  - Advantage - Wide Area coverage

Carrier's positioning

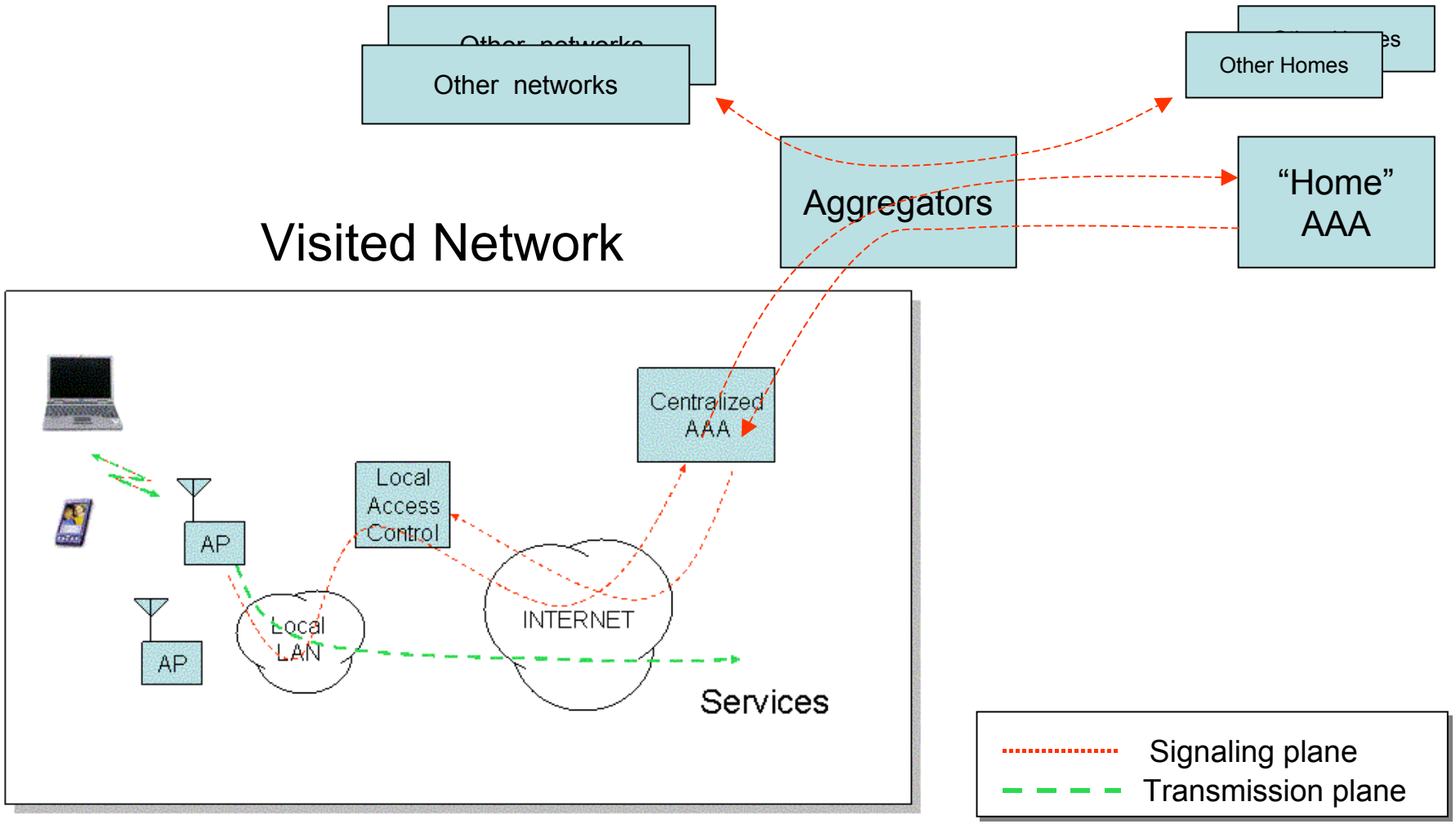
- "Value Add" possibilities
  - Common Bill
  - Customer Care
  - Market promotion
  - Consistence of service (same user experience)
- Conundrum:

	WiFi	Cellular Data
Cost (per bit)	Low	High
Speed	Fast	Slow
Roaming	Island	integrated

Public WLAN



Public WLAN Roaming



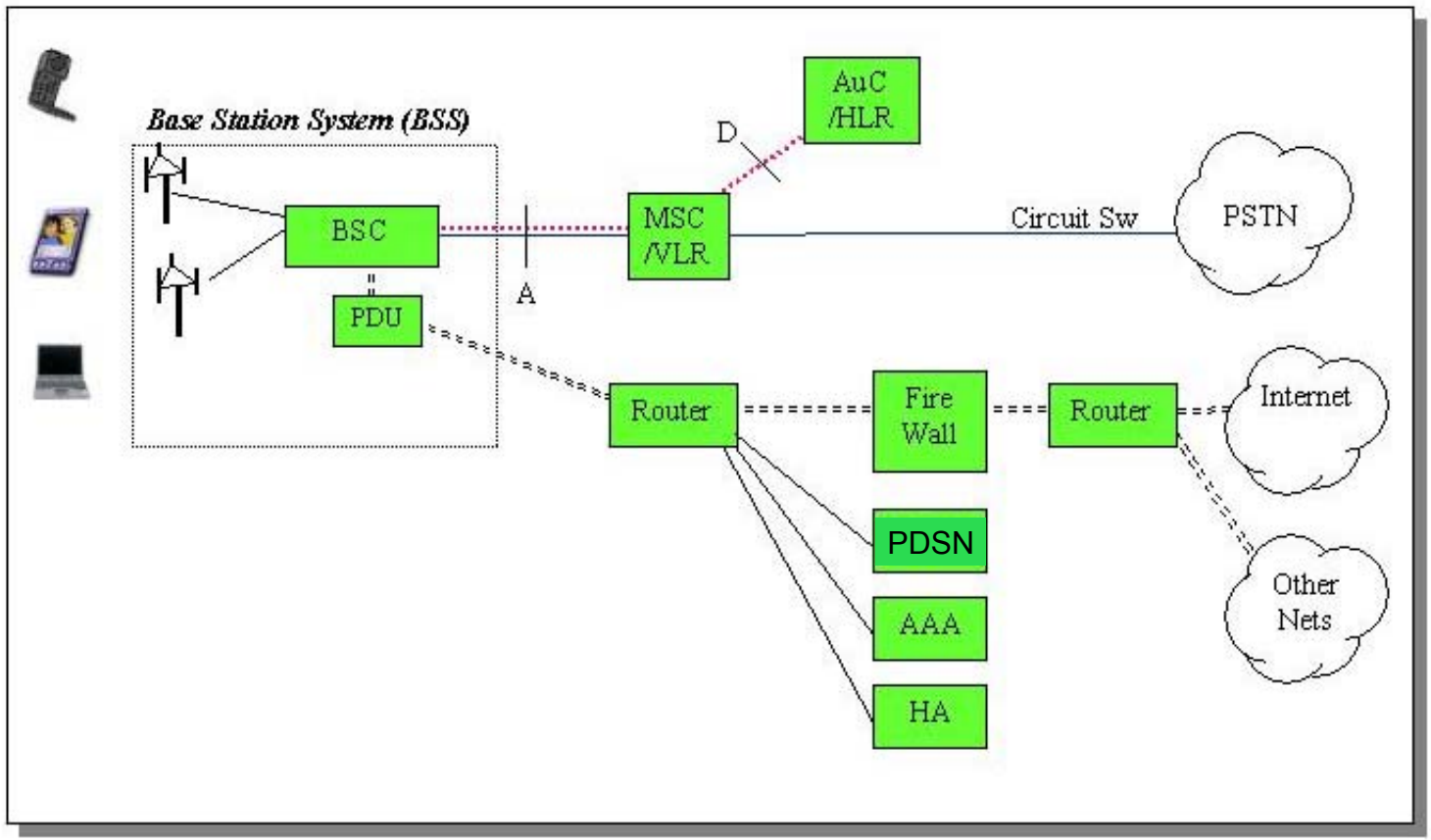
Specific areas of integration

- Back Office functions
  - Billing –
  - Customer Care –
- Signaling plane functions
  - Registration / Authentication
  - Subscriber Data Base / service authorization
- Transmission plane functions
  - Services
- Mobility functions
  - Roaming
  - Handoff

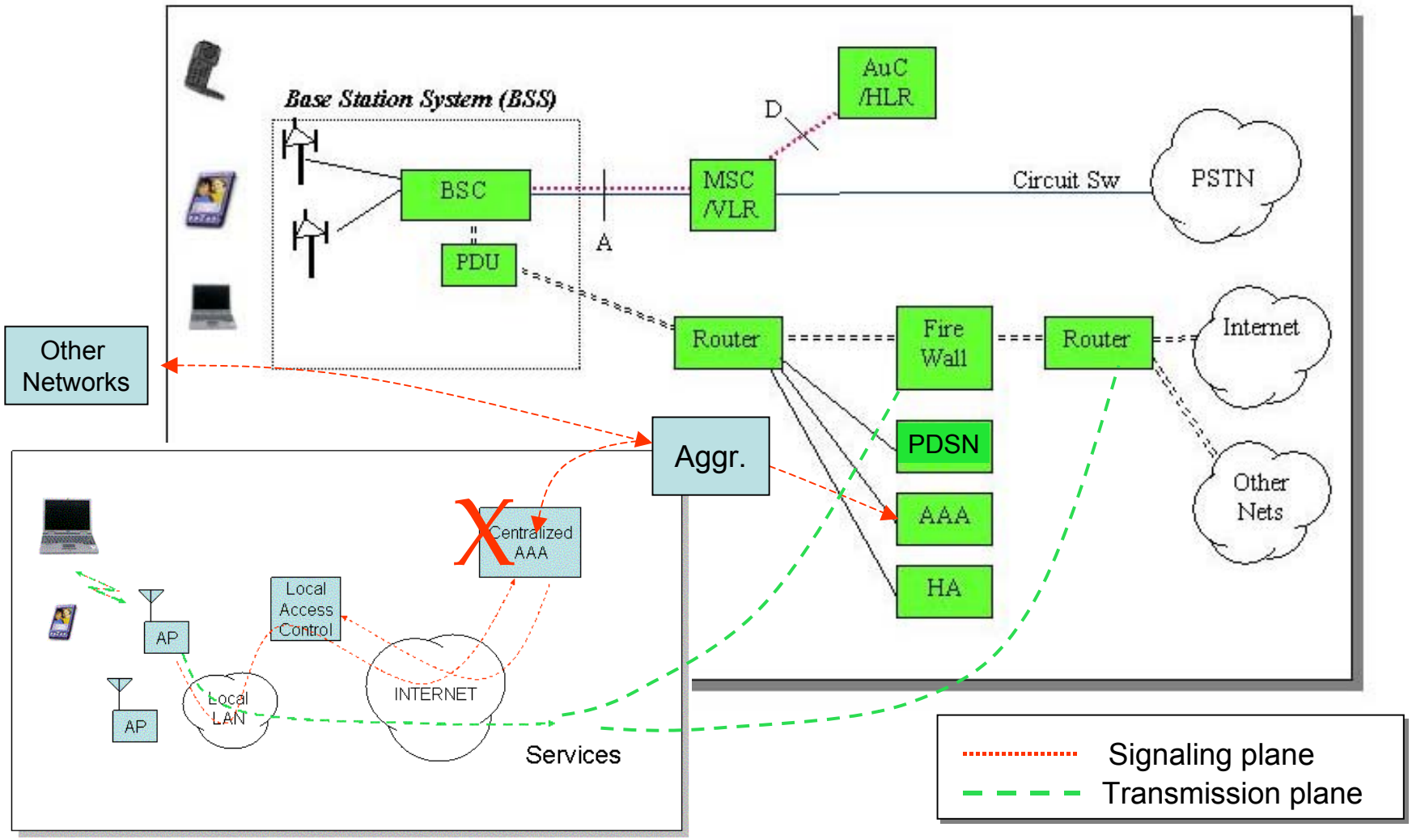
Signaling Plane

- GSM and CDMA data networks are different
  - CDMA – IETF Protocols – TCP / UDP, etc over IP
  - GSM – GSM protocols – MAP over SS7
- Signaling plane functions
  - Authentication
  - Service profile- authorization of privileges for the subscriber

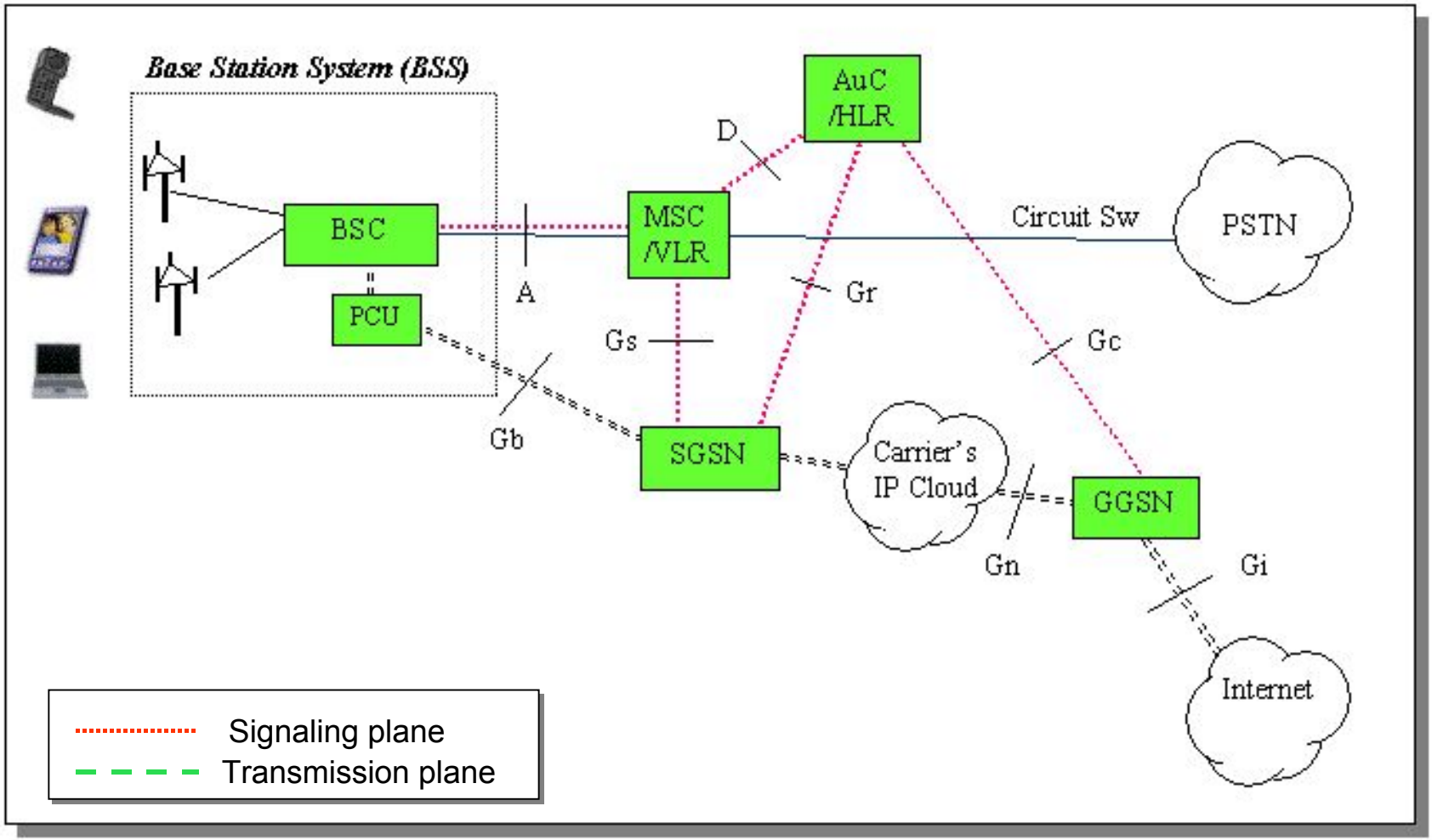
CDMA 2000



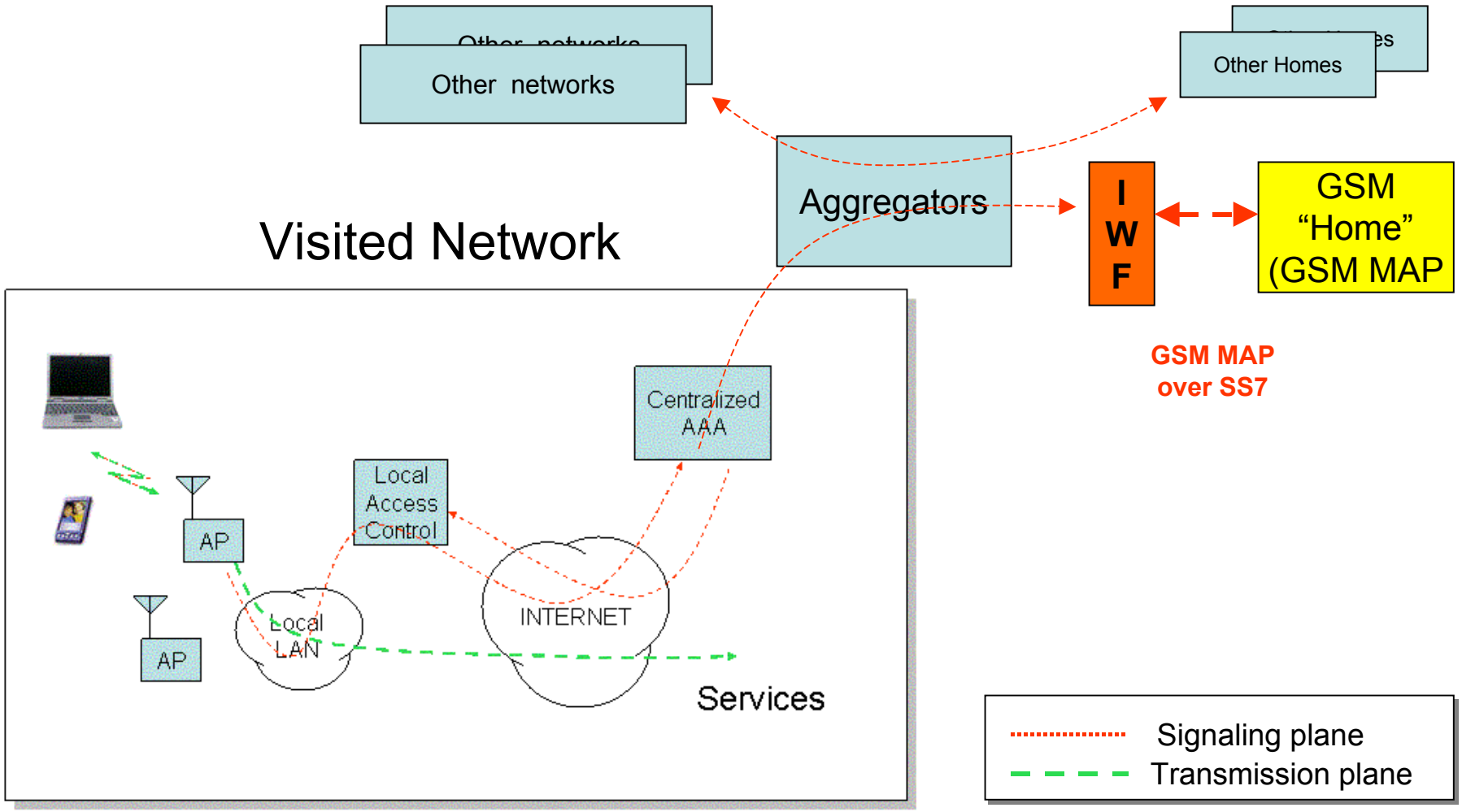
CDMA 2000



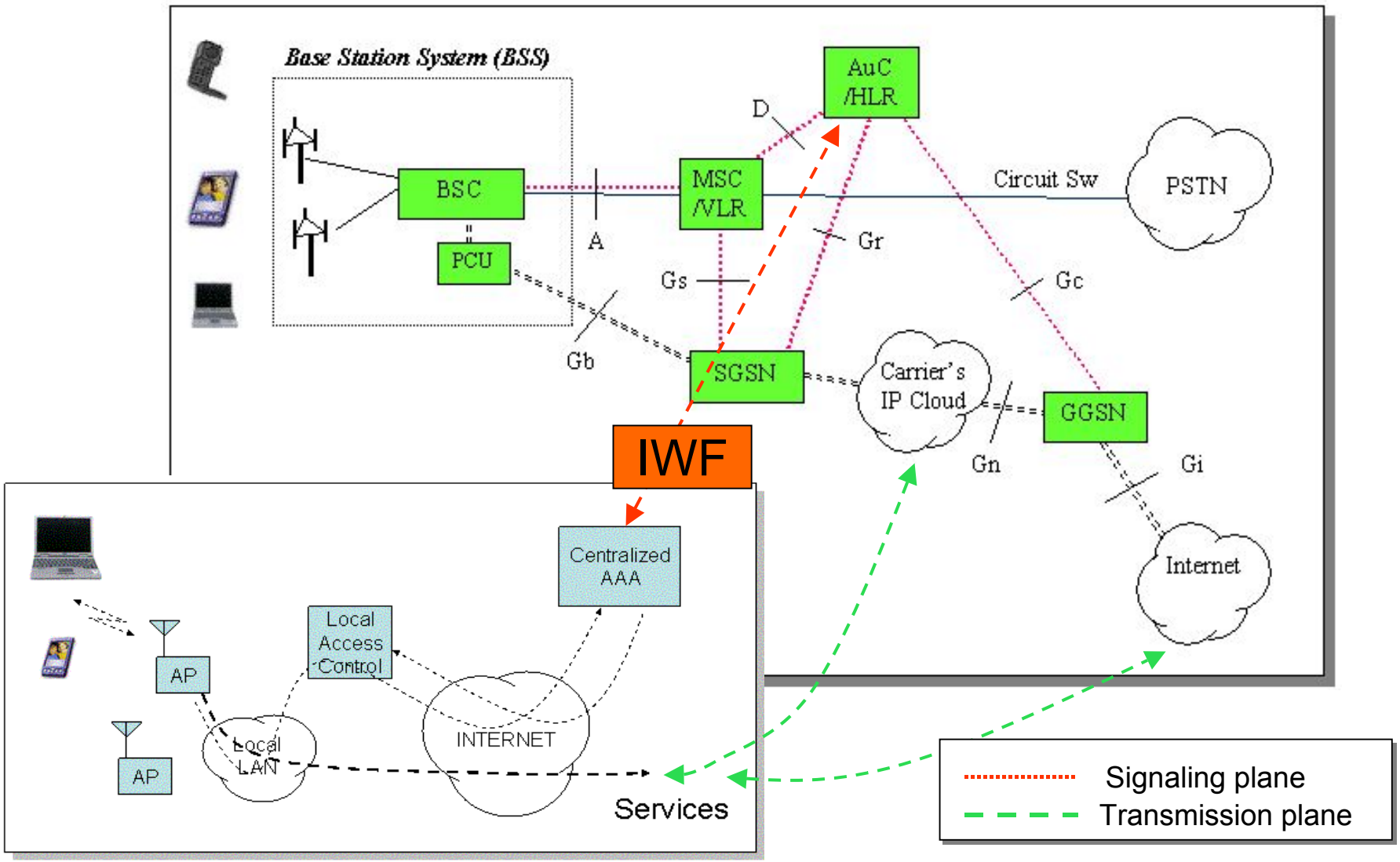
GSM



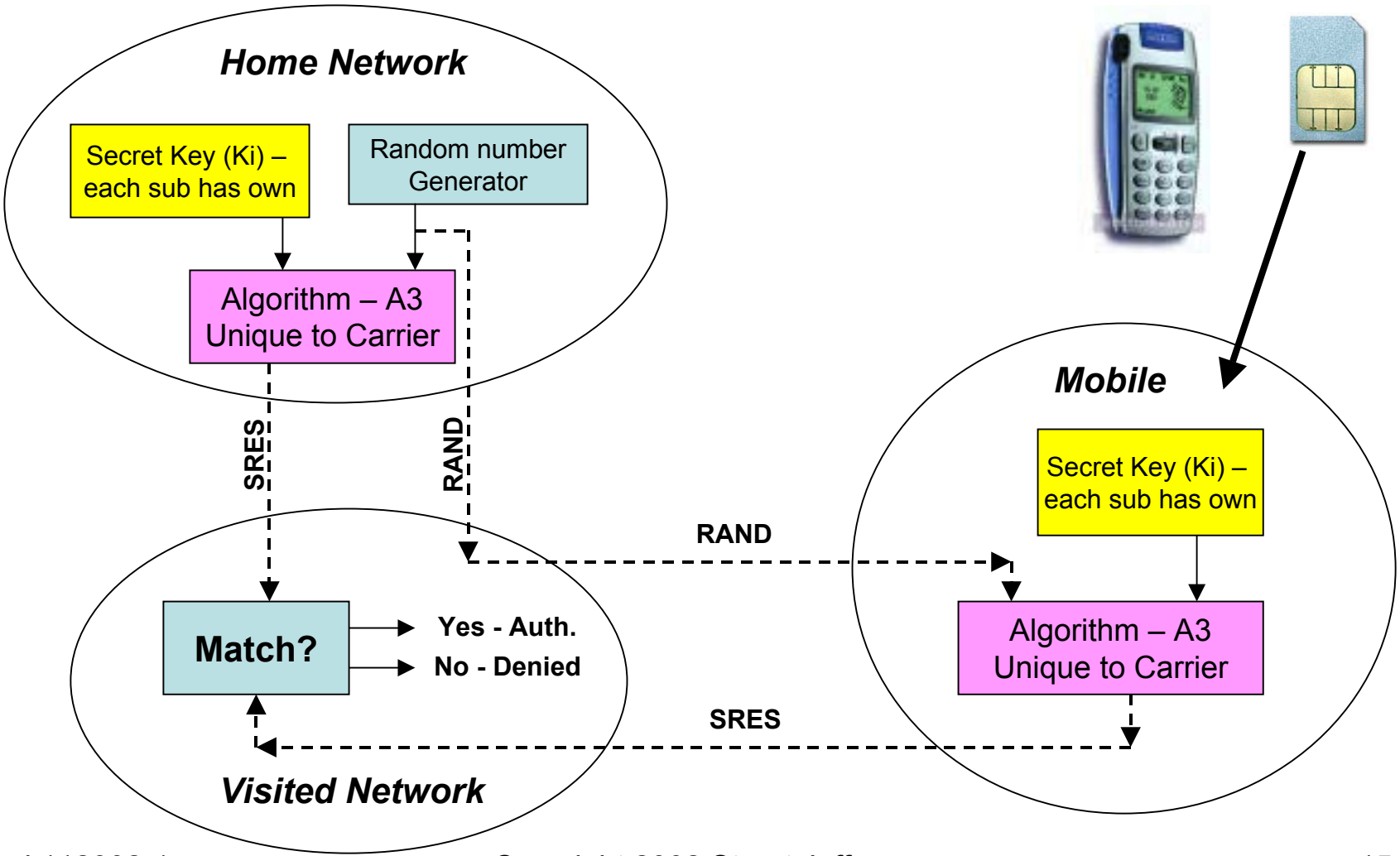
Public WLAN Roaming



GSM

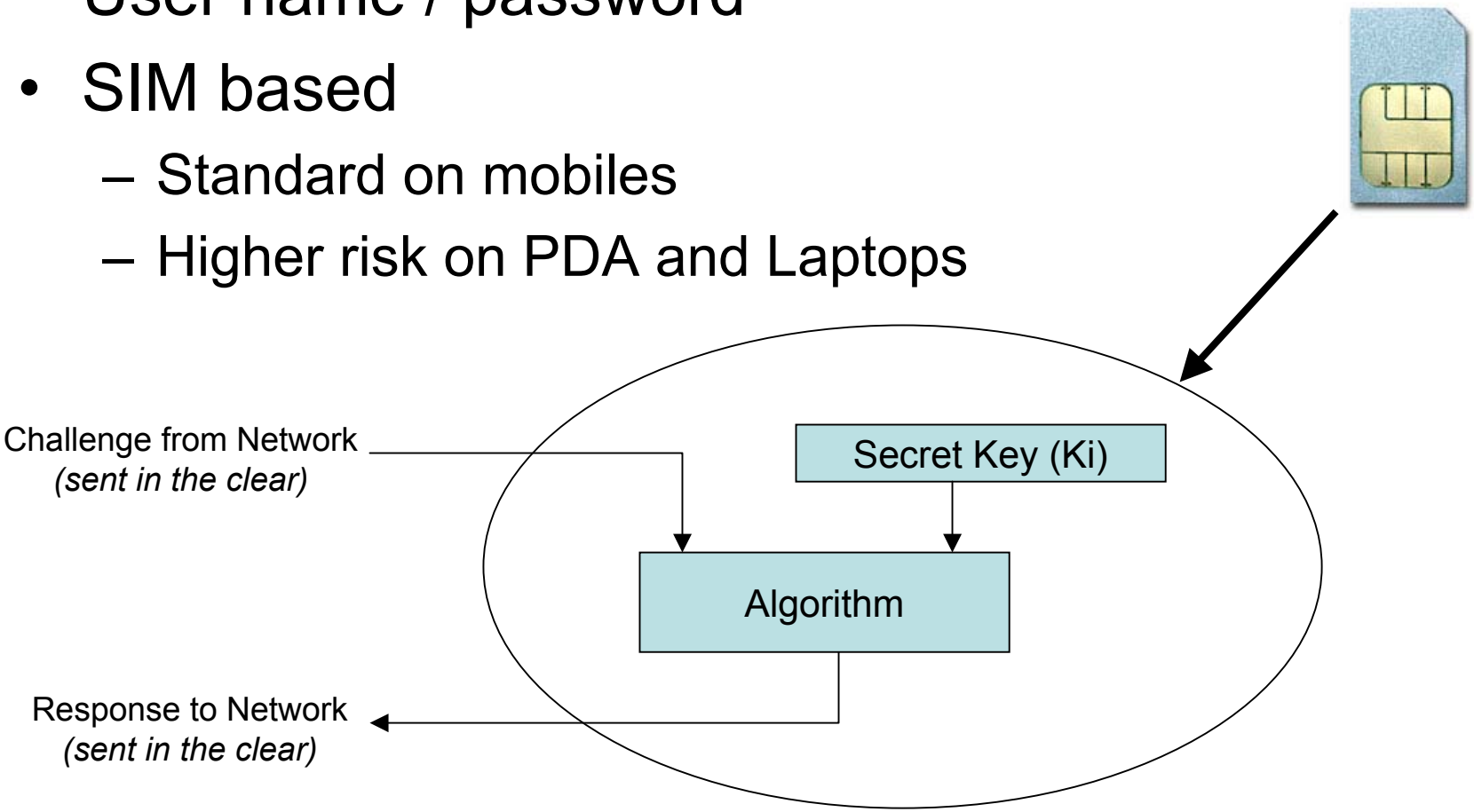


GSM Authentication with SIM



Registration / Authentication

- User name / password
- SIM based
  - Standard on mobiles
  - Higher risk on PDA and Laptops



SIM Adapters

802.1x LAN Authentication Standard

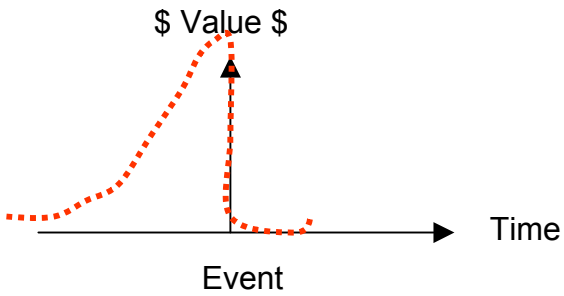
- EAP that work with 802.1x
- Large number of IETF Drafts
- Several related to GSM and require SIM on device
  - EAP-SIM – Nokia
  - EAP- SIM – GMM – Transat, Intel
- Adjungo's EAP CAP
  - Works in pre 802.1x environments
  - Works with and without SIM on user device

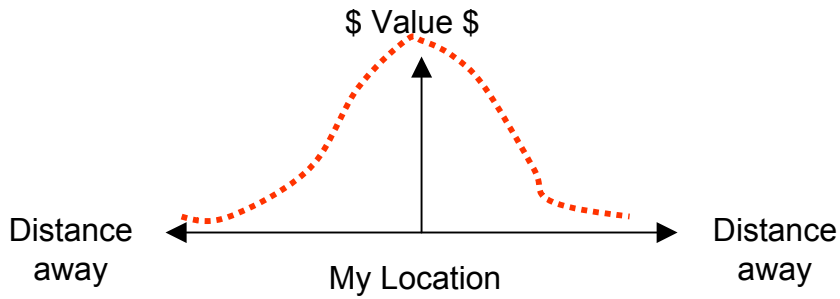
Companies IWF Gateways
(probably not all of them)

Services

64 Billion $ Question is what are they?

- Walled Garden or Internet?
  - Information has a time value
  - location value





- Why take traffic to the core? Take it directly to internet?
- Problem statement
  - There are many killer applications on the internet - most based on low cost transport
  - Killer application for cellular data is different – because transport cost is not low - *saving time or wasting time*

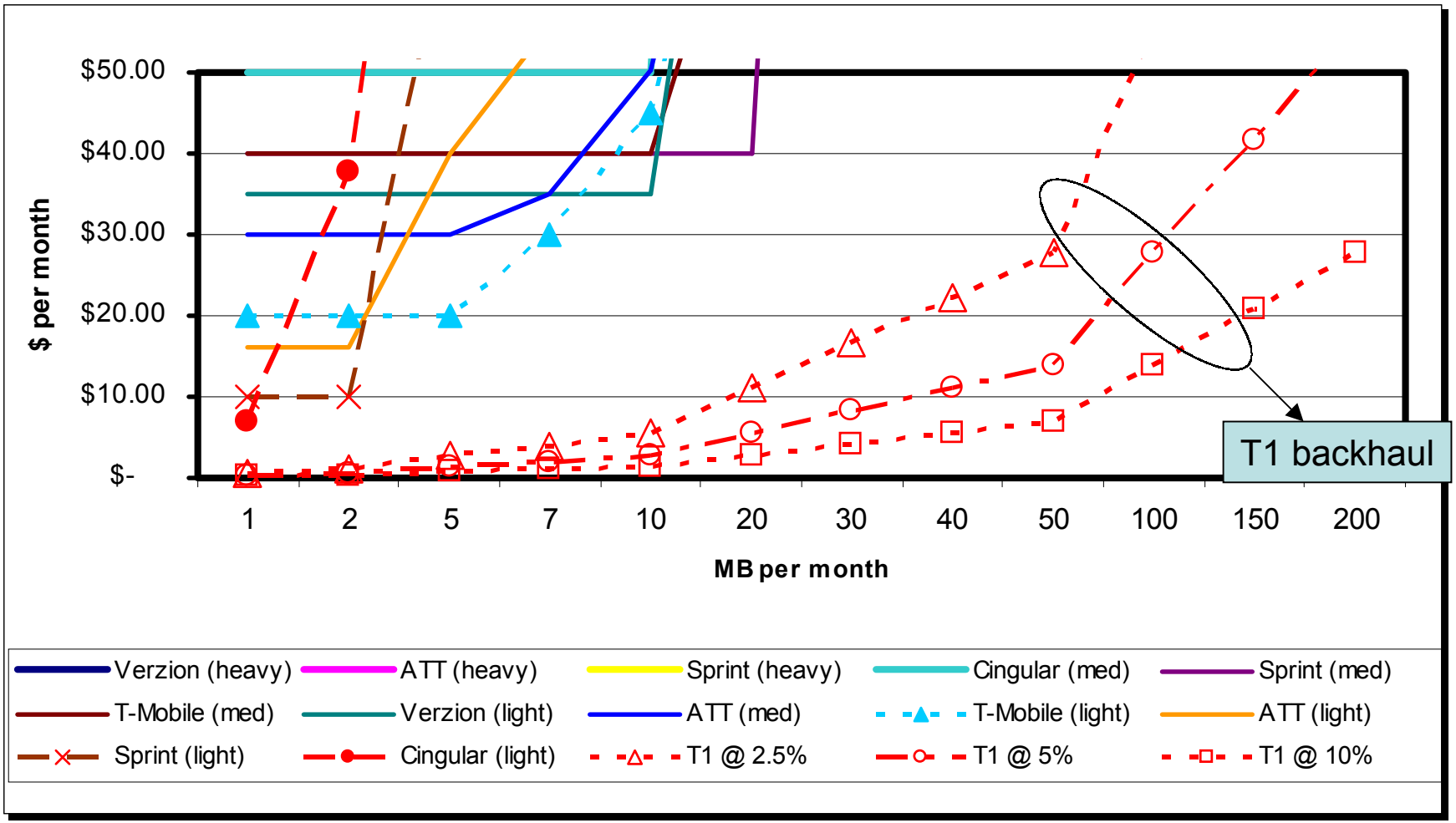
Wireless Data Cost Comparison
(prices as of Aug 2002)

Tech.	Speed vs. 45 Kbps	Available	Equipment to connect	Cost (typical)
1XRTT	~ 1.5 X Dialup	Everywhere	Cellular data card	Subscription plus $0.30 to $0.50 per min
GPRS	~ 1.5 X Dialup	Everywhere	Cellular data card	Subscription plus $ 4.00 per MB
Hot Spots	10 to 20X Dialup	Very Localized	WiFi Card	~ $0.15 per min

Cellular Data Cost Comparison

(source data from RCR, August 19, 2002 page 26)

(T1 service ~ $0.167 per min)



RCR Data

(source data from RCR, August 19, 2002 page 26)

CARRIERS' DATA PLANS

	Price plan	Data price per MB	Overage price per MB
Sprint PCS			
PCS Vision:			
With voice plans	$10 for 2 MB	$5	$20.48
	$35 for 8 MB	$4.38	$20.48
Data only plans	$40 for 20 MB	$2	$20.48
	$60 for 40 MB	$1.50	$20.48
	$80 for 70 MB	$1.14	$20.48
	$120 for 120 MB	$1	$10.24
	$100 for unlimited MB	N/A	N/A
Cingular			
Wireless Internet Express:	$7 for 1 MB	$7	$30.72
	$15 for 3 MB	$5	$30.72
	$30 for 7 MB	$4.29	$30.72
	$50 for 13 MB	$3.85	$30.72
Verizon Wireless			
Express Network:	$35 for 10 MB	$3.50	$8.19
	$55 for 20 MB	$2.75	$6.14
	$75 for 40 MB	$1.88	$5.12
	$100 for 75 MB	$1.33	$4.10
	$150 for 150 MB	$1	$2.56
	$100 for unlimited MB	N/A	N/A
AT&T Wireless			
Mobile Internet:	$16 for 2 MB	$8	$7.99
Handset/PDA or	$20 for 3 MB	$6.66	$6.66
Laptop access	$30 for 6 MB	$5	$5.02
	$40 for 10 MB	$4	$3.99
	$60 for 20 MB	$3	$2.97
	$80 for 40 MB	$2	$2.05
	$120 for 80 MB	$1.50	$1.54
	$200 for 200 MB	$1	$1.02
mMode:	$3 for 0 MB	N/A	$20.48
Handset access	$8 for 1 MB	$8	$10.24
	$13 for 2 MB	$6.25	$10.24
T-Mobile/VoiceStream			
T-Mobile Internet:			
Phone access	$20 for 5 MB	$4	$5
PDA access	$40 for 10 MB	$4	$4
Laptop access	$60 for 20 MB	$3	$4
Nextel			
Packetstream:	$13 for 1/4 MB	$52	N/A
	$16 for 1 MB	$16	N/A
	$30 for 5 MB	$6	N/A
	$40 for 10 MB	$4	N/A
	$60 for 20 MB	$3	N/A
Packetstream Gold:	$55 for unlimited MB	N/A	N/A

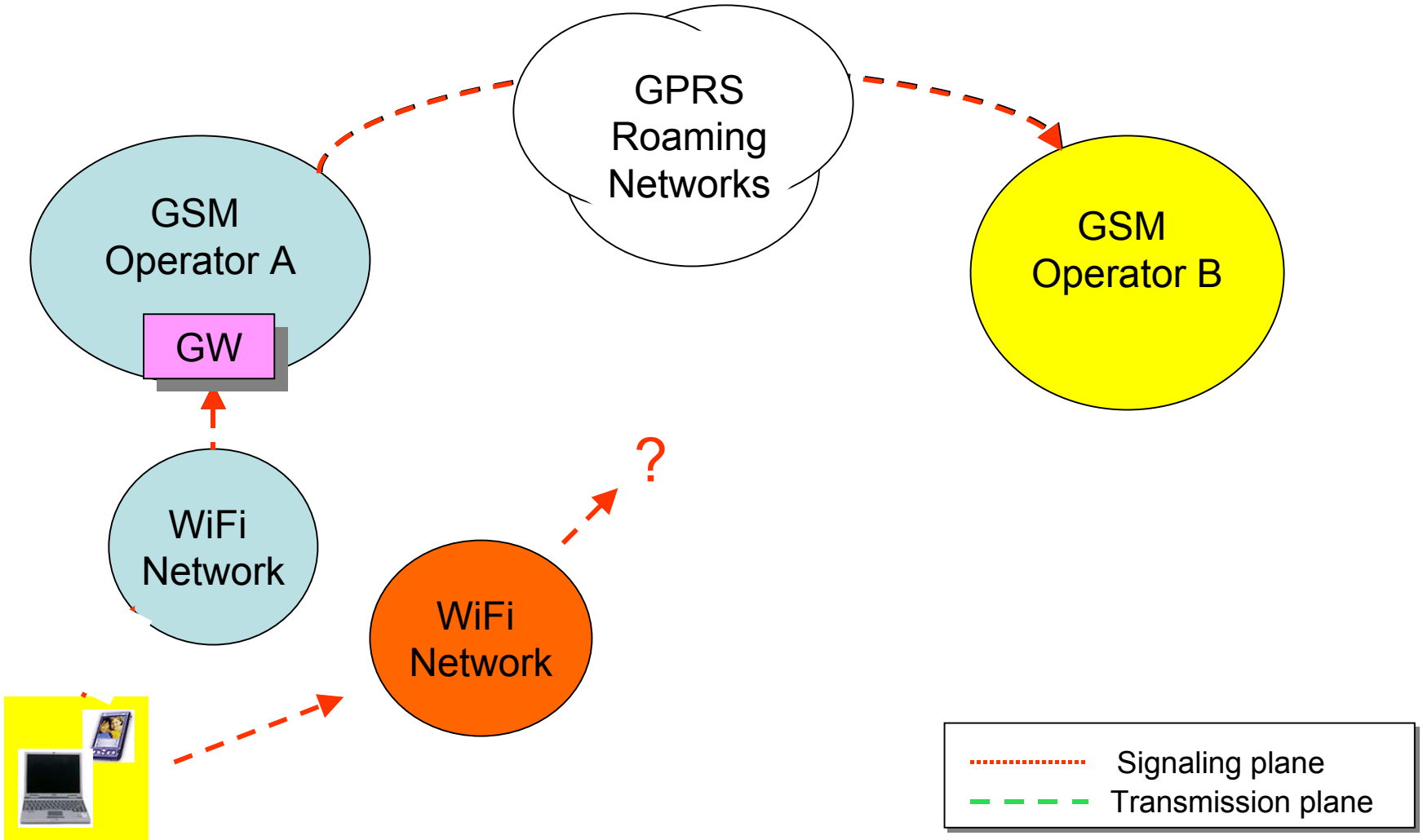
Mobility Functions

Handoff

- Disconnect and reconnect
  - Rather simple approach
  - Creates disconnect –restart apps.
    - Hurts VoIP
    - FTP
    - Streaming
  - No problem to Web-browsing
- True handoff
  - Need mobile IP (hold address)
  - Need to communicate in advance to RAN
    - For WLAN to WAN ok
    - For WAN to WLAN, issues
- But is there really a need?
  - Economics are very different
  - Cost of equipment much higher

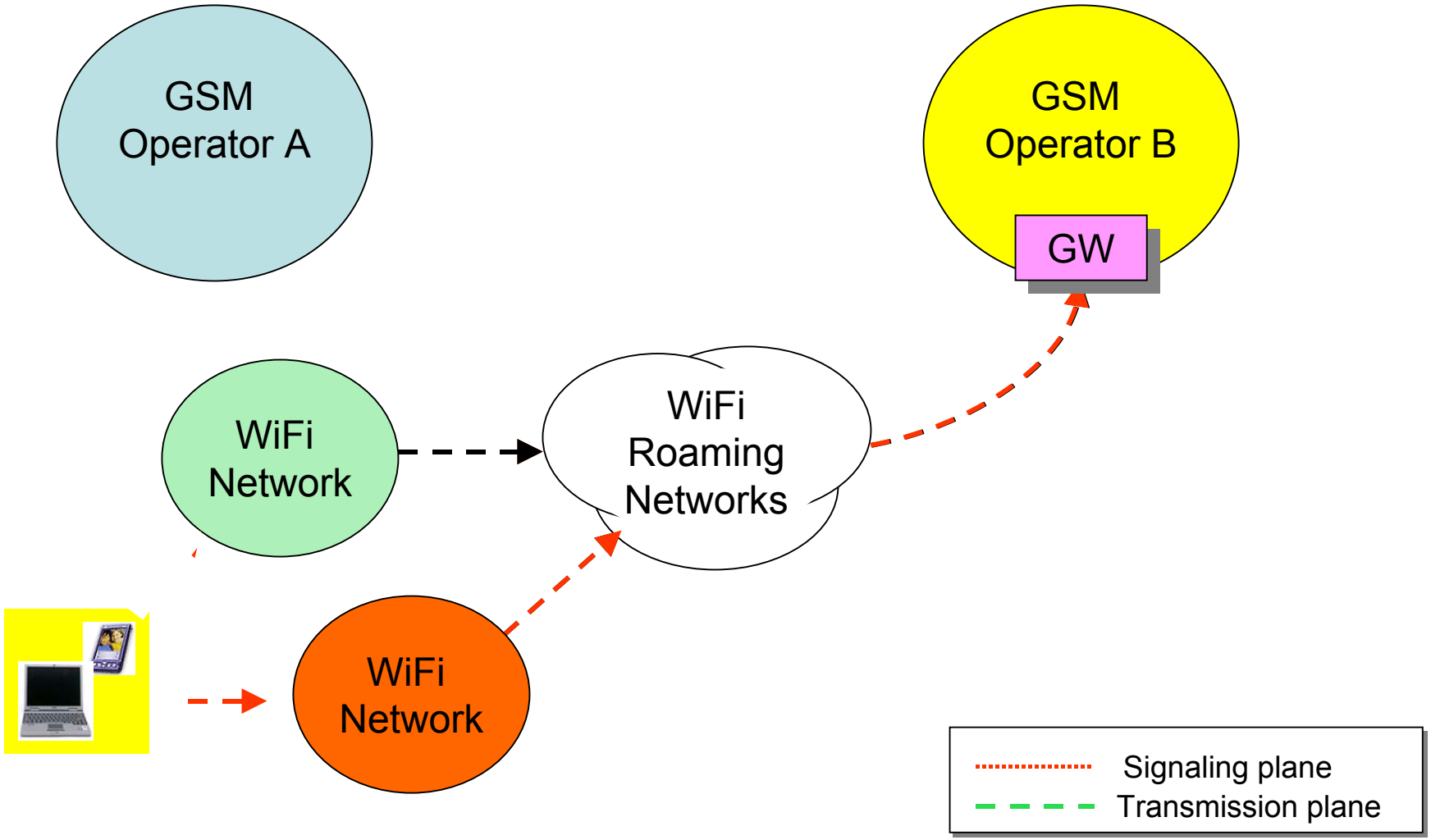
Roaming – Vertical

(signaling plane)



Roaming – Horizontal

(signaling plane)



Summary

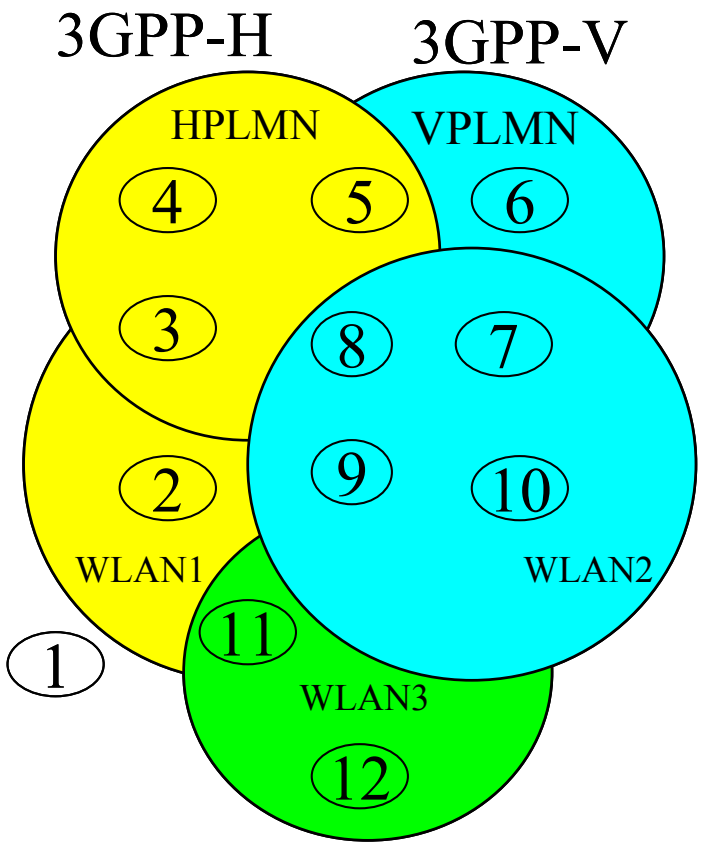
- Carrier's can't ignore WiFi
- Many carrier's are "dabbling" in this space
  - T-mobile – Mobilestar
  - AWS – Denver Airport
  - Sprint – teaser announcements
  - Telia – Home Run
  - Asia – Many operators in Singapore, Korea, Taiwan, Japan
- Lot of standards working going on
- Really big issue
  - Cost is different
  - Speed is different
  - Maybe they are really different….
- How this will converge with 3 G is unclear

Backup Material

References

Nr	Title	Description	Location
1	3GPP TR 22.934 V2.0.0 (2002-09)	3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Feasibility study on 3GPP system to Wireless Local Area Network (WLAN)interworking;(Release 6) (GSM based document)	http://www.3gpp.org/ftp/Specs/archive/22_series/22.934/
2	P.S0001-A v3.0	P.S0001-A v3.0 Wireless IP Network Standard (CDMA Based Document)	http://www.3gpp2.org/Public_html/specs/index.cfm
3	EAP-SIM	IETF Document on EAP-SIM	http://www.ietf.org/internet-drafts/draft-haverinen-pppext-eap-sim-07.txt
4	EAP-SIM-GMM	IETF Document on EAP-SIM-GMM	http://www.ietf.org/internet-drafts/draft-buckley-pppext-eap-sim-gmm-00.txt
5	WLAN-GPRS Integration for Next-Generation Mobile Data Networks	Detailed paper on WLAN / GPRS integration. Good tutorial. Uses a lot of material from TR22.934	IEEE Wireless Communications – October 2002 – Pages 112-124
6	Global Roaming in Next Gen networks	Interconnection of WLAN into 3 G networks	IEEE Communication, Feb 2002 – Pages 145-151

From 3GPP TR22-934



State	Description	WLAN Coverage	3GPP PLMN Coverage
1	Switch on	No coverage	No coverage
2	Single network WLAN1 coverage	Coverage only available from WLAN1(s)	No coverage
3	Overlapping 3GPP & WLAN coverage	Single network coverage	Home network coverage
4	Single network 3GPP-H coverage (HPLMN)	No coverage	Home network coverage
5	Multiple networks 3GPP coverage	No coverage	Coverage from home network and other operator(s)
6	Network(s) 3GPP-V coverage (VPLMN)	No coverage	Coverage from visited network(s) only
7	Overlapping 3GPP & WLAN coverage	Coverage only available from WLAN2(s)	Coverage from visited network only
8	Multiple 3GPP & Multiple WLANs	WLAN1(s) & WLAN2(s) (NOTE 1):	Coverage from Home and Visited Networks
9	Multiple WLAN coverage	Coverage available from WLAN1(s) & WLAN2(s)	No coverage
10	Single WLAN2 network coverage	Coverage only available from WLAN2(s)	No coverage
11	Multiple WLAN coverage	Coverage available from WLAN1 & WLAN3	No coverage
12	WLAN(s) coverage not interworked	Coverage only available from WLAN3(s)	No coverage
NOTE 1 : May also include WLAN 3 (Not Illustrated)			