MW-3A Integration of 802.11 and Third Generation Wireless Data Networks

Paper Review

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Objective

- Seamlessly Integrate 3G and 802.11 networks
- Maintain QoS in transitions)
- Maintain sessions in transitions
- Examine two approaches to integrate these networks

Background

- 3G connections are slow, but have roaming agreements and larger coverage areas
- 802.11 connections are much faster but have small coverage areas
- Users must manually reconfigure when transferring between
- Billing is directly from each individual carrier

Background (cont)

- 3G networks are ubiquitous
- 802.11 networks available at a few locations
- Users must have an prearranged agreement with a 3G provider
- Users must have prearranged agreements with each 802.11 provider
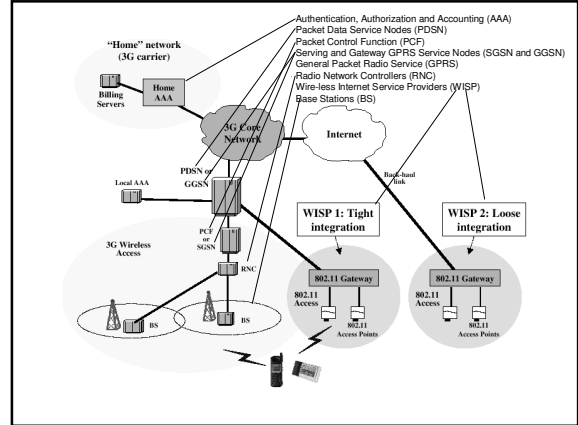
Principle Contributions

- Combining cellular data standards which contain Authentication, Authorization and Accounting (AAA) services with 802.11 W-LAN which has high data rate in limited coverage areas

Techniques – What Existed

- 802.11 wireless networks which have limited range but have bandwidths of 1 to 11 Mbps (802.11b) and up to 54 Mbps (802.11a)
- CDMA2000 (Code Division Multiple Access), 144Kbps in a 1.25MHz channel and up to 3.6864 Mbps in a 5MHz channel

Two concepts were explored

- Tightly coupled Internetworking
  - 802.11 network appear as another 3G access network,
  - 802.11 data is streamed through the 3G network
- Loosely coupled Internetworking
  - 802.11 networks do not have any direct link to the 3G network,
  - Data streaming is separate

Authentication, Authorization and Accounting (AAA)
Packet Data Service Nodes (PDSN)
Packet Control Function (PCF)
Serving and Gateway GPRS Service Nodes (SGSN and GGSN)
General Packet Radio Service (GPRS)
Radio Network Controllers (RNC)
Wire-less Internet Service Providers (WISP)
Base Stations (BS)

Tightly Coupled Networks	Loosely Coupled Networks
High Cost	Low Cost
• Increased traffic in 3G	• Traffic not changed
• Reconfigure 3G & 802.11 gateways	• Small change to 802.11 gateways
• 3G owns 802.11 nets	• 802.11 nets may be either independent or 3G owned
• Smaller base, 802.11 limited to 3G customers	• Larger base, 802.11 have both 3G and independent 802.11 customers

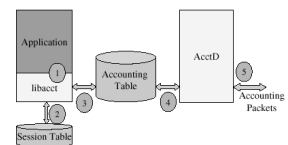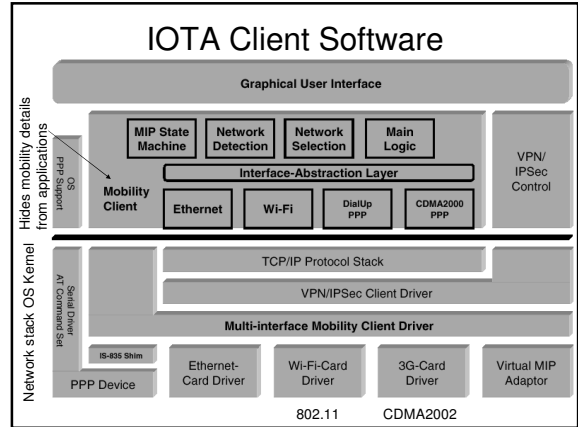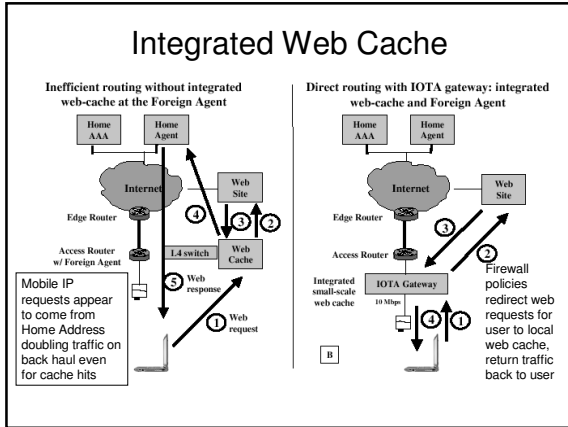| Tightly Coupled Networks	Loosely Coupled Networks
Integrated Services	Independent Services
• Authentication native	• 802.11 contacts 3G for authentication
• Customer receives one bill	• 802.11 calculates billing, forwards to 3G, customer receives one bill
– Roaming native to 3G	– Roaming agreements between 3G and 802.11 providers

IOTA Gateway Architecture
Loosely Coupled
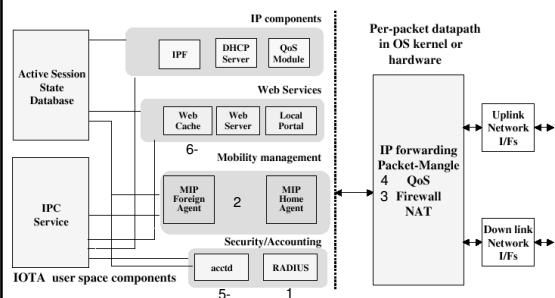
Accounting

1 application triggers accounting start, stop

2 libacct collects accounting info

3 libacct stores info in DB on disk

4 acctd periodically polls accounting table

5 accd formats info into RADIUS start, stop, update messages, retrying if messages fail

Integrated Web Cache

Inefficient routing without integrated web-cache at the Foreign Agent

Home AAA
Home Agent
Internet
Edge Router
Web Site
Access Router w/ Foreign Agent
L4 switch
Web Cache

④ ③ ②
⑤ Web response
① Web request

Mobile IP requests appear to come from Home Address doubling traffic on back haul even for cache hits

Direct routing with IOTA gateway: integrated web-cache and Foreign Agent

Home AAA
Home Agent
Internet
Web Site
Edge Router
Access Router
Integrated small-scale web cache
IOTA Gateway
10 Mbps

③
②
④ ①

B

Firewall policies redirect web requests for user to local web cache, return traffic back to user

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IOTA Client Software

Graphical User Interface

Hides mobility details from applications

OS PPP Support

MIP State Machine | Network Detection | Network Selection | Main Logic

Interface-Abstraction Layer

Mobility Client

Ethernet | Wi-Fi | DialUp PPP | CDMA2000 PPP

VPN/ IPSec Control

Network stack OS Kernel

Serial Driver AT Command Set

TCP/IP Protocol Stack

VPN/IPSec Client Driver

Multi-interface Mobility Client Driver

IS-835 Shim

PPP Device | Ethernet-Card Driver | Wi-Fi-Card Driver | 3G-Card Driver | Virtual MIP Adaptor

802.11   CDMA2002

Experimental Results

Network Transitions:
Finding if delays in transitions are acceptably low

• First Registration time is large
• Re Registering and Switching Registrations time is small

IOTA MOBILE-IP REGISTRATION DELAYS (ALL IN MILLISECONDS)

	FirstReg f	ReReg r	SwitchReg s
Ethernet	370	40	50
802.11b	410	40	60
CDMA2000	390	260	260

Experimental Results
QOS: Is bandwidth allocated fairly

All users have same QoS
(3.5 Mbps each)
• single user gets full bandwidth
• new users are added, they get an equal share (of 4.5 Mbps)

Experimental Results
QOS: Is bandwidth allocated fairly

Class of service
• gold is guaranteed 1.5 Mbps
• silver is guaranteed 1.0 Mbps
• bronze is guaranteed 0.5 Mbps

Experimental Results
QOS: Is bandwidth allocated fairly

Background of 3Mbps

• Gold gets its full bandwidth (1.5 Mbps)
• Silver starts (1.0 Mbps), rate is proportioned between the two clients
• Bronze starts (0.5 Mbps), rate is proportioned between 3 clients

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Advantages, Disadvantages by Authors

- Advantages
  - Loosely coupled networks seamlessly hand off connection, maintaining user sessions
  - User agreements and billing are centralized so users only need one use agreement and receive only one bill
  - Users do not need to manually reconfigure their connection to switch between 3G and 802.11 networks
  - 3G operators do not have to own the 802.11 networks
- Disadvantages
  - Does not support UMTS

Critical Evaluation

- They seemed to do a good job evaluating the scenario proposed
- They will pursue UMTS in the future as an additional protocol to CDMA2002
- They did not evaluate any other protocols or even mention why they did not consider them
  - TDMA, Bluetooth, GPRS, GSM, SGSN, GGSN, FDMA, QPSK, etc