Connected Vehicles: IP in Motion

BRKMWI-2002

Gaétan Feige

Cisco Networkers 2007 powered by cisco

HOUSEKEEPING

- We value your feedback, don't forget to complete your online session evaluations after each session and complete the Overall Conference Evaluation which will be available online from Friday.
- Visit the World of Solutions on Level -01!
- Please remember this is a 'No Smoking' venue!
- Please switch off your mobile phones!
- Please remember to wear your badge at all times including the Party!
- Do you have a question? Feel free to ask them during the Q&A section or write your question on the Question form given to you and hand it to the Room Monitor when you see them holding up the Q&A sign.

Session Abstract and Objectives

- The session will introduce several business cases driving the deployment of IETF Mobile IP in infrastructures. Opportunities for new business models will be highlighted including Mobile IP VPN and Networks on the Move applications. Network design recommendations to achieve successful deployment will be presented.
- This session is a step by step description of existing deployments and how to replicate them. For Mobile IP technology items please check the other sessions.

Mobility

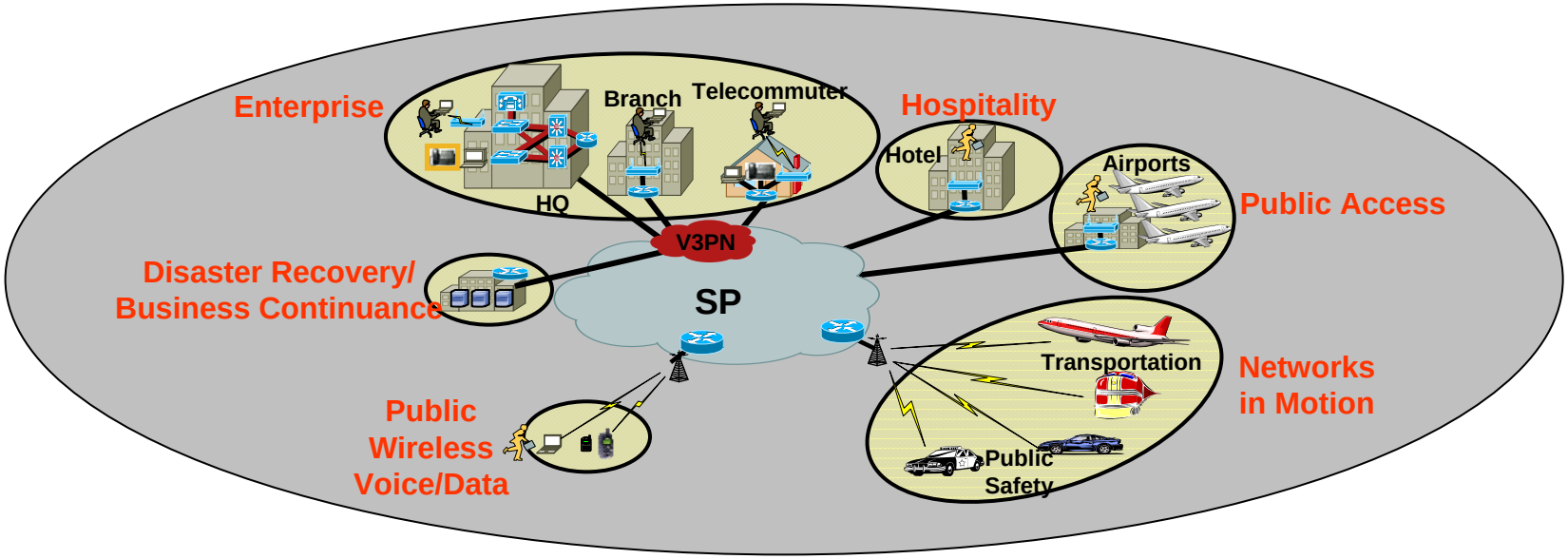
An Idea ?

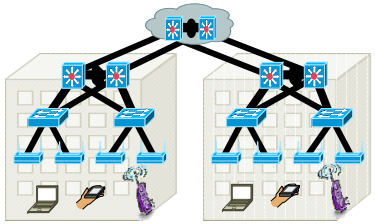
A Concept ?

Something Unreal ?

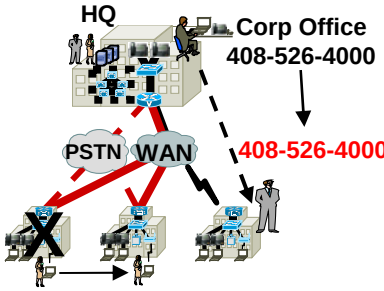
The Mobility Step by Step Evolution

Evolving from IP enabled applications towards overall secured connectivity

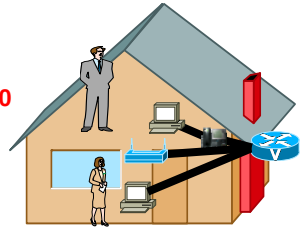




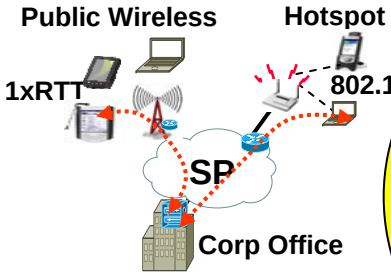
Campus Mobility



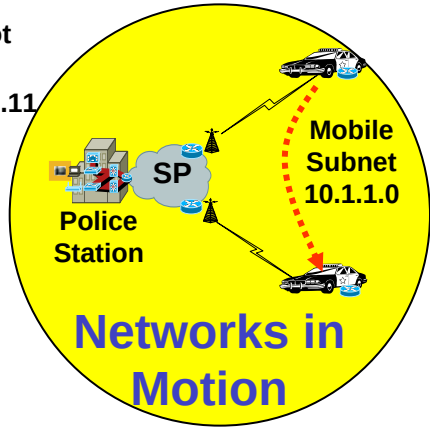
Branch Mobility



Telecommuter



Users on the Move

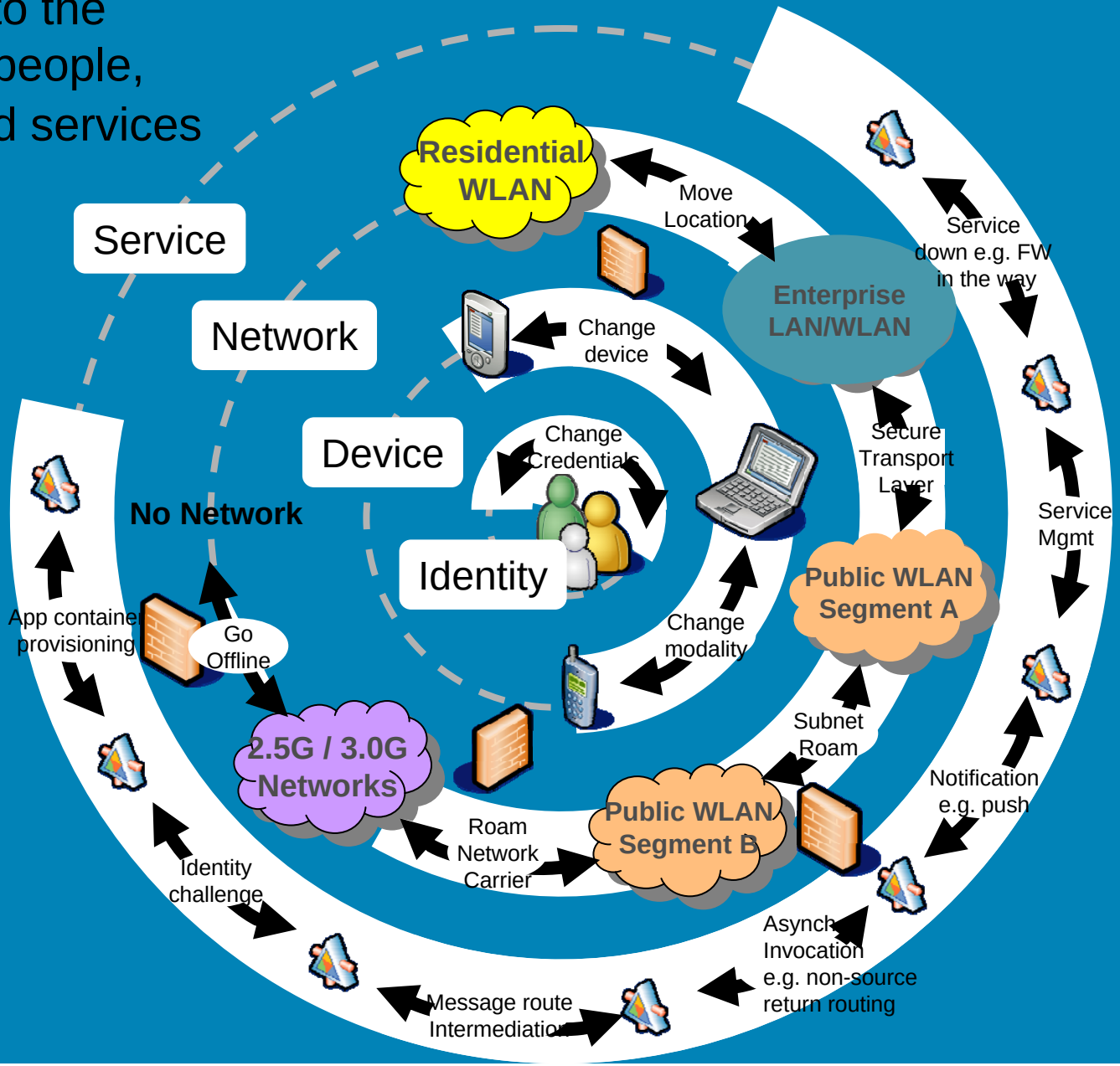


Networks in Motion

From nomadic Mobility to **On the move Mobility**

An Introduction to the Mobility Challenges

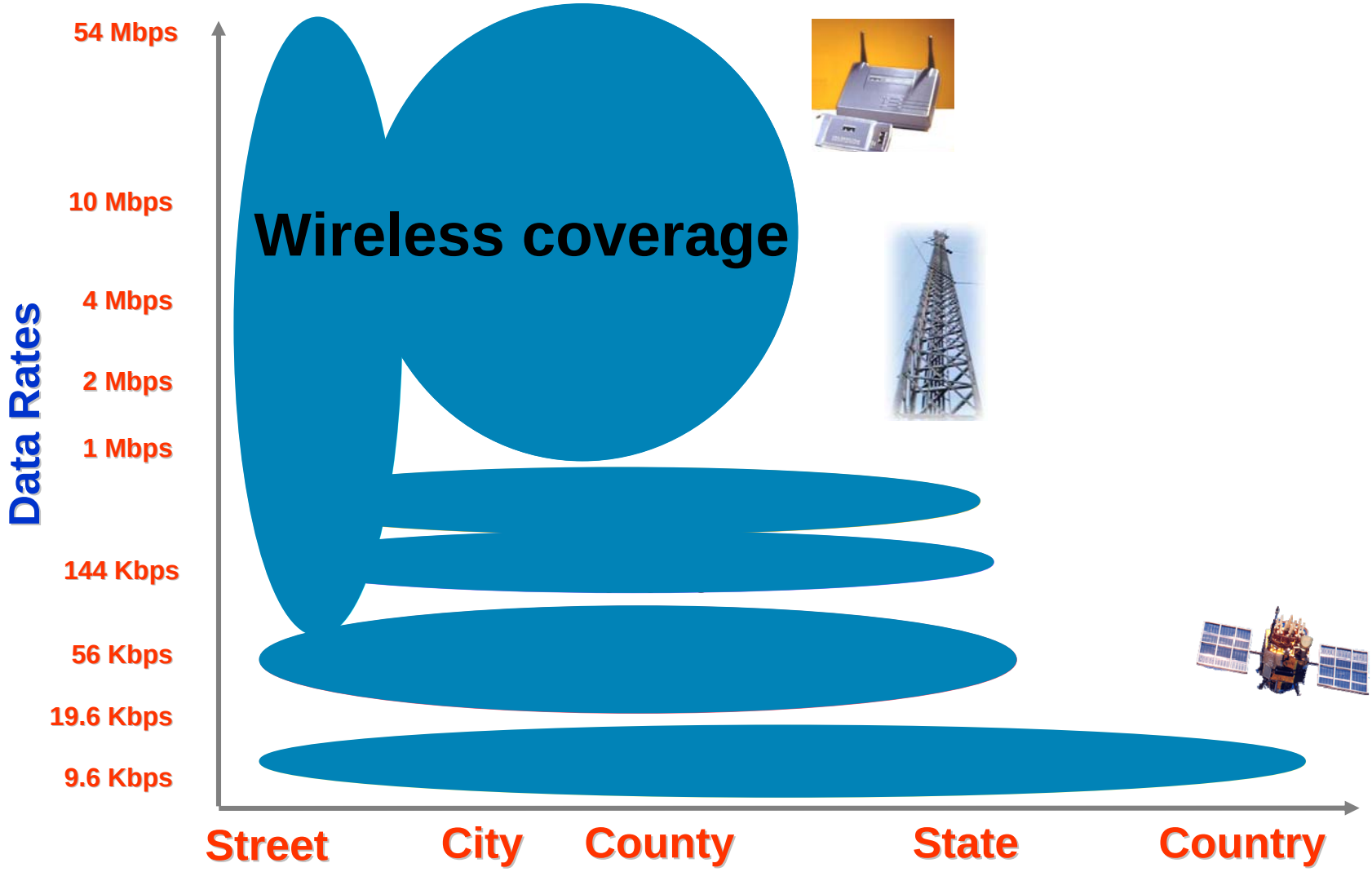
Obstacles to the mobility of people, devices and services



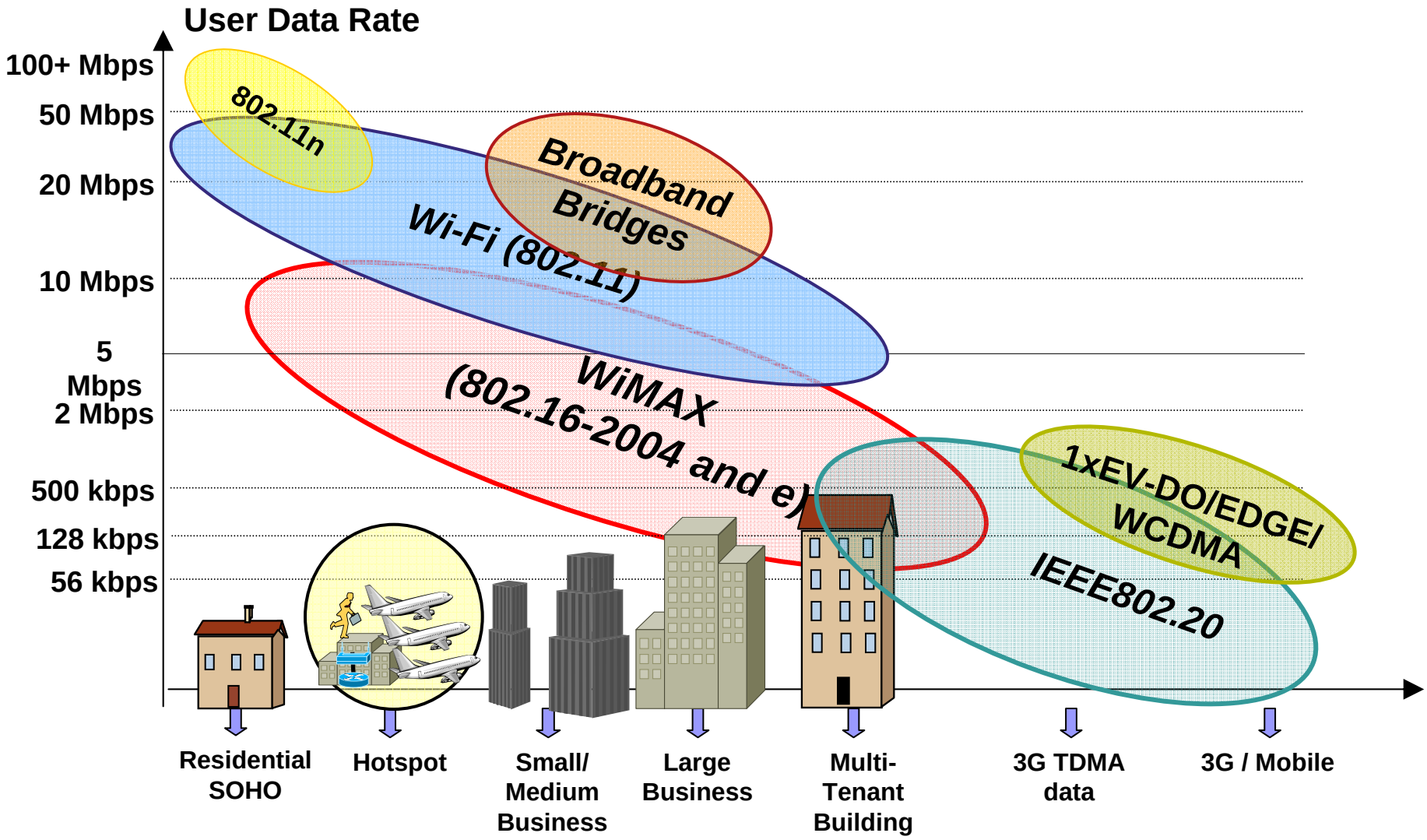
Changing mindsets is tough
Early adopters help drive the model
The market takes time

- Technologies need to mature
- Service requirements need to be understood
  - Developments need to take place to meet the service requirements which will be defined
  - Operators / Manufacturers must then offer these services / equipments
- Users have to adopt using them
  - Mobile email today is 1% of users ! It is starting
- A few leading customers pave the way

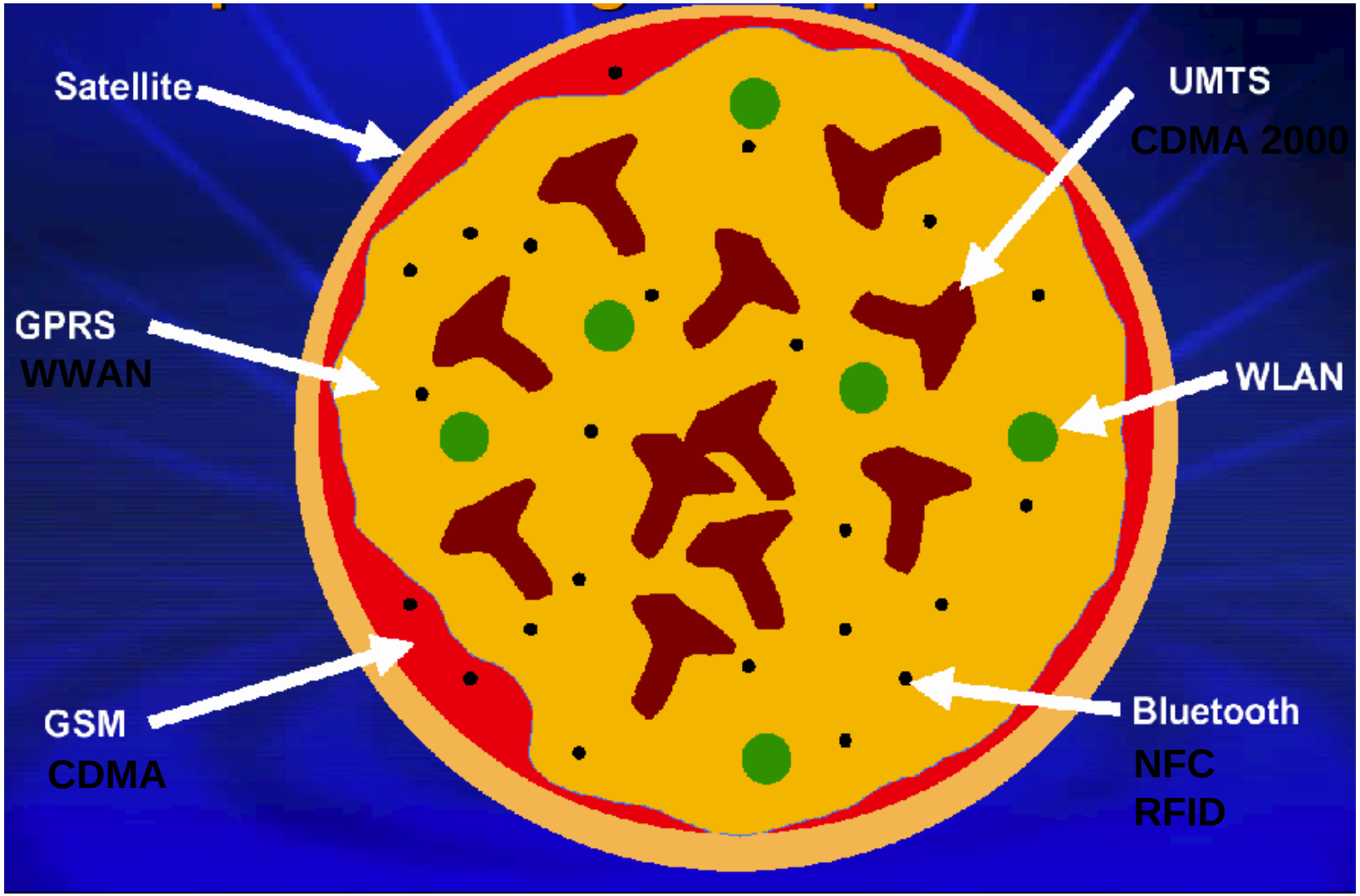
Benefit as much as possible from the available wireless Infrastructure !



Wireless Access Technologies have specificities



IP Mobility is Wireless and Multi-Access



Mobile IP
A quick reminder

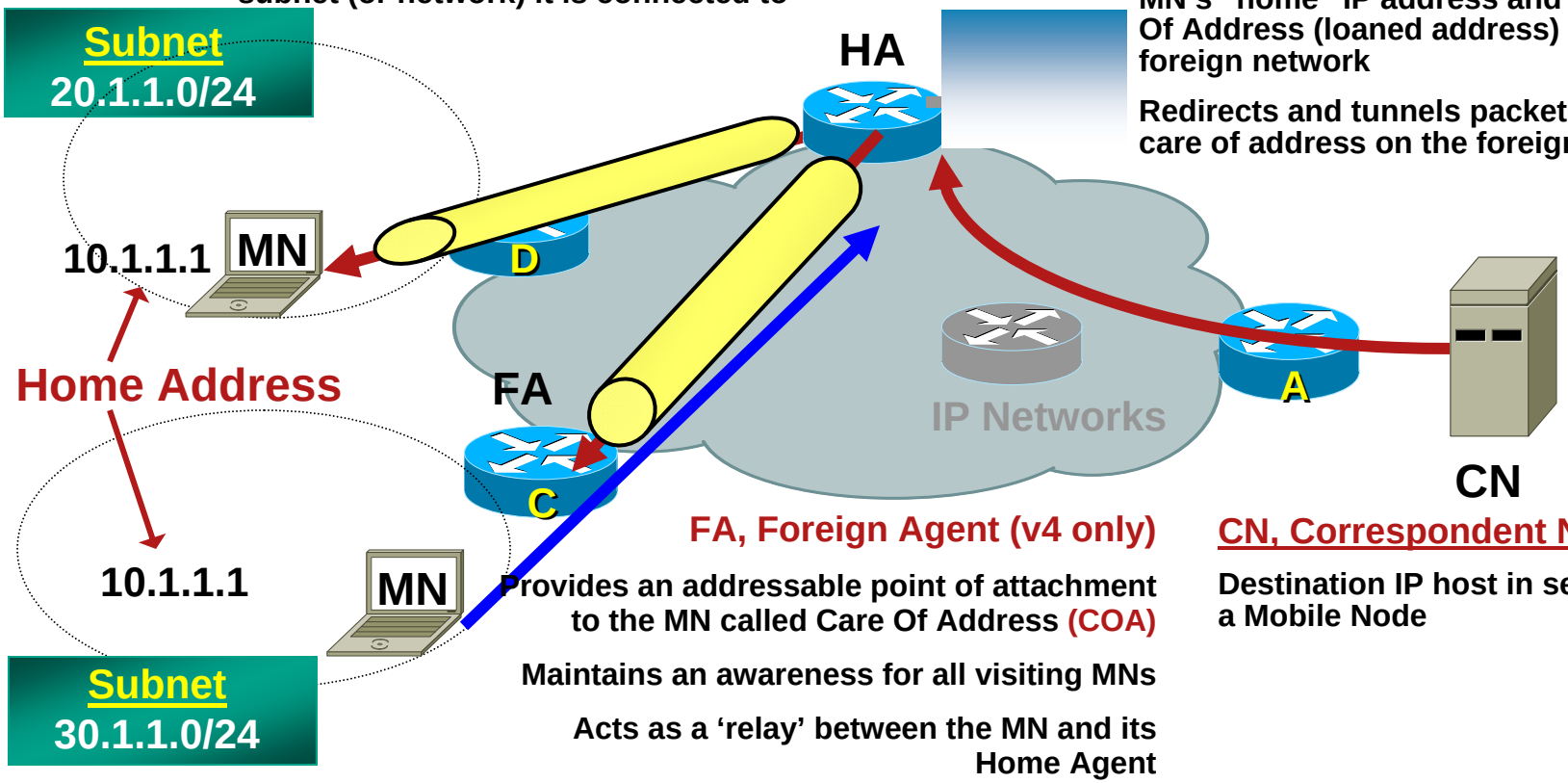
"Mobile IP provides an IP node the ability to retain the same IP address and maintain uninterrupted network and application connectivity while traveling across networks."



Mobile IP v4 Reminder

MN, Mobile Node

An IP host that maintains network connectivity using its "home" IP address, regardless of which subnet (or network) it is connected to



HA, Home Agent

Maintains an association between the MN's "home" IP address and its Care Of Address (loaned address) on the foreign network

Redirects and tunnels packets to the care of address on the foreign network

FA, Foreign Agent (v4 only)

Provides an addressable point of attachment to the MN called Care Of Address (COA)

Maintains an awareness for all visiting MNs

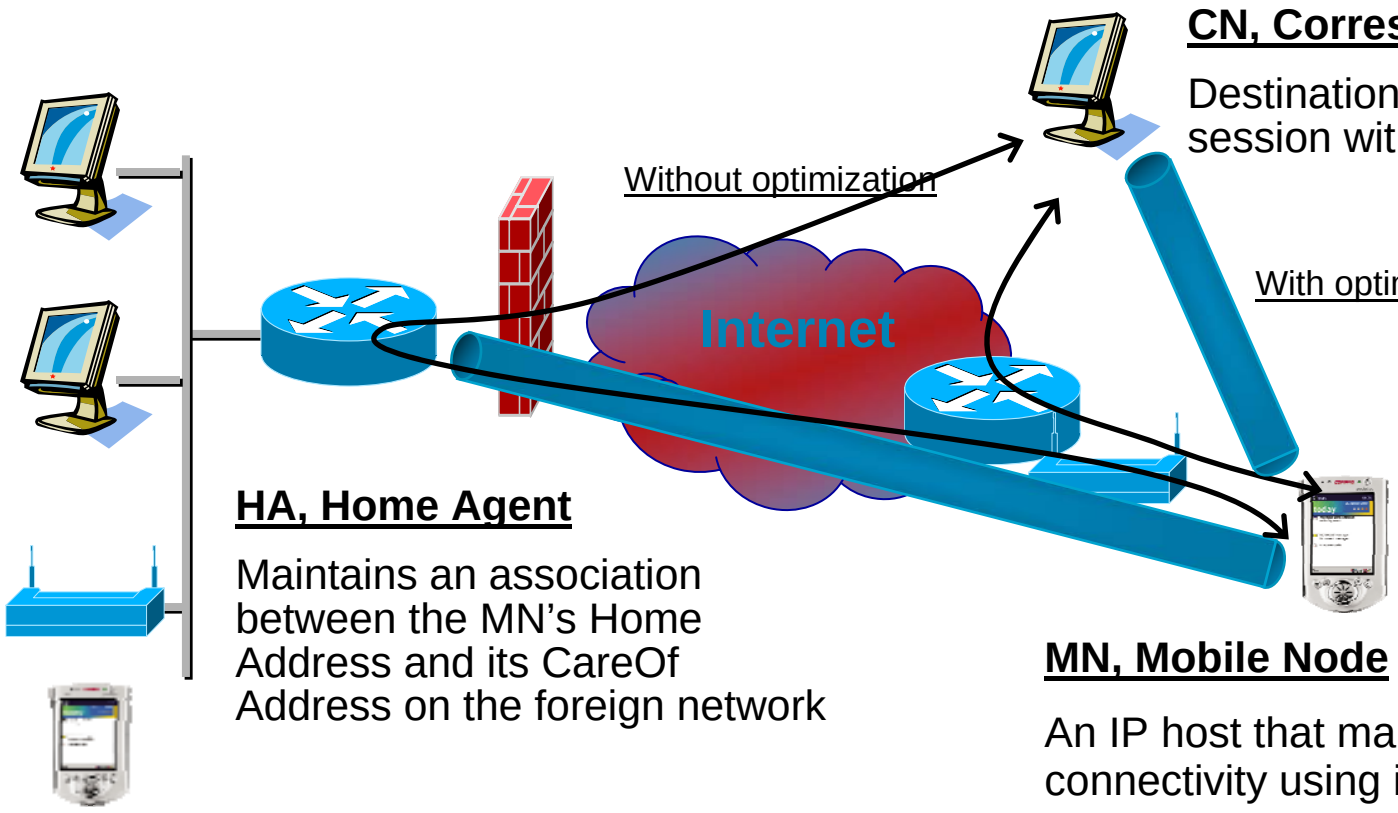
Acts as a 'relay' between the MN and its Home Agent

Receives all packets for the MN from the MN's Home Agent

CN, Correspondent Node

Destination IP host in session with a Mobile Node

Mobile IP v6 reminder (RFC 3775)



CN, Correspondent Node

Destination IP host in session with a Mobile Node

HA, Home Agent

Maintains an association between the MN's Home Address and its CareOf Address on the foreign network

MN, Mobile Node

An IP host that maintains network connectivity using its "home" IP address, regardless of which link (or network) it is connected to

Mobile IP Myth

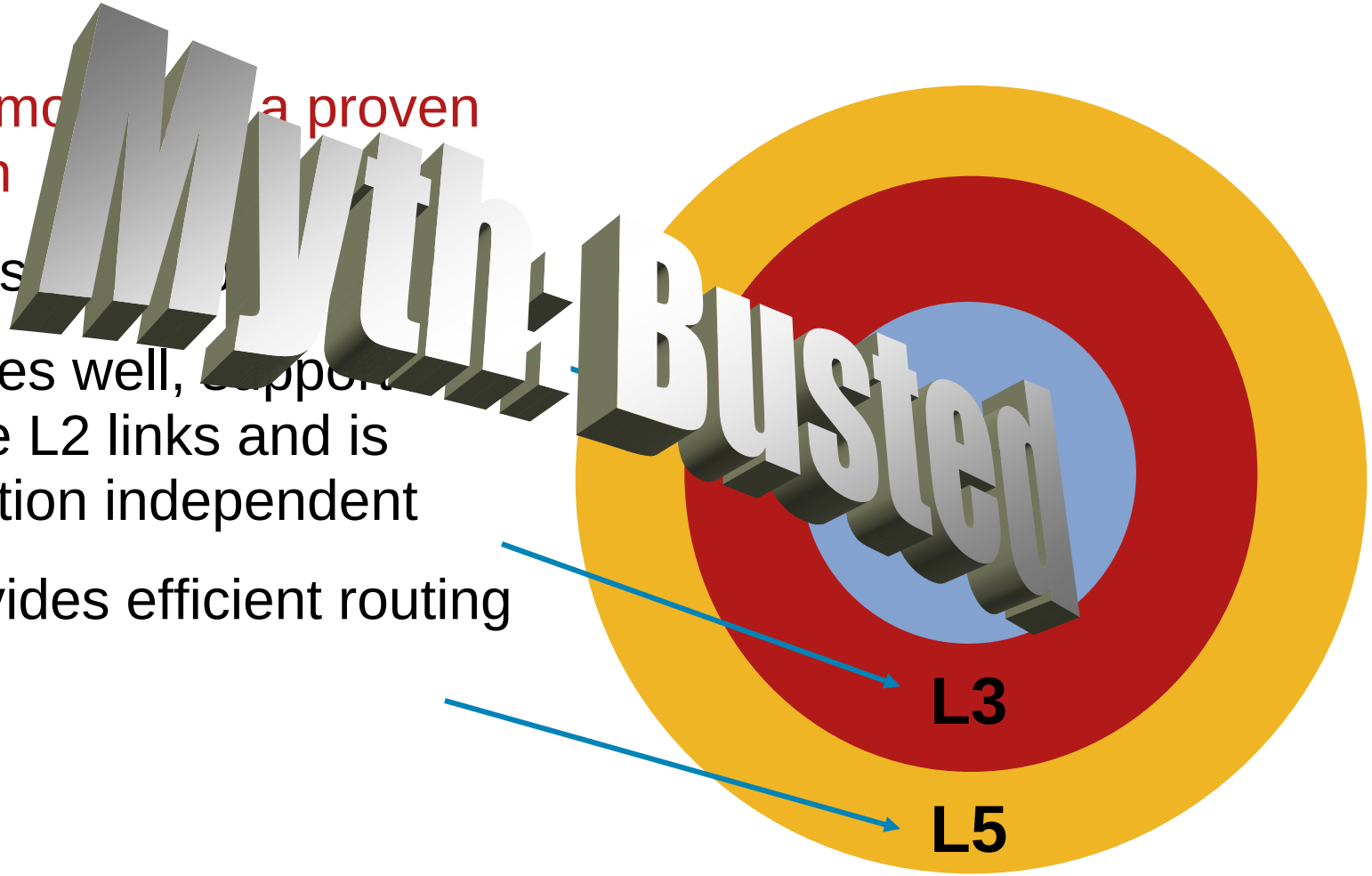
Mobility does not belong at layer 3
Make before break handover

Myth: L3 Mobility

- What are people say?
  - “Layer 3 mobility is to slow”
  - “Layer 3 mobility doesn’t provide an optimal path”
  - “Layer 3 mobility doesn’t work”
- So where does mobility belong?
  - Layer 2 because it is fast
  - Layer 5 integrated with SIP

Science: L3 Mobility

- Tiered mo a proven solution
- L2 is fas
- L3 scales well, suppor multiple L2 links and is application independent
- L5 provides efficient routing



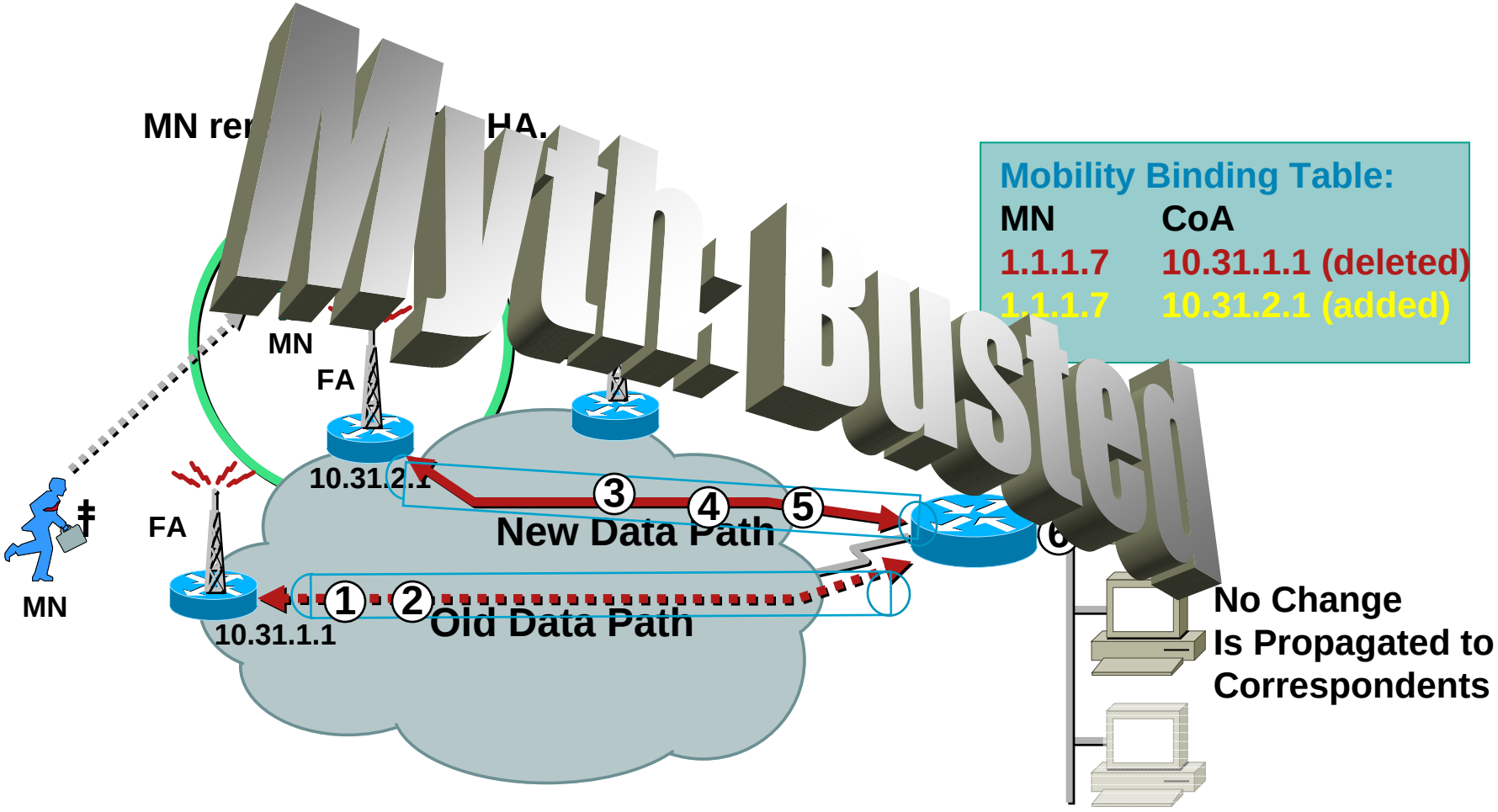
Myth: Handover

- Call it what you will
  - Make before break
  - Voice quality handover
  - Seamless handover
- The goal Zero Packet Loss Handover
- Mobile IP can do it

Science: Handover

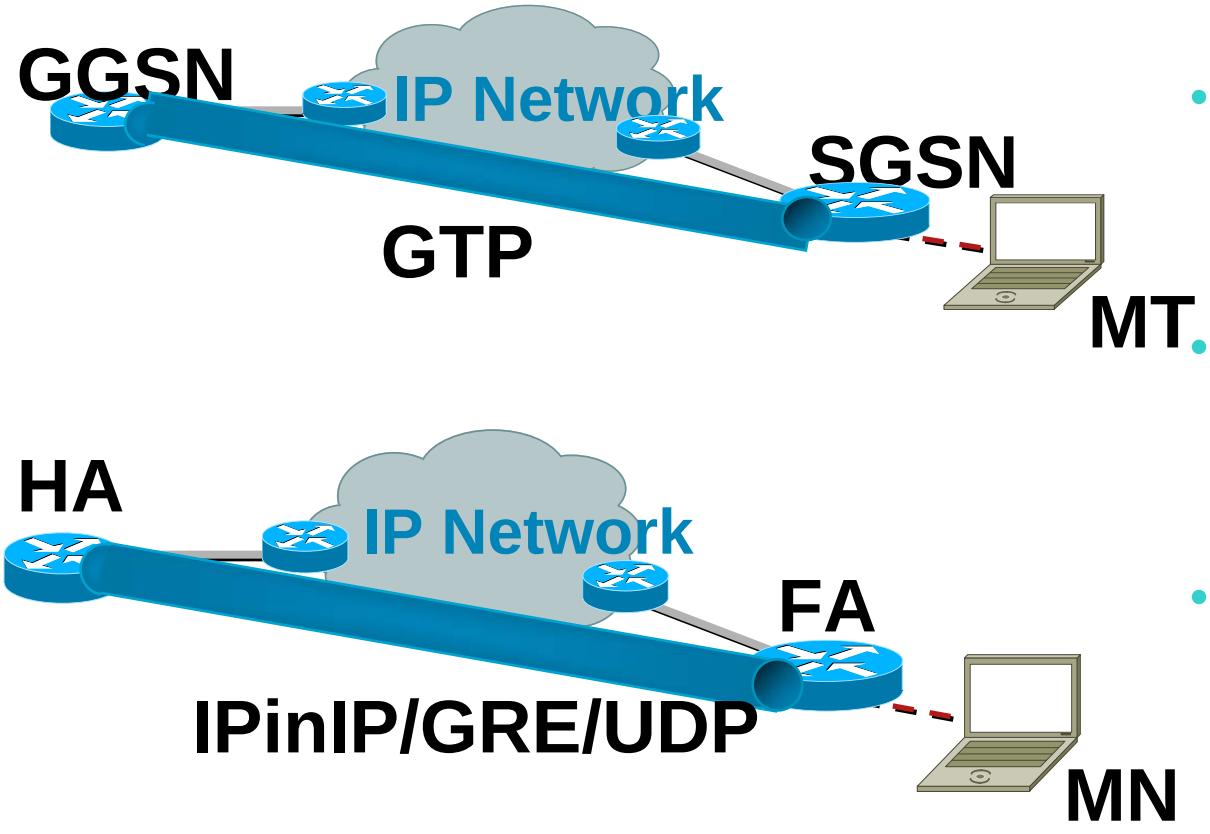
- Mobile IP Handover quality depends on layer 2
- Make before break is a Layer 2 concept
- If the old and new layer 2 are available at the same time no packets will be lost
- Easy to see when changing between link types
- Most link types don’t support this unlike GSM does (e.g. 802.11 does not)

Science: Handover



ⓝ Data packet with sequence number

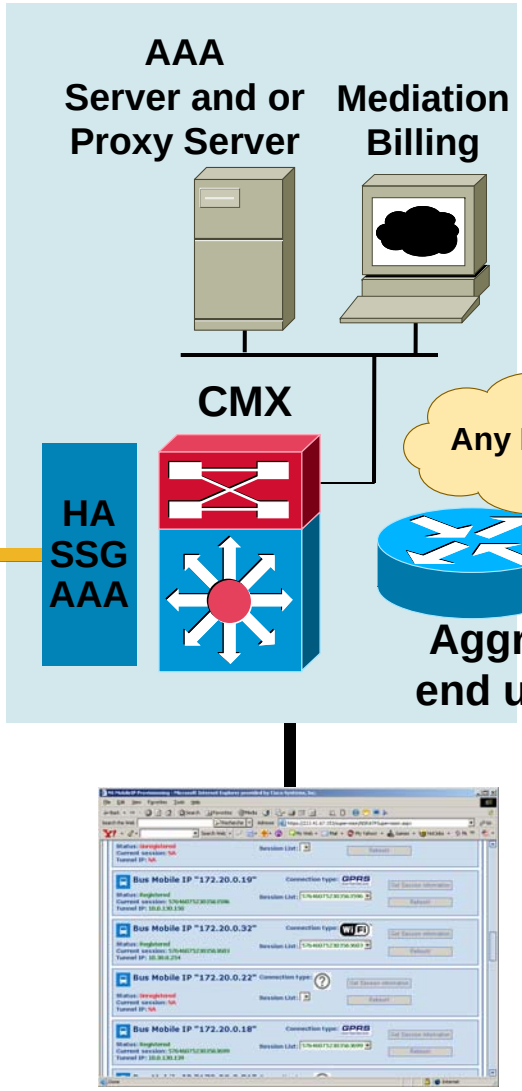
Mobile IP mobility versus other mechanisms



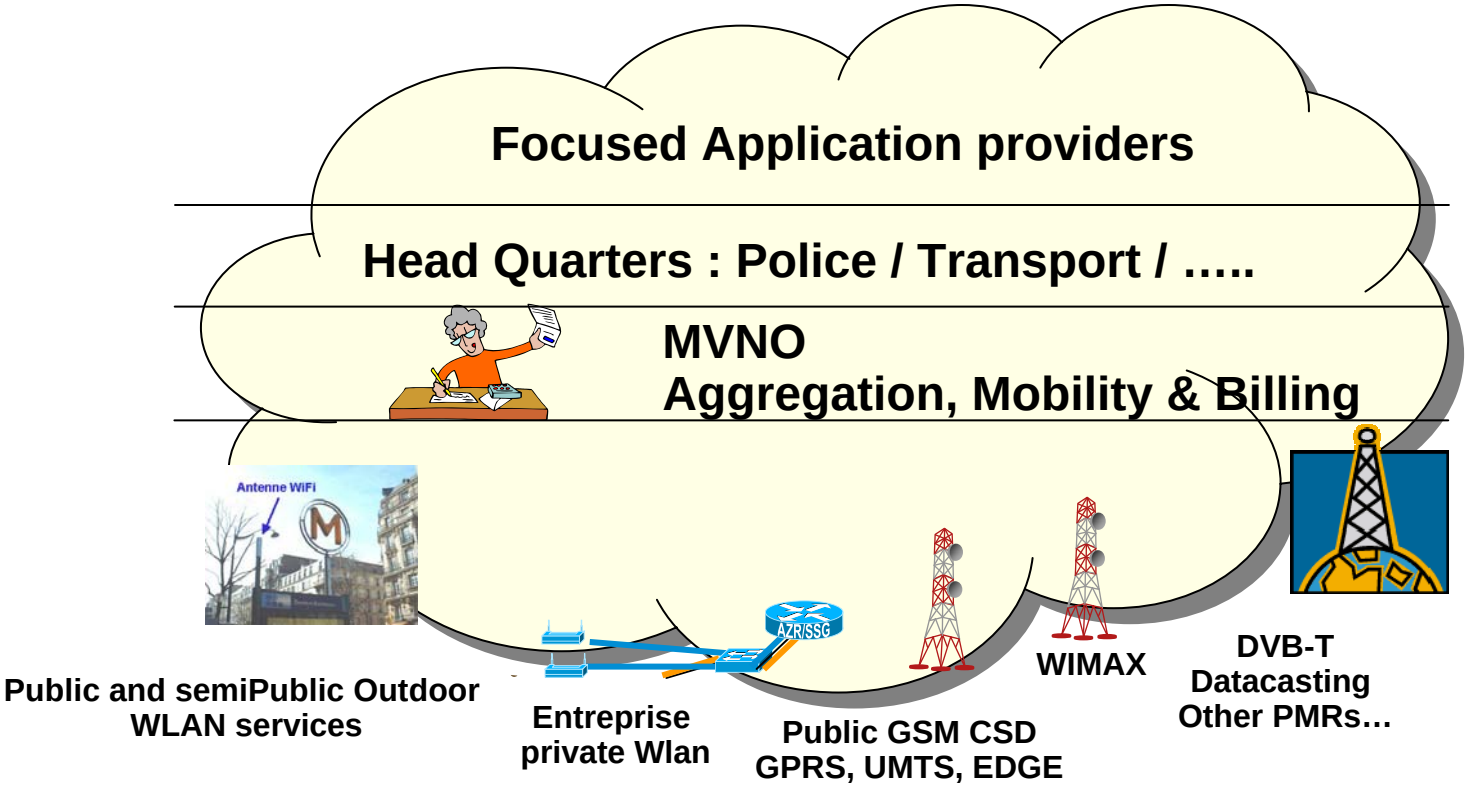
- In GPRS the GGSN is the anchor point of a user connection, equivalent to a HA in Mobile IP
- As a user moves in GPRS he changes point of attachement from SGSN to SGSN
- The mobility from GGSN to SGSN is managed with tunnels in “both” technologies
- The only difference is the handover trigger algorythm

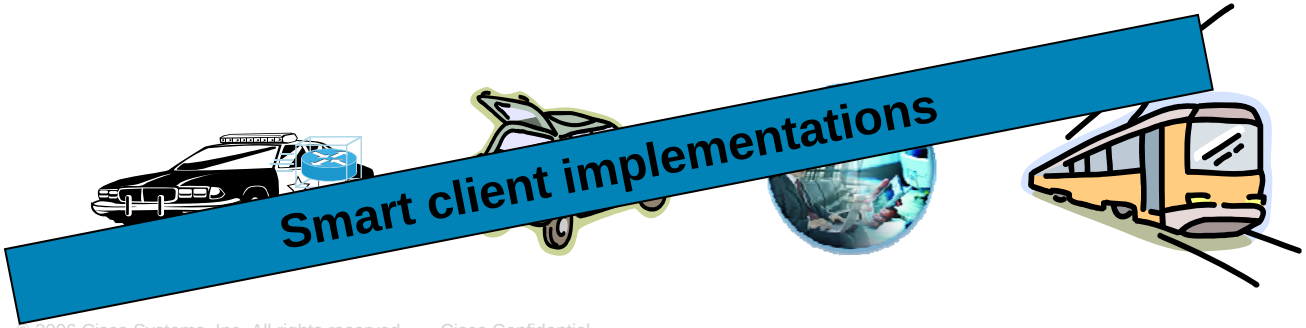
Early Adopters Deployments

Overall System Architecture



Deployment's Generic Architecture

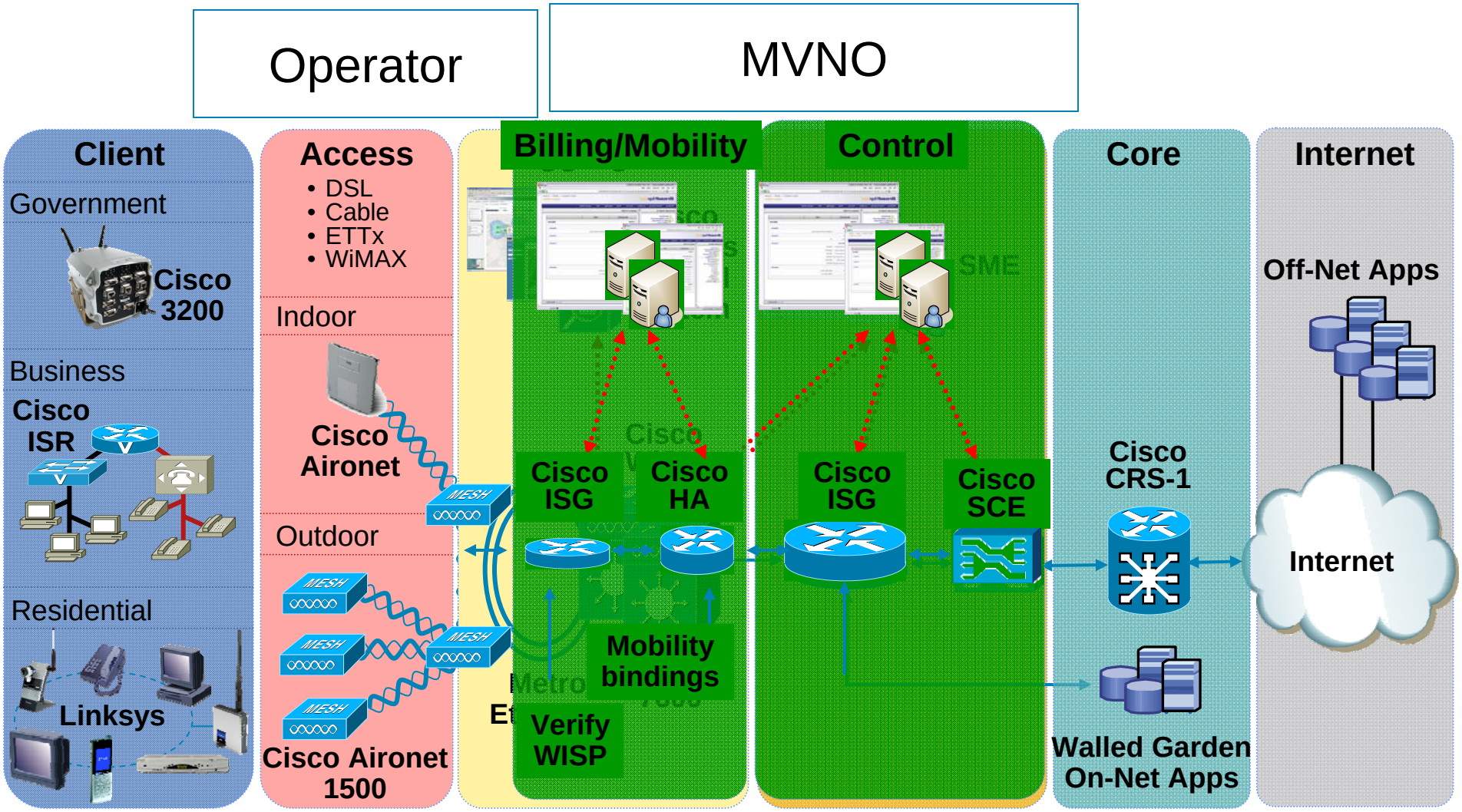




Why a MVNO ?

- Customers / End Users can not deal with so many access network providers
- The MVNO is in charge of negotiating “roaming” agreements, authentication methods and billing capabilities, IP architecture issues such as IP addresing with the access networks
- The MVNO is the single point of contact for the end user
- The MVNO must provide not only technology value add but also management, deployment simplification solutions (tools to help manage the fleet)
- The MVNO is a logical function that needs to be undertaken by an entity (operator, new entrant, IT department, …)

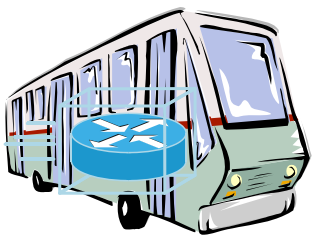
Cisco Service Mesh Architecture

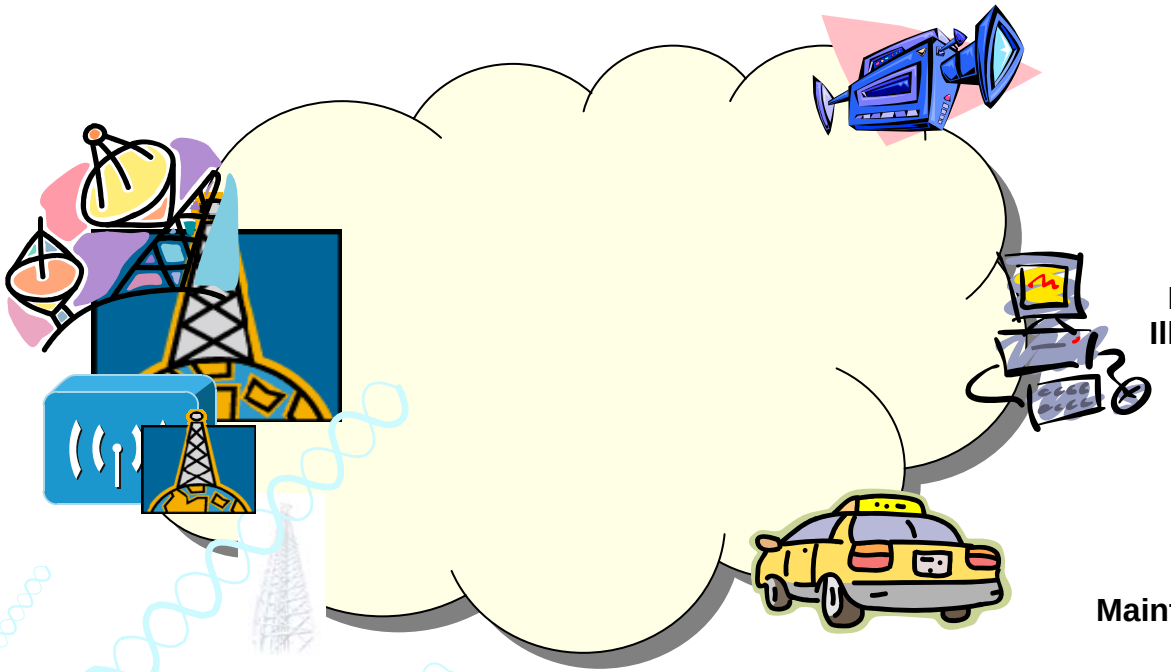


Early Adopters Proving the Model

1. Paris RATP Public Transportation Company
2. Swisscom Mobile
3. City of Westminster, London

Professional Applications in Mobility for the transportation market





Travelers Information

Multimedia info screen
Localised Portal
Centralised infos

Operation

E-ticketing
Driver info management
Illegal parking snapshots

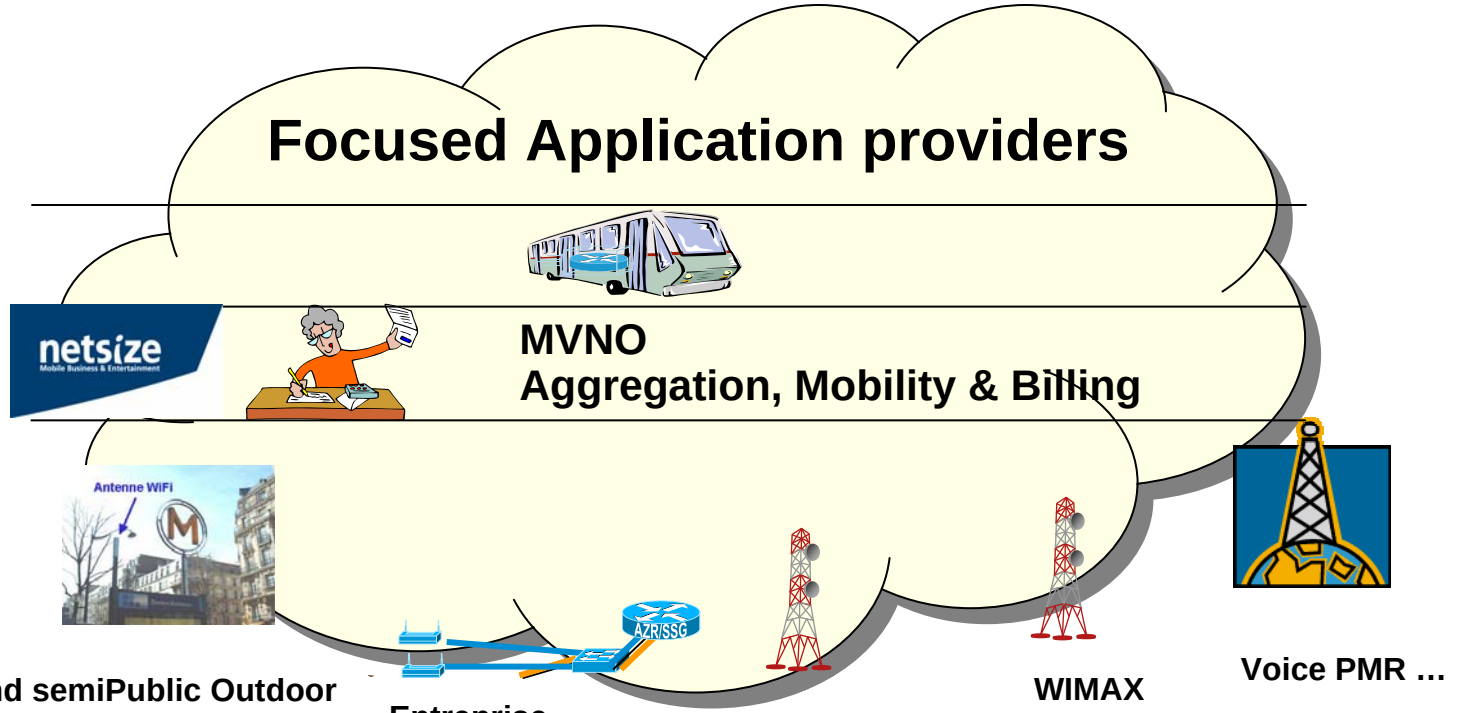
Maintenance

Telemetry
Maintenance localised portal

Security

Video surveillance
Emergency contactless cards

RATP's Generic Architecture



Public and semiPublic Outdoor WLAN services

Entreprise private Wlan

Public GSM CSD GPRS, UMTS, EDGE

WIMAX

Voice PMR …

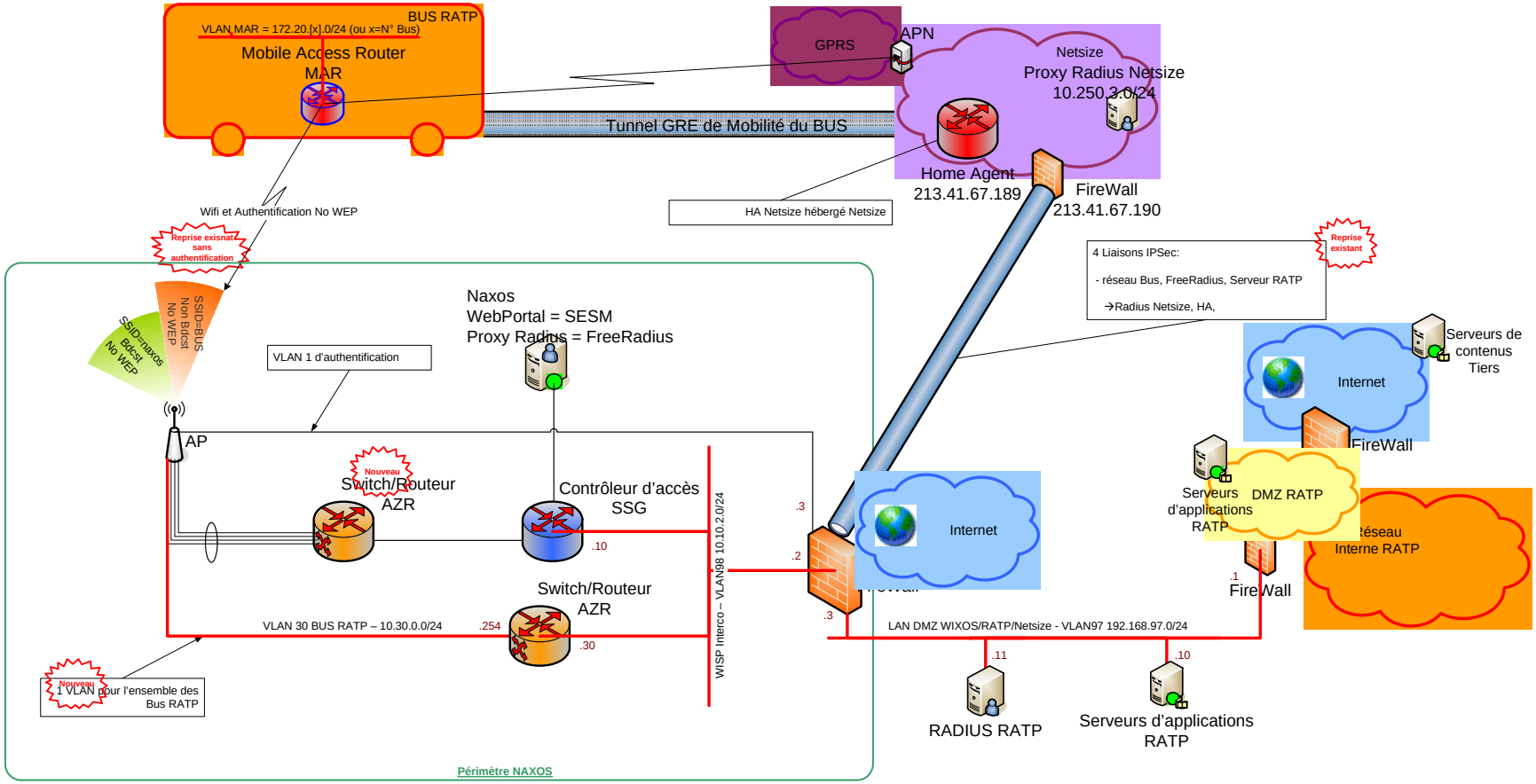
Wixos

RATP Depot WIFI

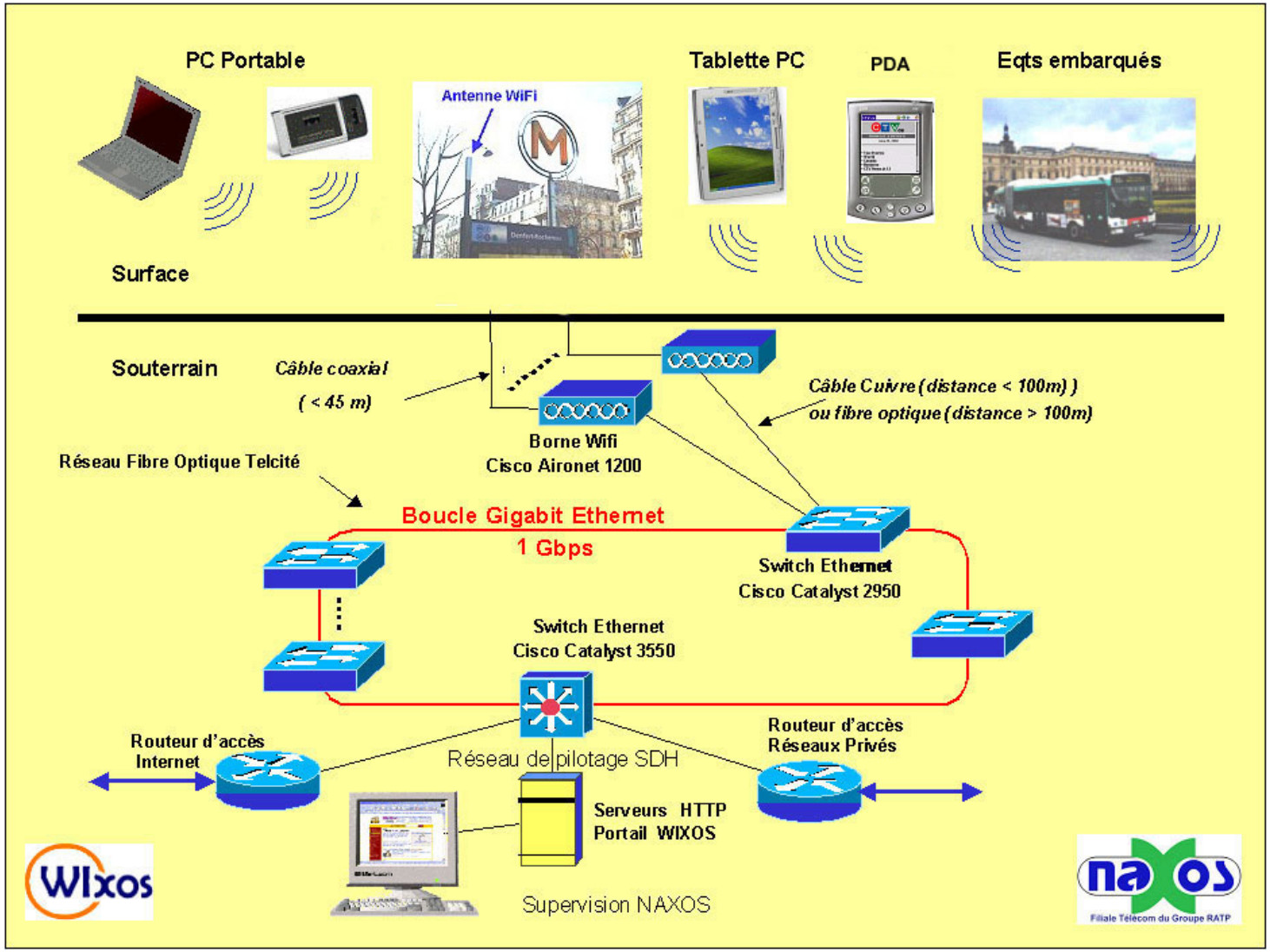
Bouygues Telecom

End to end network architecture

VisioDocument -- Architecture Temporaire			
1.0	Création	11/03/2005	MP



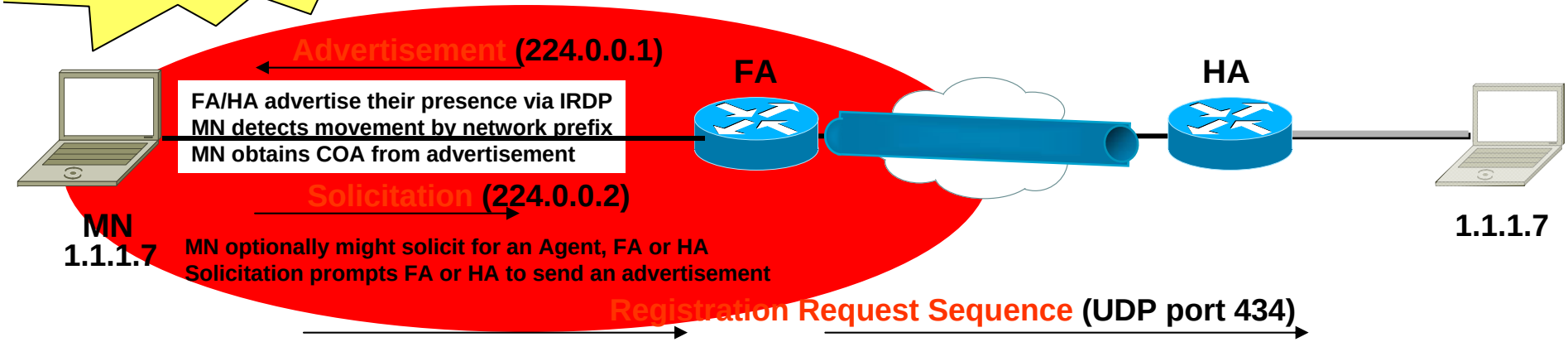
Naxos WIFI city wide infrastructure



Technology : Naxos City Wide WIFI Infrastructure

- ETTX network accross Paris
- Providing as much layer 2 as possible limited by the scale of one single layer 2 area
- APs in one area use IAPP for handover
- BUS uses WIFI 802.1x into a dedicated VLAN, not HTTP based authentication
- Foreign Agent service for speed of handover inter layer2 areas « see slide on Agent Solicitation »

Technology : Mobile IP in a nutshell



Registration Request Sequence (UDP port 434)

MN sends unicast registration request to FA (UDP DP=434)
Request includes Type of "MN's Address, HA, COA, authenticator, Tunnel type, Lifetime, Broadcast…"
FA inspects the request, if no objections "relays" the request to the defined HA

Registration Reply Sequence (UDP port 434)

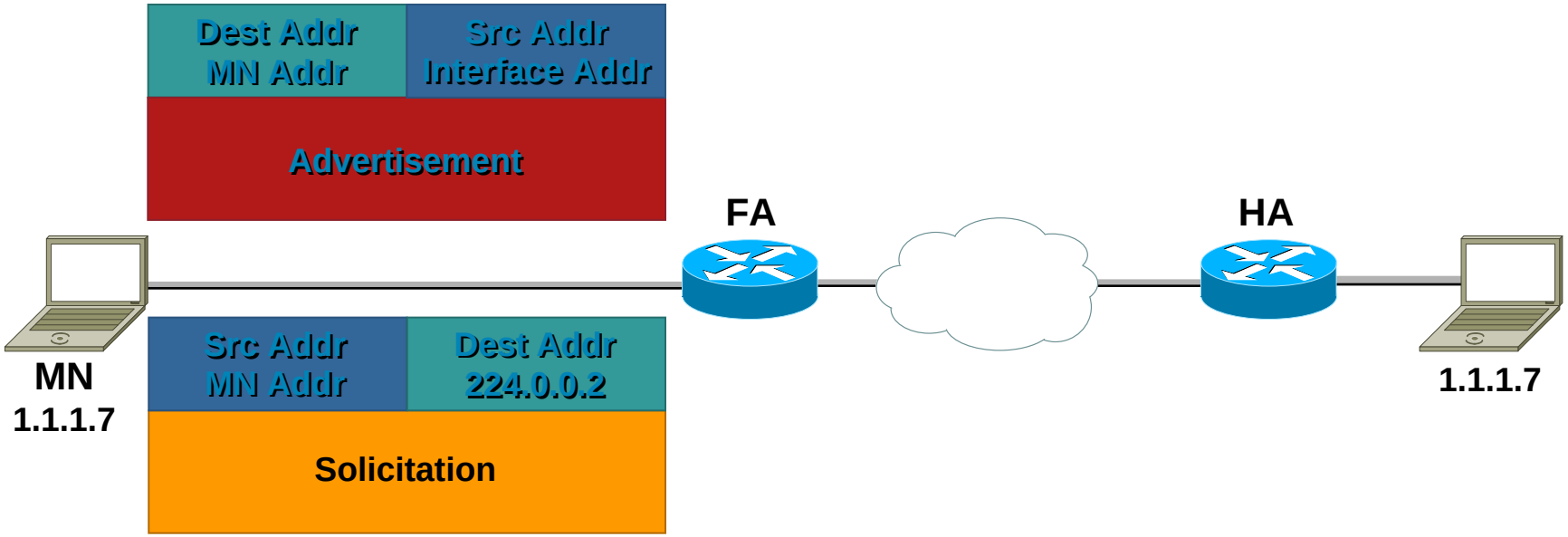
HA	Inspects the request (can it fulfill options requested, performs Authorization check) If okay, HA adds a Mobility Binding that associates the MN IP Address with the COA builds a Layer 3 tunnel to the COA (FA or direct to MN), if one doesn't already exist sends Registration Reply (UDP DP=UDP SP or request) to the COA (FA or direct to MN)
FA	Inspects the reply, if no objections "relays" the reply to the MN adds MN to list of visitors acts as default router for MN packets
HA	Sends out a Gratuitous ARP associating MN IP address with the HA's MAC address responds to ARP requests for MN IP address with its MAC address Keeps an eye out for packets routed to the MN's IP address and redirects them to the current COA
MN	if authorized MN is set to maintain active or future application traffic if rejected the MN can inspect the return code and attempt to re-register

De-registration Request (UDP port 434)

MN	Detects it's on home subnet Sends Registration Request with a lifetime of 0

Technology :

Advertisements versus DHCP



- MN sends out solicitation to “all router” multicast address 224.0.0.2 as soon as link layer is UP
- FA responds with unicast advertisement to MN
- FA response much faster than DHCP offer from DHCP server
- Mobile IP CoA quicker than CCoA

Naxos Hot Spot user management

- Cisco PWLAN solution based on:
  - SSG
  - SESM customized by CGEY
  - Radius server integrated with SESM by CGEY
- Provides both WEB based authentication & 802.1x capabilities
- 802.1x used for the BUS for Mobile IP compatibility and billing
- For more details please refer to Networkers Sesssion:

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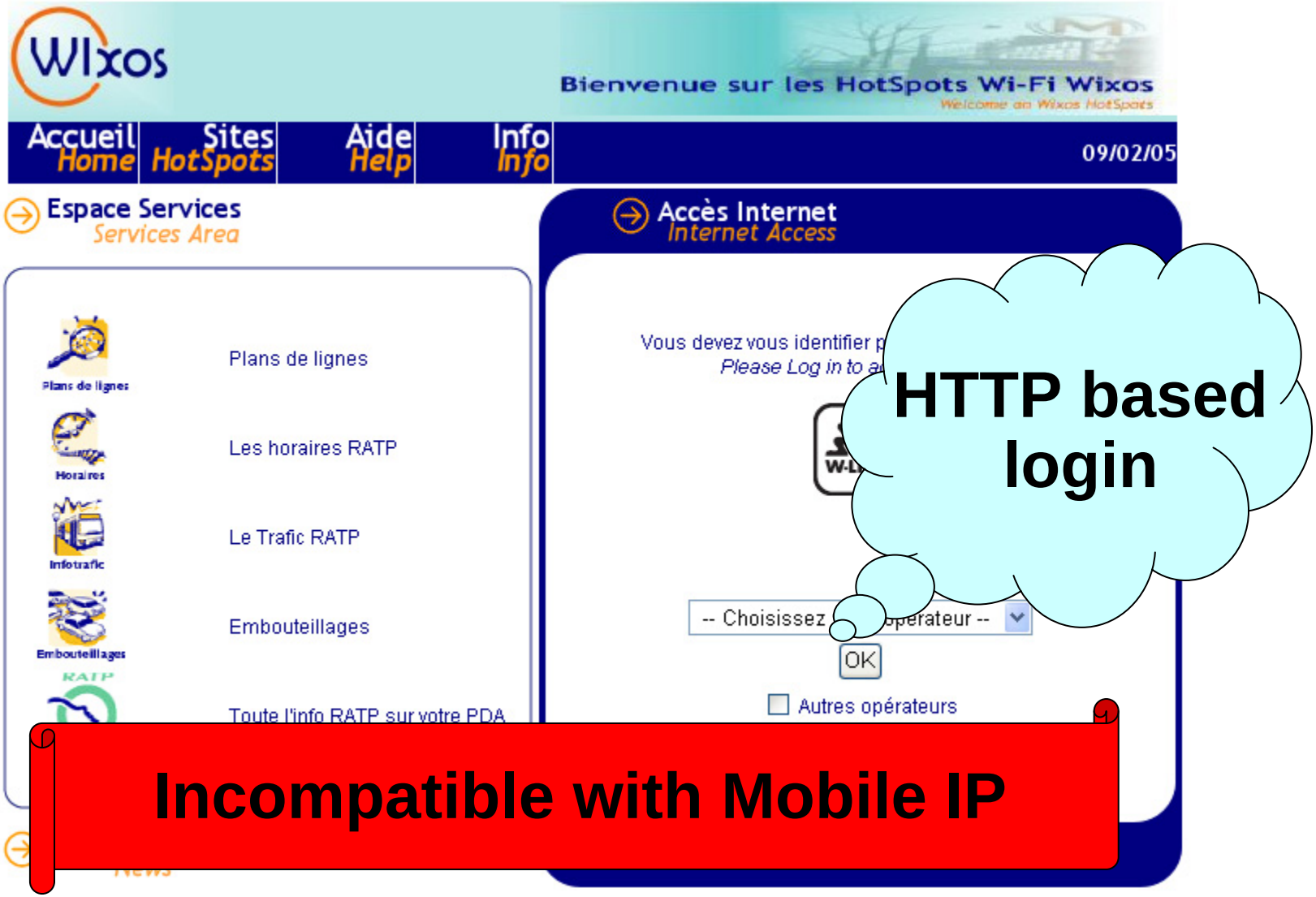
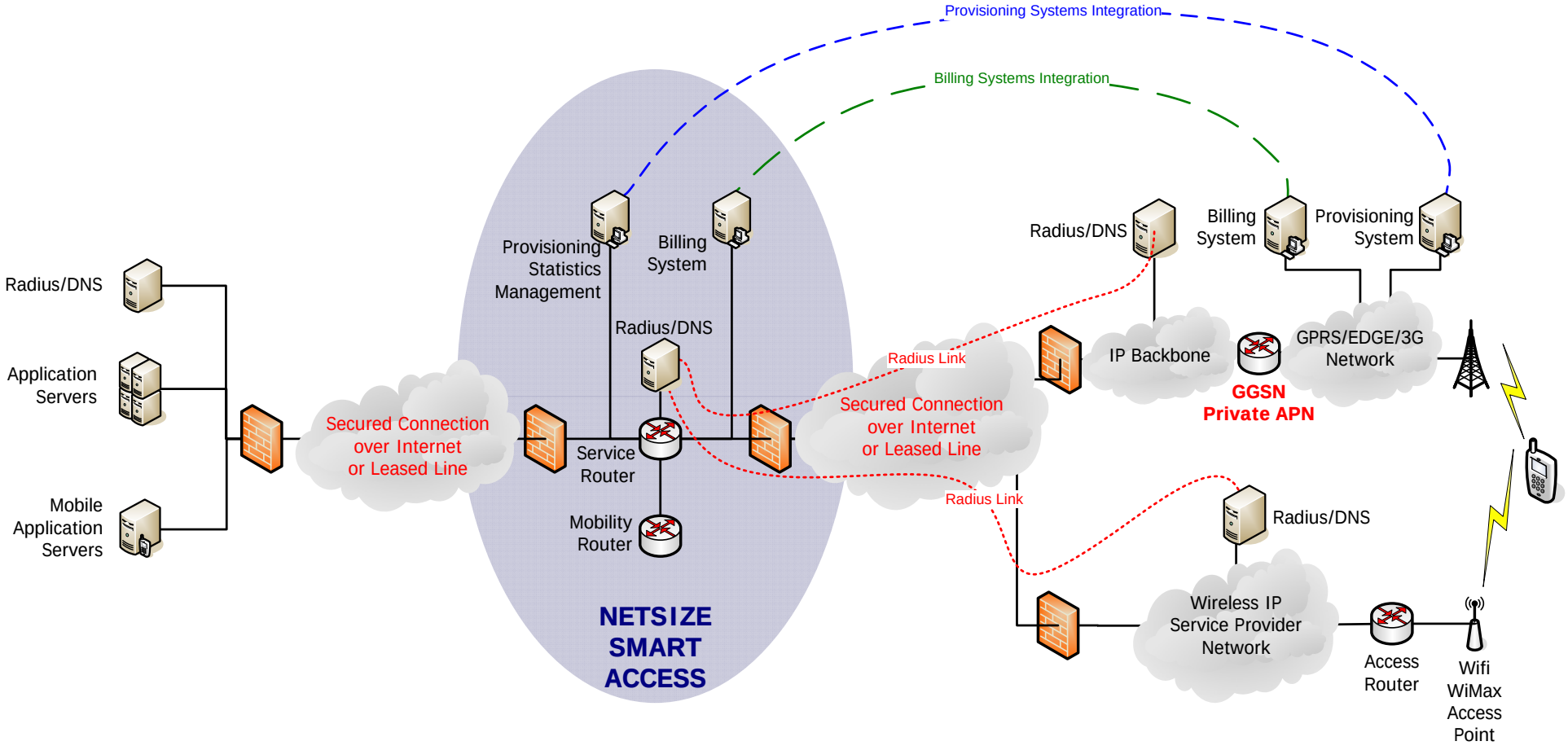
Naxos Hot Spot User Management Page



Technology : 802.1x Single Sign On

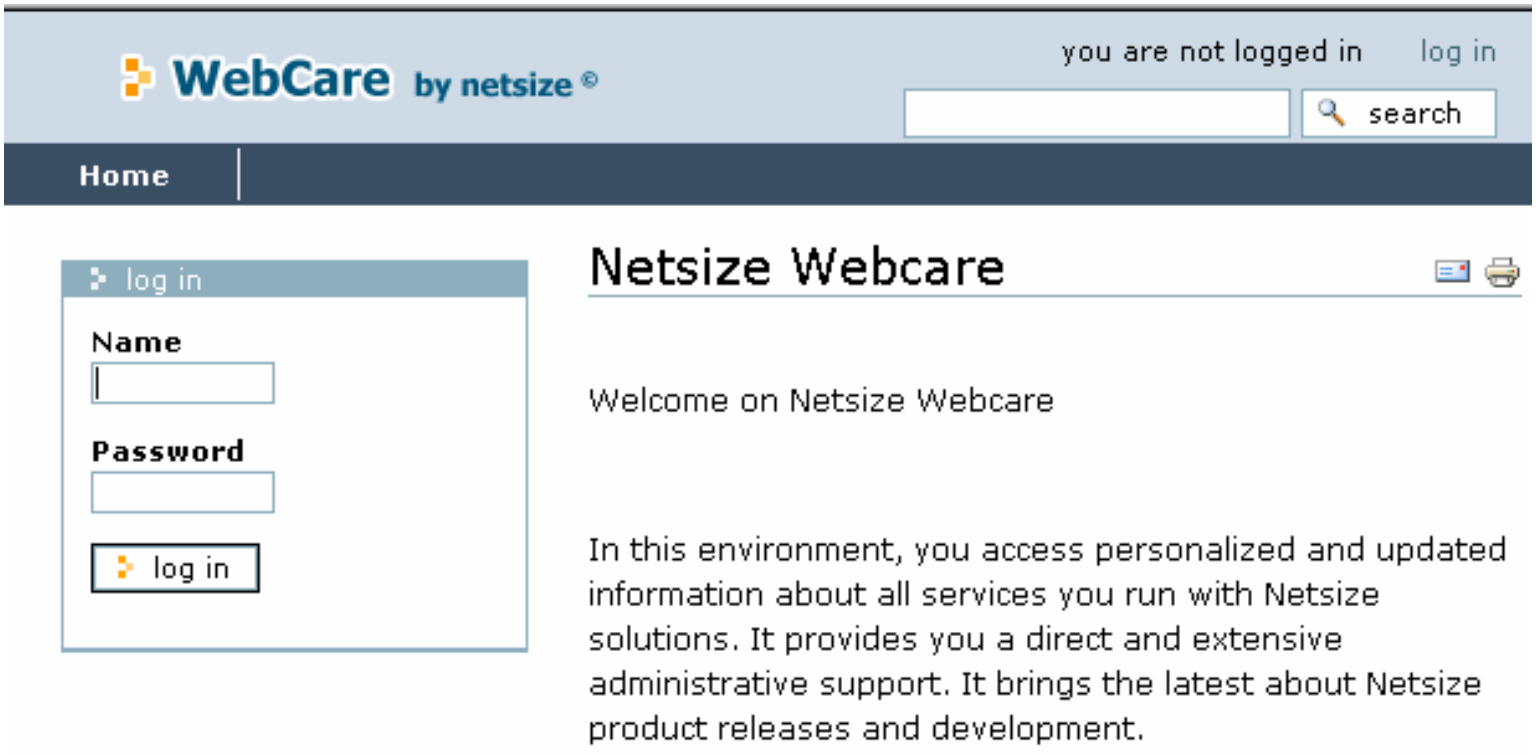
- Web based authentication methods are incompatible with mobility events, they require user intervention
- 802.1x automates authentication and can be proxied through the different layers of the model :
  1. WISP
  2. MVNO
  3. End User Backend System
- This provides Single Sign On capabilities

Smart Access Technical Architecture



Webcare

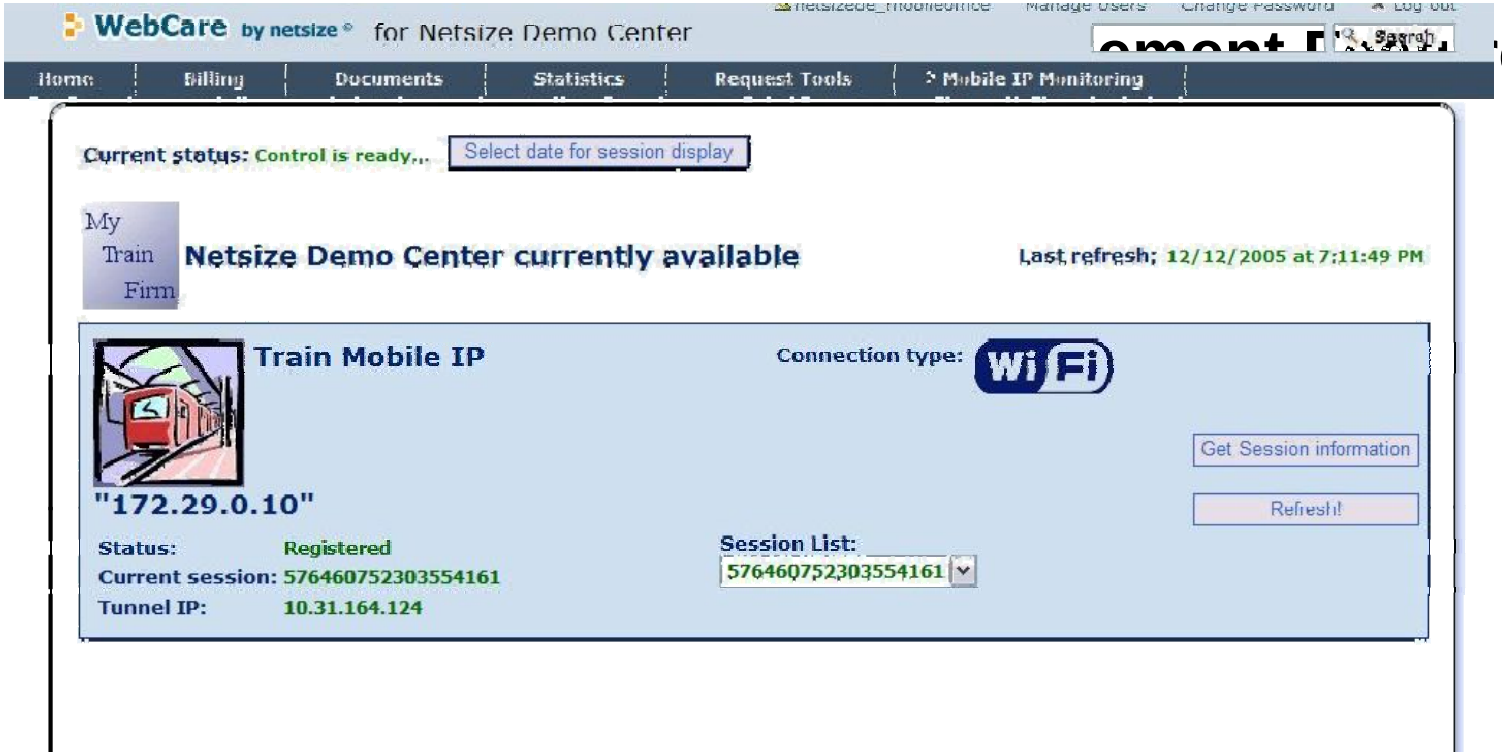
Customer self-service management application



Webcare Benefits

Centralized Access to

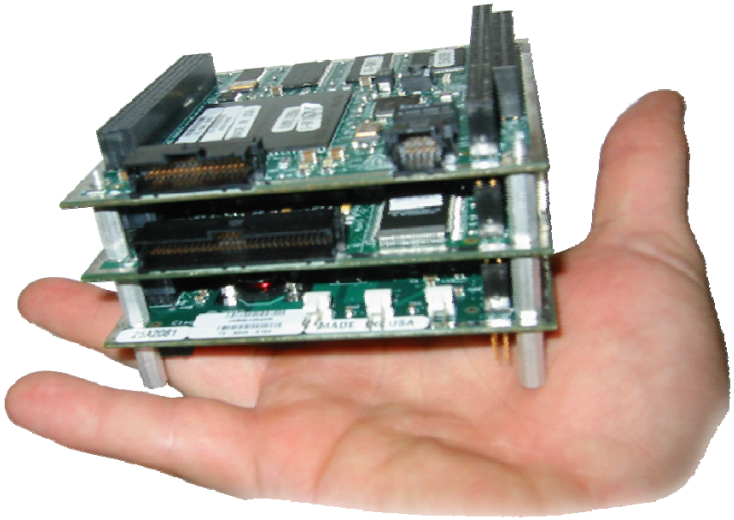
- Real Time Statistics
- Data Mining



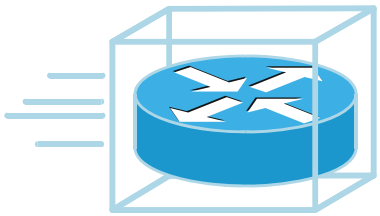
RATP's smart client : The Cisco 3200 Mobile Access Router

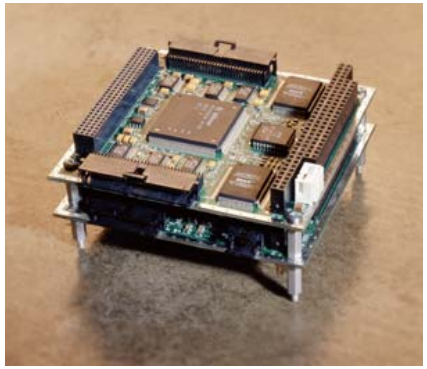
Cisco IOS router platform that extends the IP frontier to mobile vehicular environment

- **Small Footprint & Low Power consumption**
- **Ruggedized**
- **High performance in a compact, rugged design for use in vehicles**
  - **Performance comparable to 3640 or 3800**
- **Optimized for embedded applications**
- **Secure data, voice and video communications with seamless mobility across wireless networks independent of location or movement**



- **Advanced IP services and interoperability with Cisco IOS software**
- **Utilizes Cisco IOS, Mobile IP & Cisco Mobile Networks**

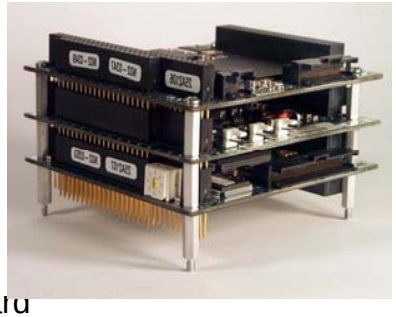




Cisco 3200 Series Hardware Overview
A complete Cisco + Partner solution

Mobile Access Router Card (MARC)

- High performance processor
- One 10/100 Ethernet
- One console
- One powered async serial (for GPS)



Mobile Interface Cards (MICs)

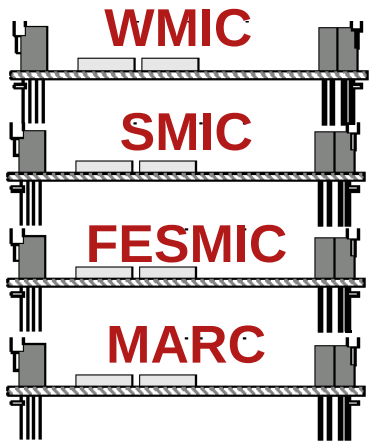
- Serial Mobile Interface Card (SMIC): 2 or 4 port sync/async serial
- Fast Ethernet Switch Mobile Interface Card (FESMIC): 2 or 4 port FE/E Switch Card
- Wireless Mobile Interface Card (WMIC): 802.11b/g
- Wireless Mobile Card 4.9 GHz
- WMIC 802.11a (5 GHz with DFS & TPC)
- UMTS / EDGE solution (Partner)
- ADSL (Partner)

Future (under study from Partners)

- WMIC Wimax

Designed for Integration

- Small footprint
- Rugged design
- DC power
- High Performance
- Flexibility & Modularity

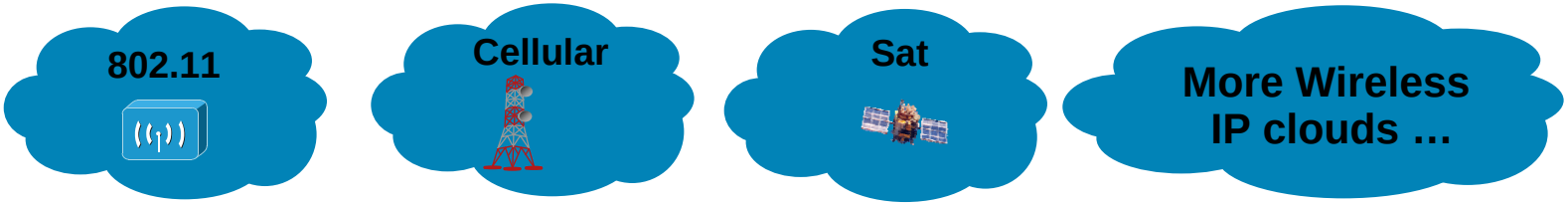


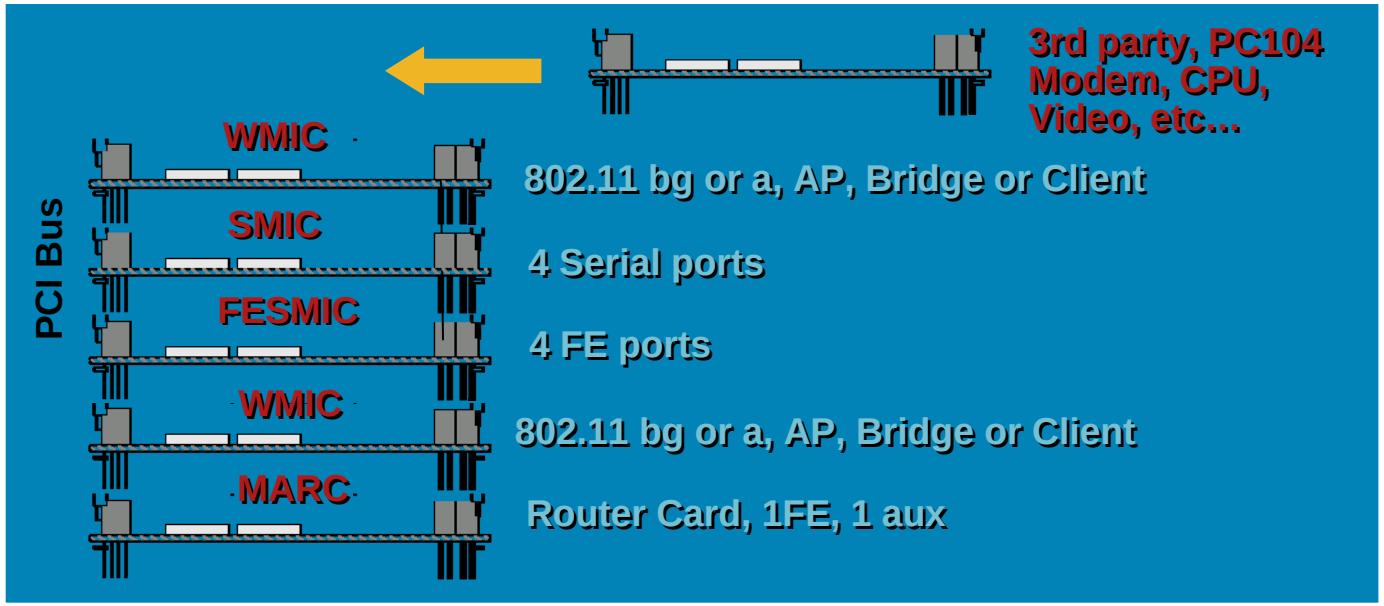
The value of IOS : feature rich over time

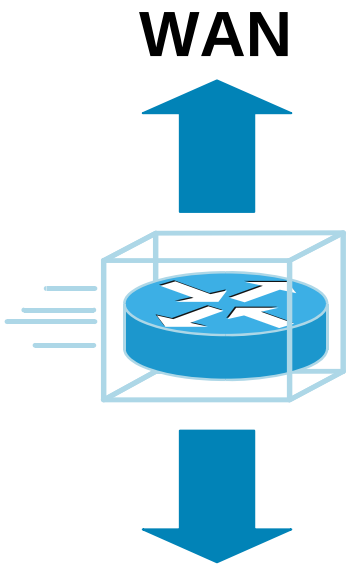
Policy Management

Access	Security	Mobility	Management
Connectivity	Authentication	Mobile IP v4	Zero touch
Performance	Authorization	Mobile IPv6	Config Express
Ease of Use	Accounting	Mobile Router	IE 2100
Manageability	Assurance	Wireless	Monitoring
Availability	Confidentiality	MANET	
	Data Integrity	Data Integrity	

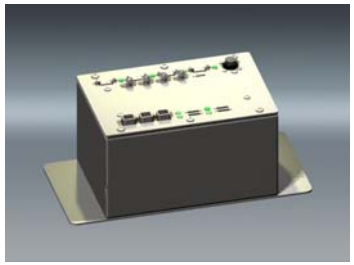
Configuration for Vehicles







Specific Product environment



MetroCan Vehicle Solutions

AnyLynx Mobile Solution

Cisco Enclosure

Early Adopters Proving the Model

1. Paris RATP Public Transportation Company
2. Swisscom Mobile
3. City of Westminster, London

swisscom mobile

Bundled offers

• PWLAN WEB-

• MOBILE UNLIMITED

• Dashboard

BLACKBERRY

• Natel Data Basic
• Natel Corporate

• Mobile Internet Package

Access

WLAN

GSM
•GPRS
•EDGE
•UMTS

Unlimited Vision

1 Network Price PC-Card Connect Offer

Swisscom Mobile

Multi Access

PSTN
ISDN
ADSL
Cable TV

Home

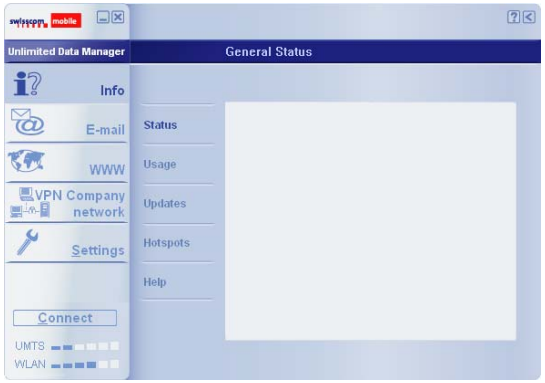
Company HQ

Affiliates

47

swisscom mobile

Seamless Mobility it' s Unlimited Connection at Swisscom Mobile



Multistandard communication

PC-data card

Transparent costs Information

Seamless pricing

To be **ALWAYS** with the **BEST** service & bandwidth **CONNECTED**

Mobile IP software

Seamless connectivity

Uninterrupted flow

Permanent security

Swisscom Mobile—Mobile Unlimited

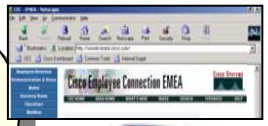
- GPRS + UMTS + WiFi + Mobile IP
- Seamless user experience with one card
- Mobile IP Client is part of the software package
- EAP-SIM Authentication for WiFi
- User automatically make use of the best available network
- In production since Q3/04

What applications for the unlimited service Imagine …

Connect further value added Professional Applications

Imagine on board connectivity, as standard office connectivity

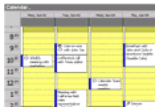
Email



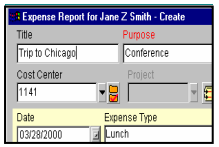
Intranet

IM

Web



Calendar



Workforce optimisation

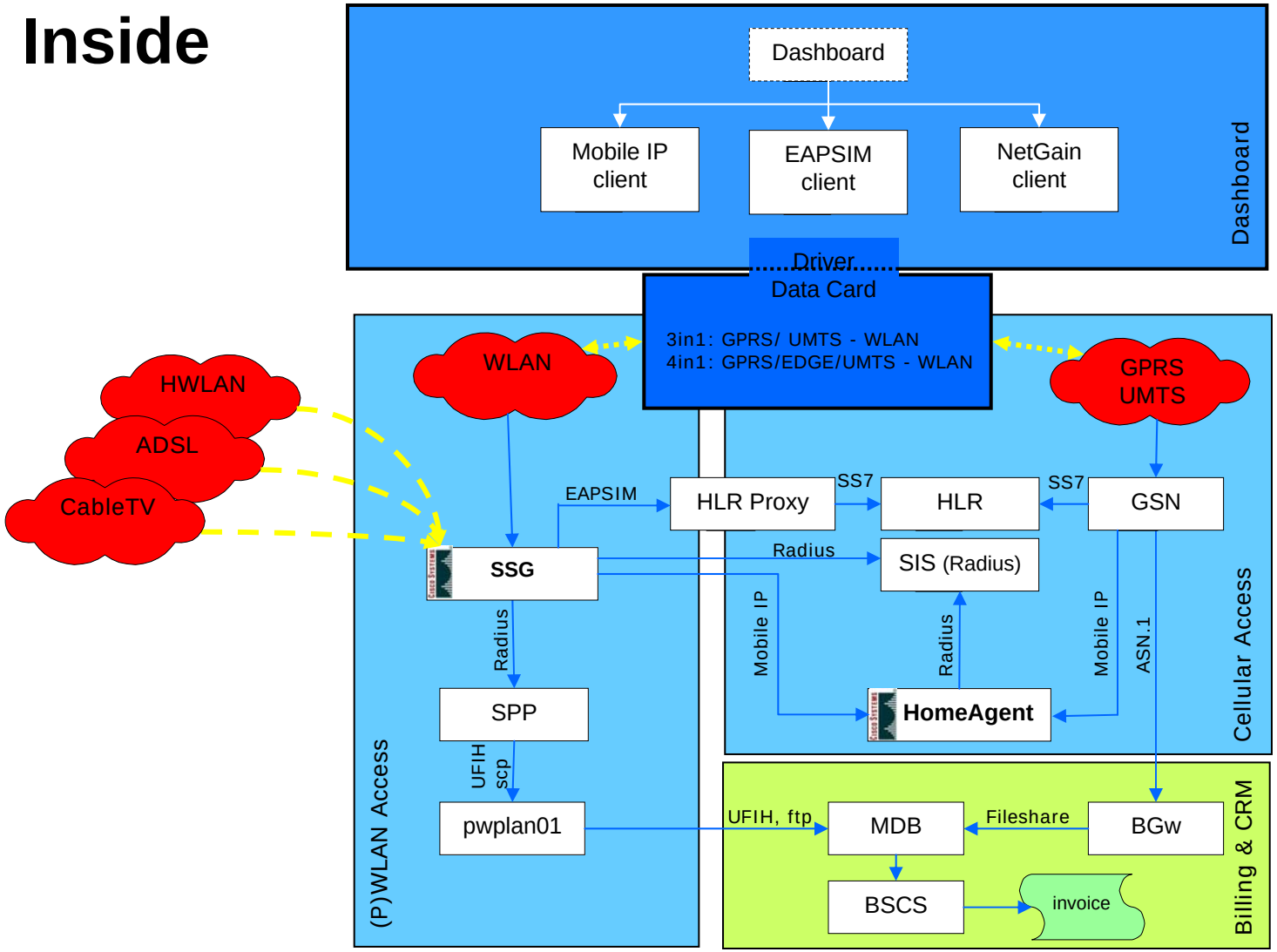
eLearning/ eCommunication

Client Device

- **Mobile IP Client :**
  - **A software agent in the notebook manages connectivity**
    - keeps track of user preferences and authentication
    - handles connecting and re-connecting
    - restores sessions on the current access channel in case of incidents
    - monitors available access networks
    - initiates changes between access networks when needed
    - unburdens the business user of the task of minding connectivity
  - **A software “virtual device driver” in the notebook**
    - shields applications from the actual device drivers
    - allows the software agent to manage connectivity efficiently
    - implements the Mobile IP protocol
    - thus allows seamless handover between networks
    - running applications keeps alive
- **Hardware : advanced mobile data card**
  - supporting 3 in 1 (WLAN,GPRS, UMTS) ,or 4 in 1 (GPRS, EDGE, UMTS and WLAN)
  - supporting seamless handover

Solution Architecture

Inside



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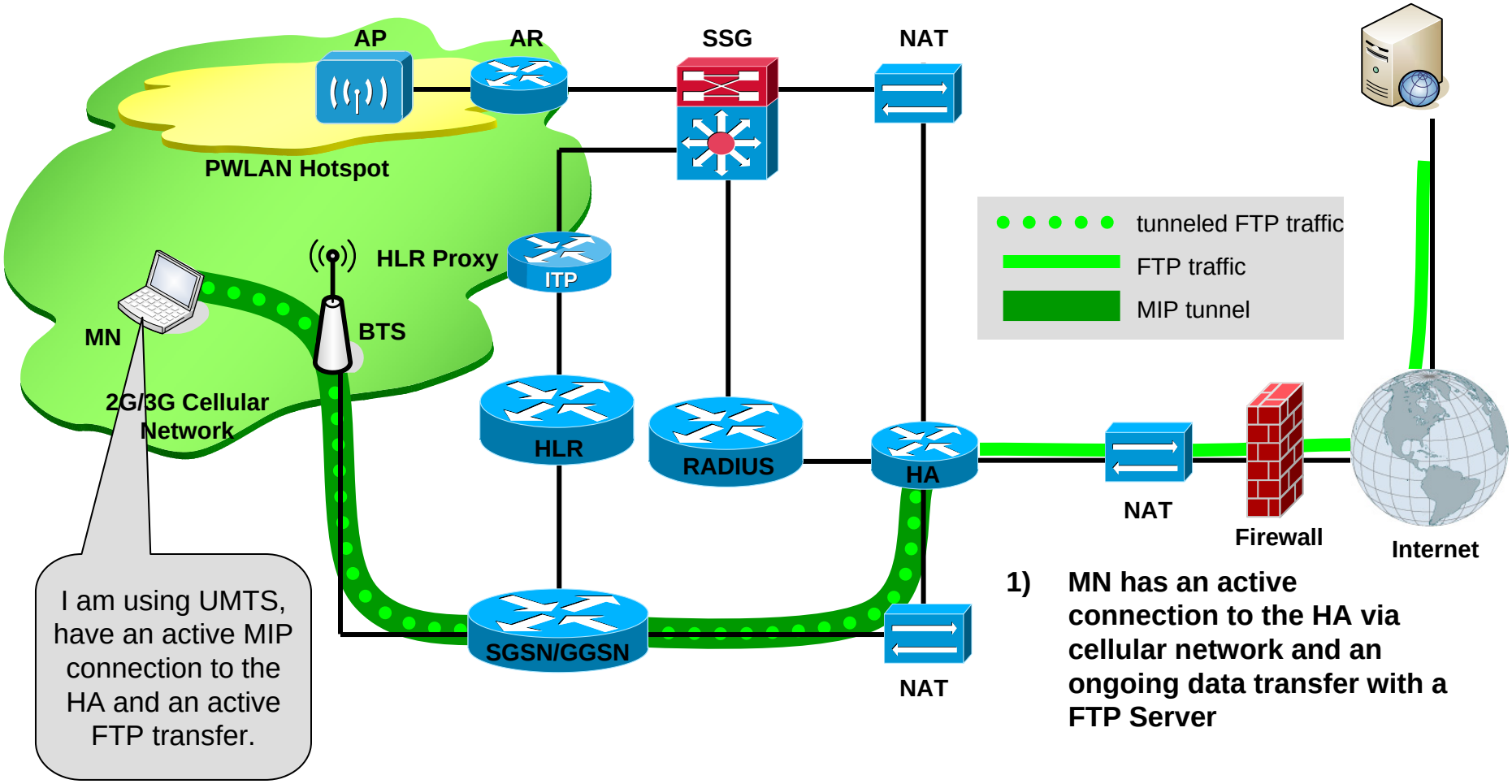
Packet Flow Handover UMTS → PWLAN



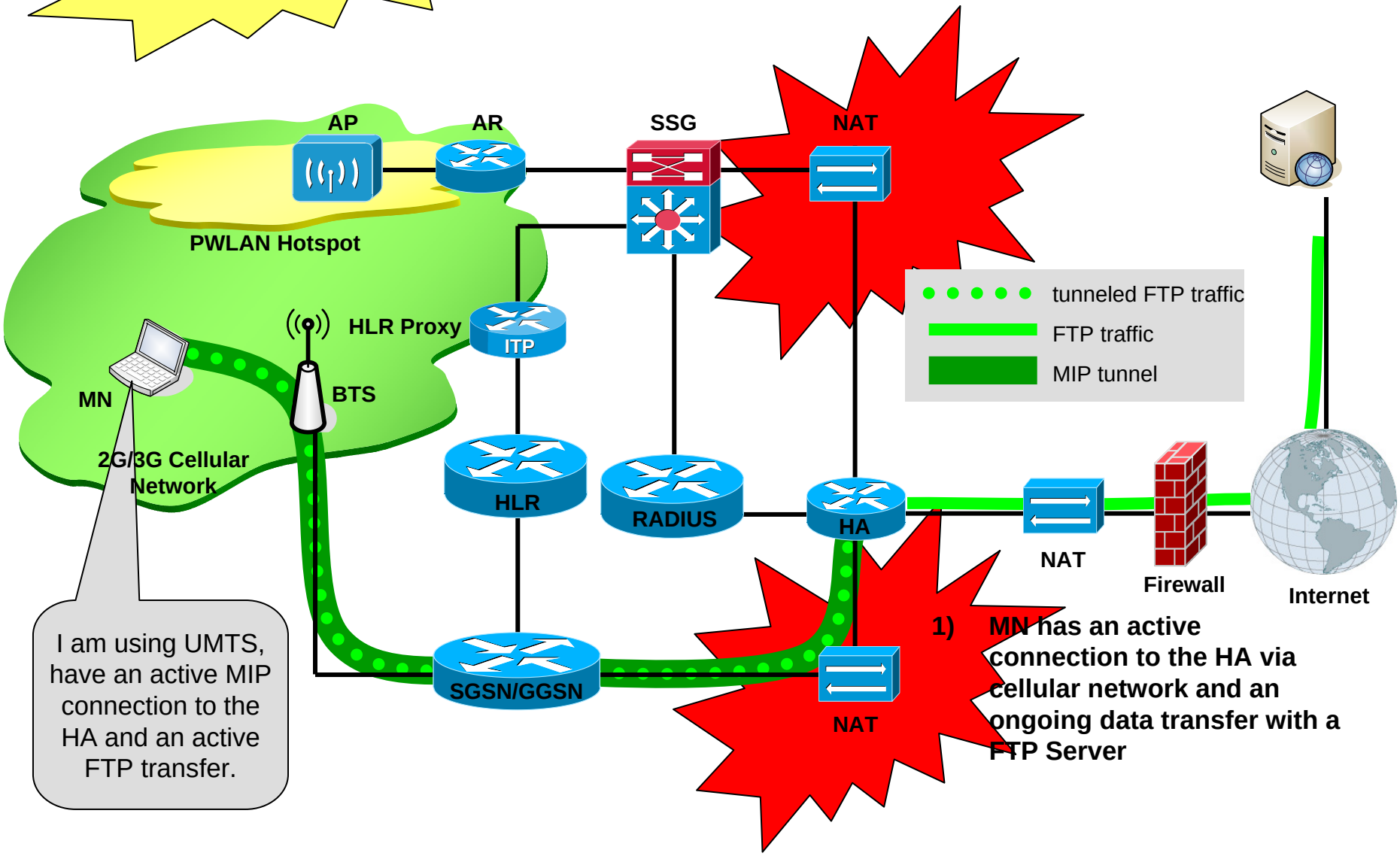
1) **MN has an active connection to the HA via cellular network and an ongoing data transfer with a FTP Server**

…is called *Mobile Unlimited*, in Switzerland
How will it be called in your country ???

Optus Autralia is the second big launch

http://www.apcmag.com/apc/v3.nsf/0/938CC3FCD64F22FBCA2570CA007DB9D8

Technology : Mobile IP NAT traversal



Swisscom's smart client implementation

- Project started in year 2001
- Swisscom Innovation (R&D team) was driving it
- In house development of Mobile IP & VPN client
- Swisscom has now given this to an outside company

Early Adopters Proving the Model

1. Paris RATP Public Transportation Company
2. Swisscom Mobile
3. City of Westminster, London

City of Westminster

- Pilots started in 2003
- End users are people, vehicles
- Applications are location services, video surveillance, task management
- For more information please refer to Networkers Session:

Metropolitan Outdoor Wireless MWI

Other Early Adopter's Deployments

Other Early adopters proving the model

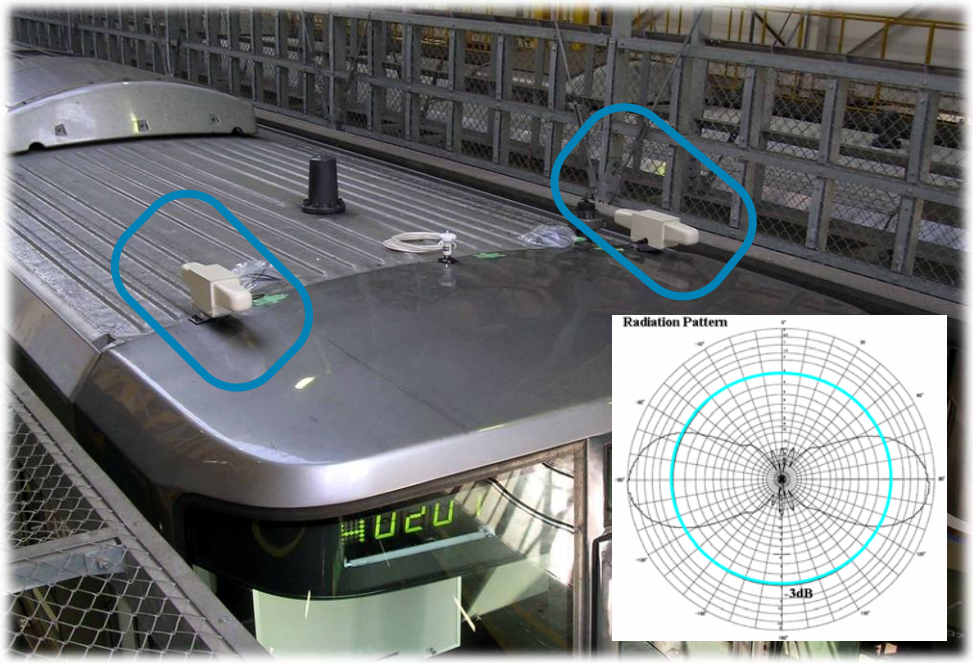
1. Train companies:
   - GNER UK
   - Thalys (France / Belgium)
   - Japan Rail
   - Italy
2. Police Forces:
   - UK
   - Zurich
   - US
3. Military:
   - Titaan

JR-West IT Train Project—U@Tech

Cisco MAR3200 in U@Tech

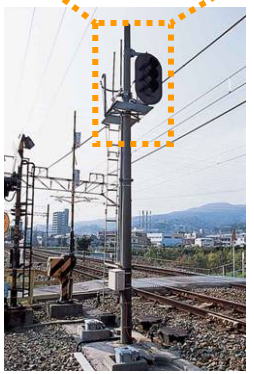
JR-West released its latest Internet Train called U@Tech in Aug. 2004.

JR-West IT Train Project—U@Tech



VoIP between the train and ground side

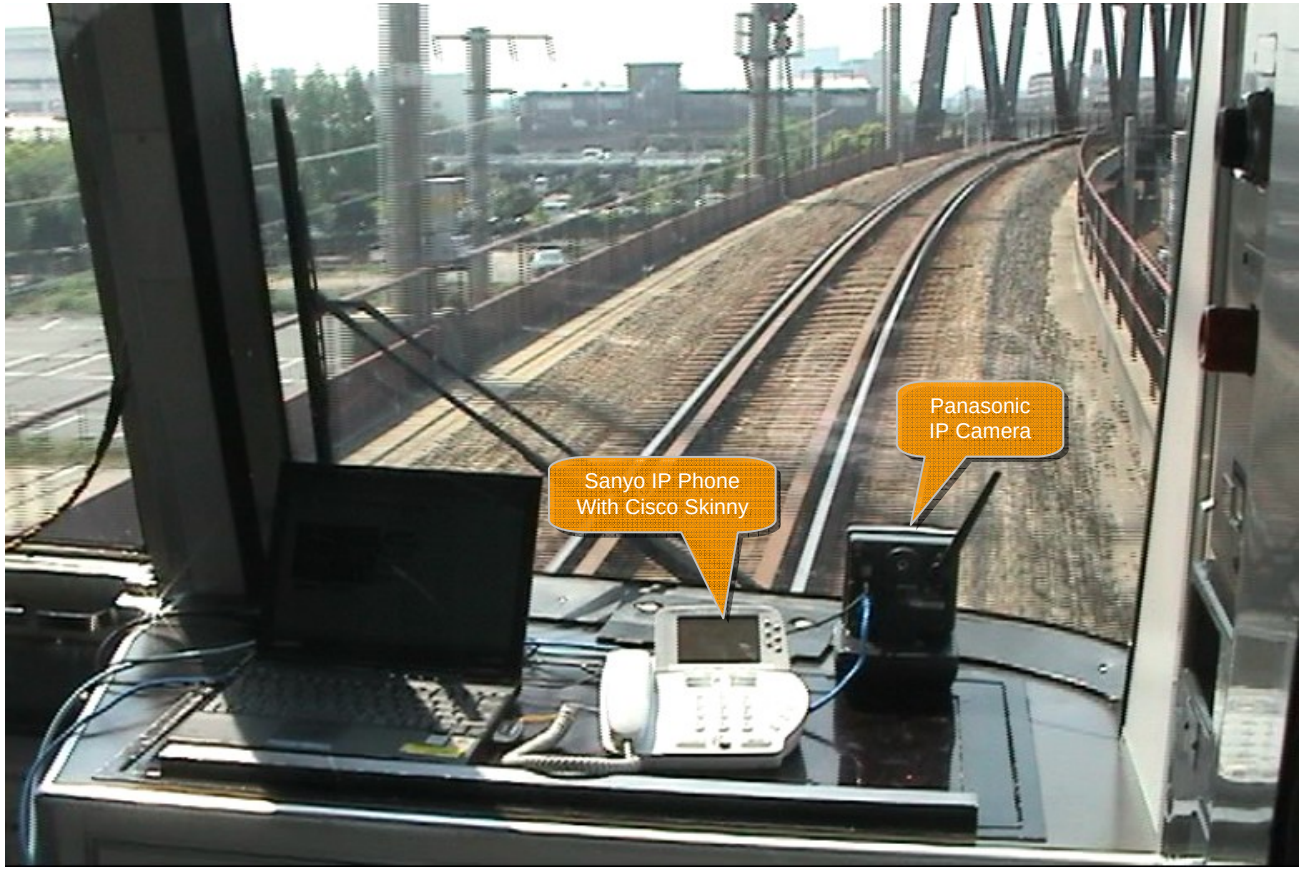
Wayside WLAN Bridge



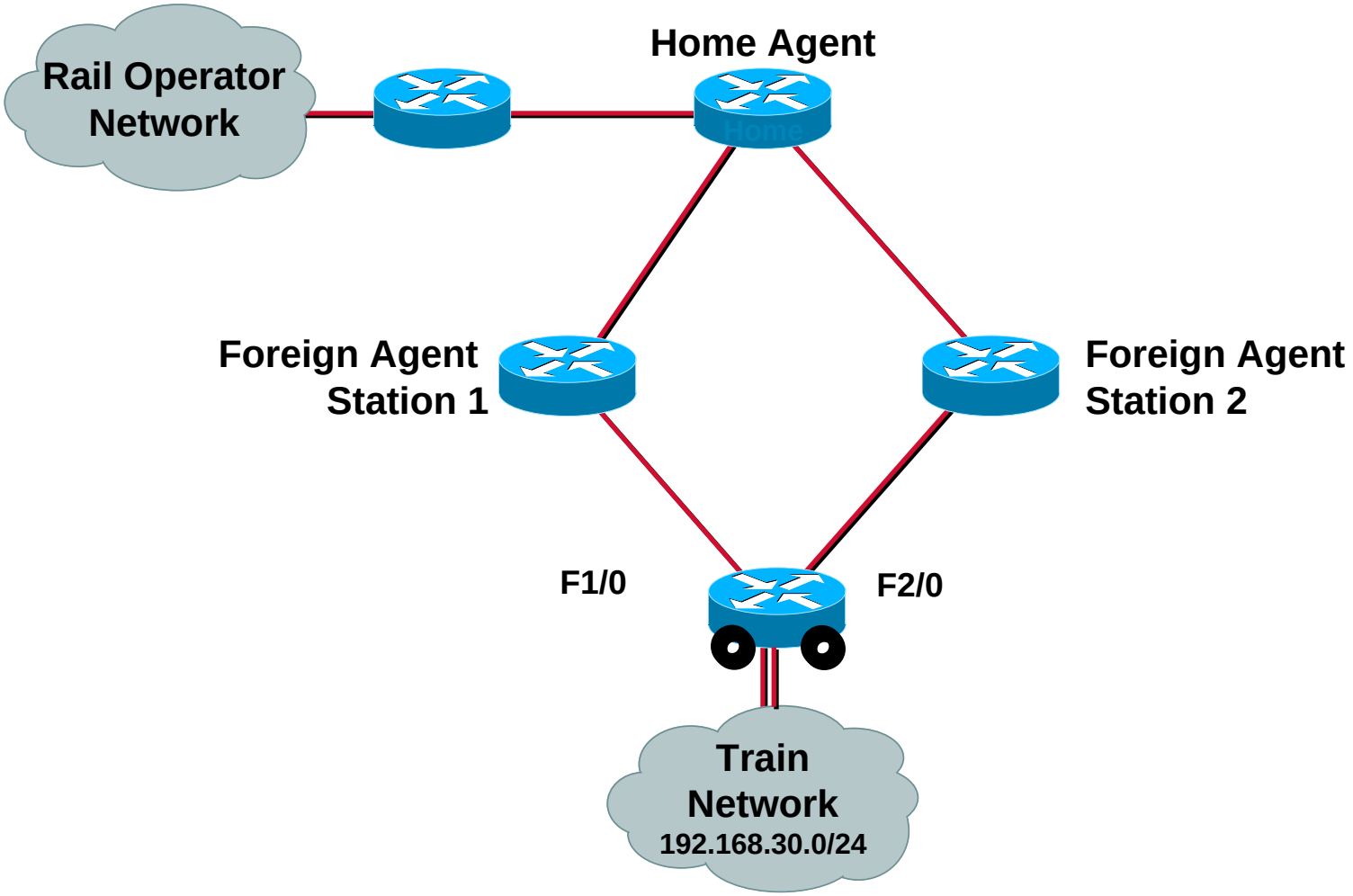
A new type of high gain antenna has been developed for WLAN communication use between train and wayside.

Wayside WLAN Antenna

JR-West IT Train Project—U@Tech

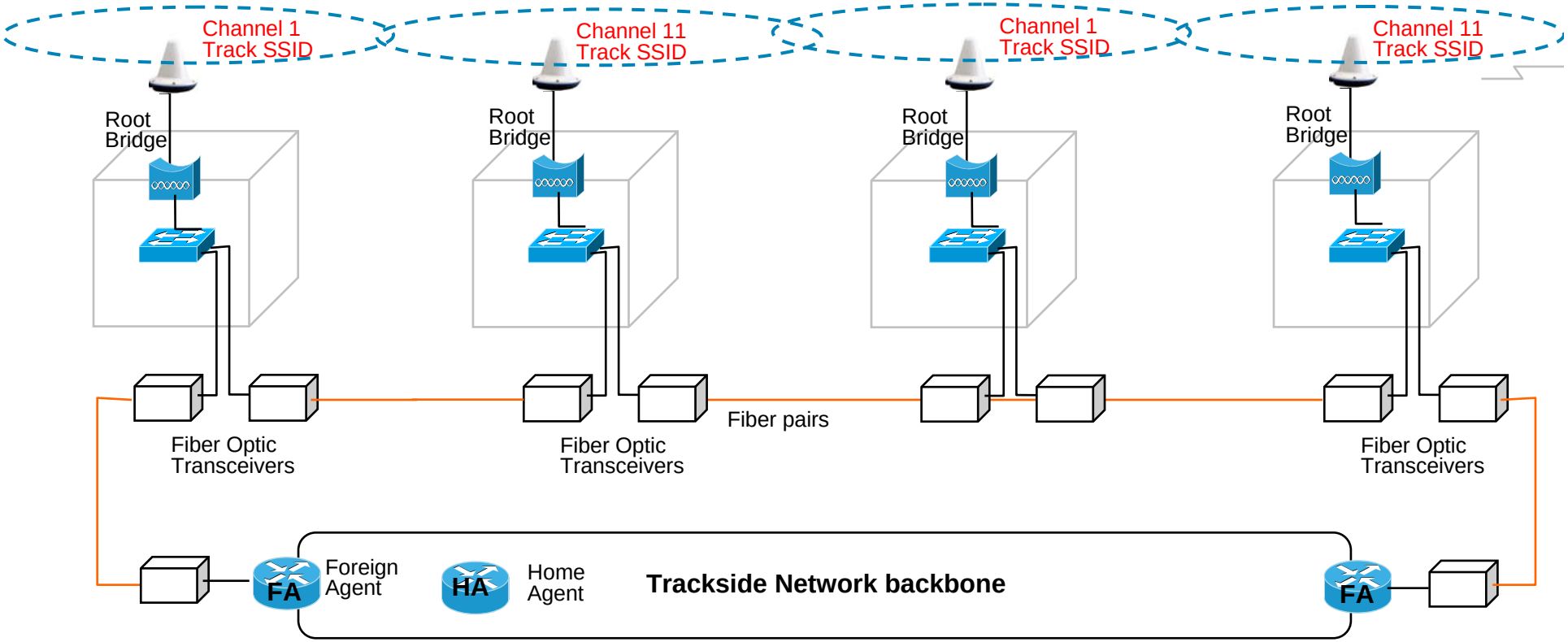


Mobile Networks—Rail Example



Along Side Track Wireless LAN Connectivity to Trains

Full ETTX backhaul along side the tracks with omni antennas



Tactical Police Vehicles
USA / UK / Swizerland

- Enabling Cisco MAR in High Speed Pursuit Vehicles for IP connectivity in Police Yard

-Secure 802.11 & GPRS connectivity using Cisco Mobile IP

-ANPR information streamed live to cars on report of a crime to enable more efficient crime prevention

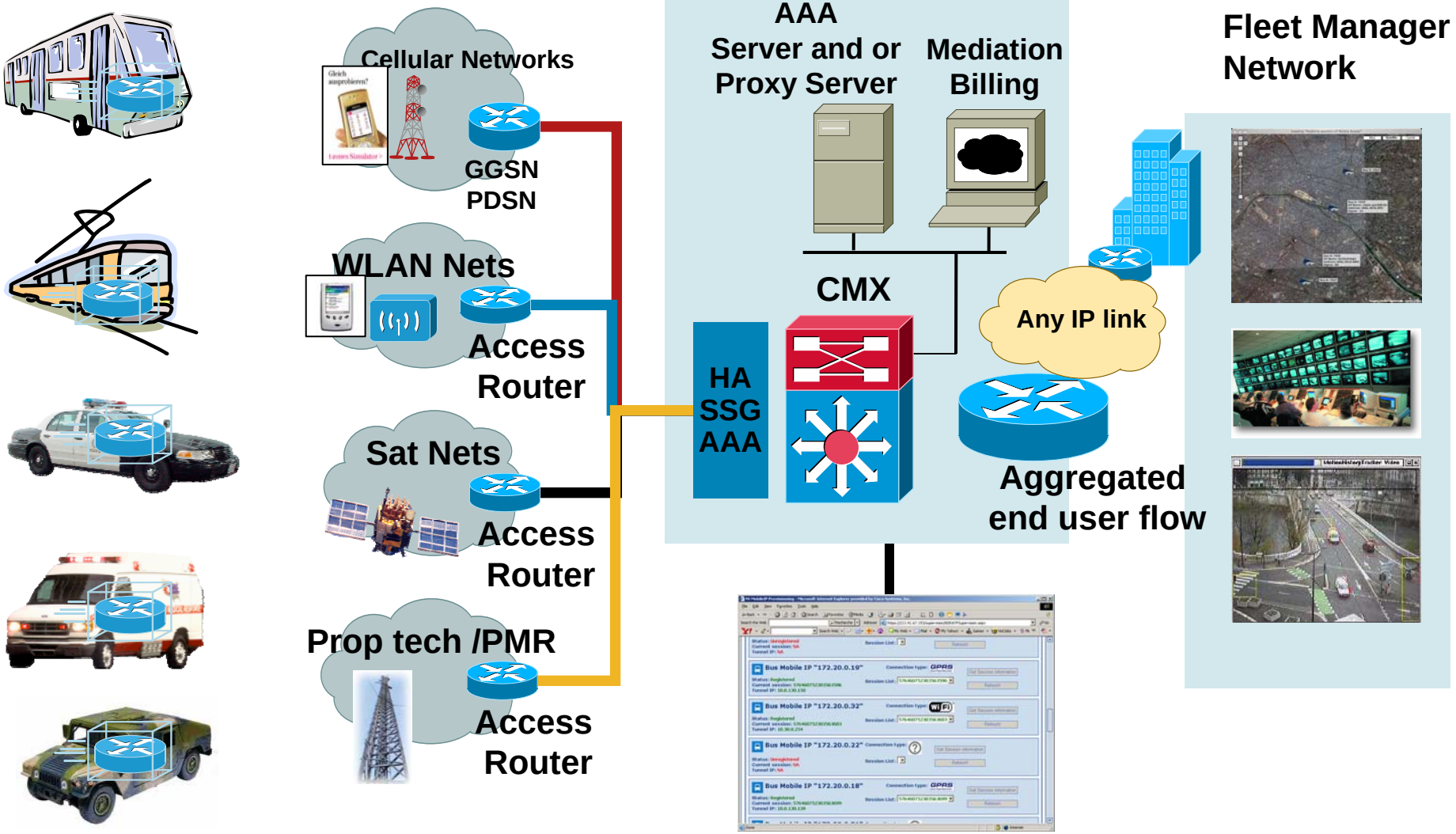
- CE Certification and technical design of final unit to meet Police & Vehicle standards

Satlynx Mobile Solution

- Automatic satellite acquisition with a single button push
- Rapid deployment and operation on the Satlynx service coverage (up to 120cm antenna with max 2W BUC)
- No need for Satlynx certified technicians on-site during line-up
- Broadband satellite connection established within 5 minutes
- The platform supports Satlynx 9000X/C, 360E and 3020 VSATs

Summary

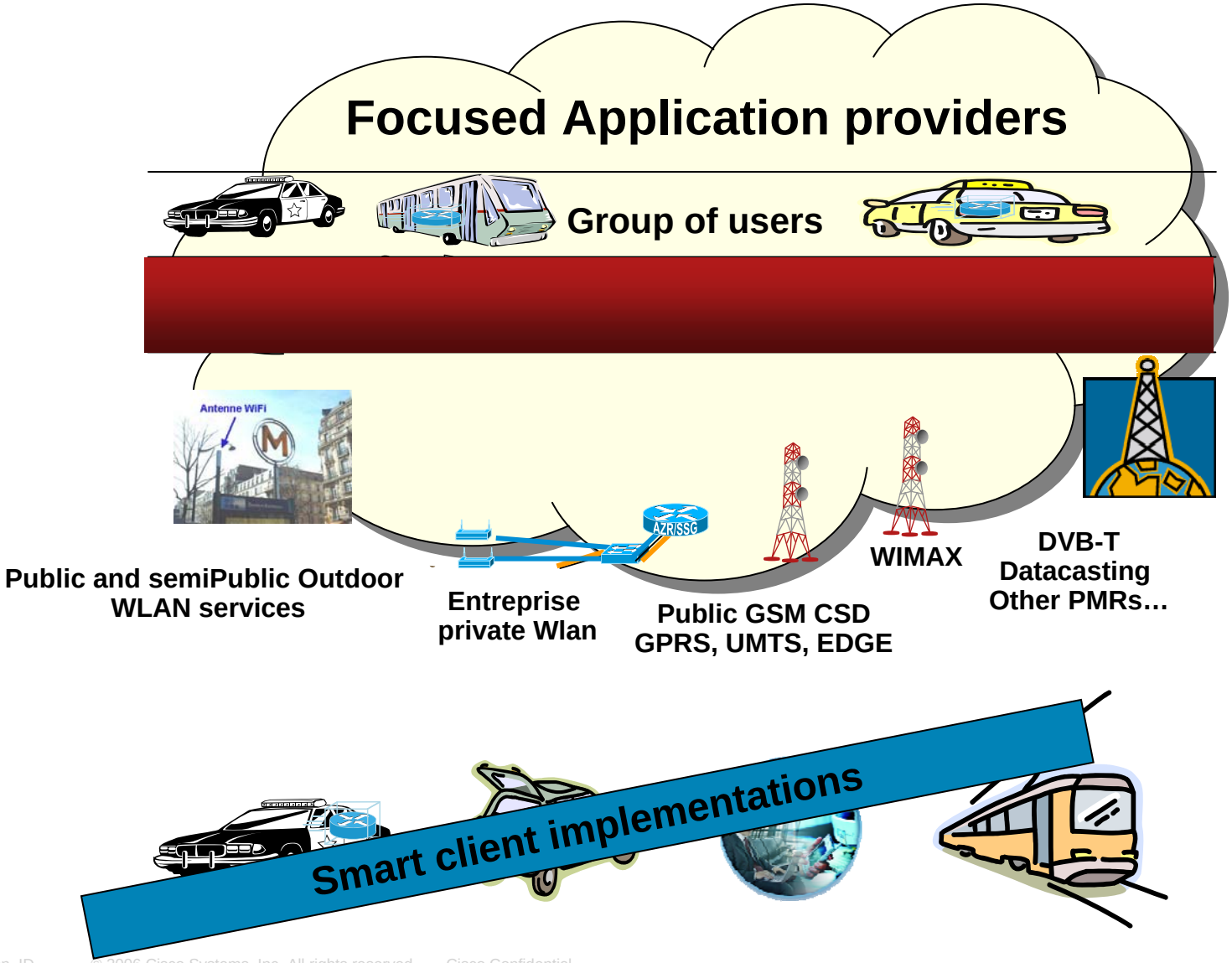
Overall System Architecture



Key Points

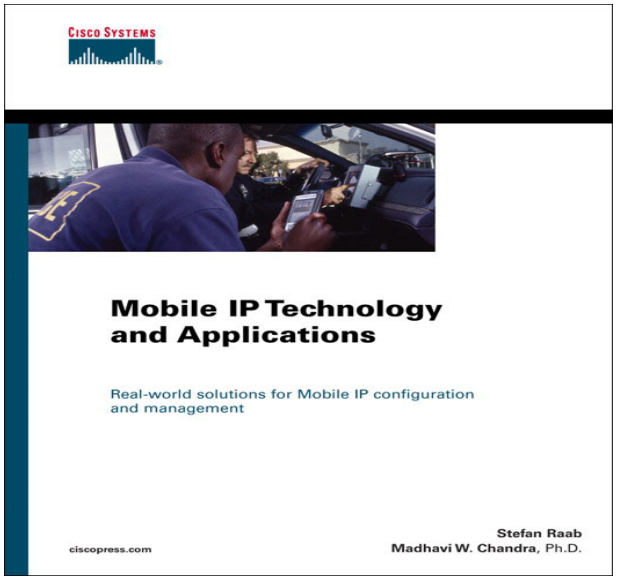
- Real deployments exist
- Architectures & models are replicable
- Business targets are initially vertical markets
- An end to end solution requires lots of competencies:
  - Use different partners and their skills
  - Split the responsibilities and skills accross multiple palyers / partners

Deployment's Generic Architecture



Recommended Reading

- Continue your Networkers learning experience with further reading for this session from Cisco Press.
- Check the Recommended Reading flyer for suggested books.



Meet the Experts
Mobility

- Eric Hamel
  Consulting Systems Engineer

- Gaétan Feige
  Consulting Systems Engineer

- Marco Centemeri
  Distinguished Systems Engineer

Q and A