TOMORROW starts here.
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Deploying Service Provider Wi-Fi

BRKSPM-2001

Srini Irigi
Solution Architect

Wi-Fi
Powered by Cisco

creating experiences together

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Service Provider Wi-Fi is all About Optimising & Monetising the Network

Agenda

- **WHY** SP Wi-Fi: Drivers/Motivators

  – Overview on SP Wi-Fi

- **WHAT** Defines SP Wi-Fi

  – Requirements, Architectures, Components

- **HOW** SP Wi-Fi is being deployed
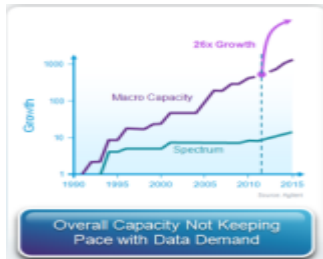
  – Use Cases, Call Flows & Case Studies

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Why are SPs Deploying Wi-Fi ??

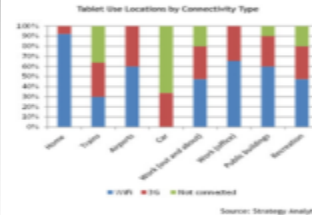# Market Dynamics Driving the Need for SP Wi-Fi

Growth in Mobile Data

Lack of Spectrum

Attractive Economics & Offload

Wi-Fi Ubiquitous in Devices

Big Shift to Indoor Consumption

High interest from Service Providers in adding Wi-Fi access

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Wi-Fi Incorporates a Number of Key Benefits for Service Providers' Business

Retention & Loyalty

Increase customer stickiness by offering free mobile Internet through public Wi-Fi

New revenues

Generate new revenue streams via innovative wireless services

ARPU Increase

Move customers up the value chain by upgrading them to premium packages

Business Services

Offer managed wireless LAN services to small businesses, retail & enterprises

Mobile offload

Optimise mobile data network or offer offload services to mobile operators

Customer Perception of Wi-Fi Offering:
Why it is important to Service Providers ?

Importance of Free Wi-Fi in Broadband Provider Choice
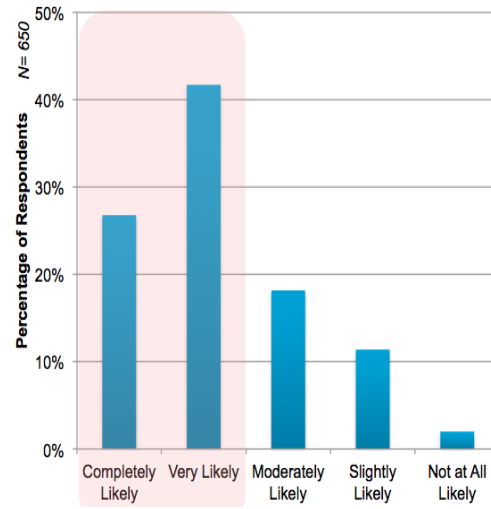(answering 'yes' to a bundled subscription)
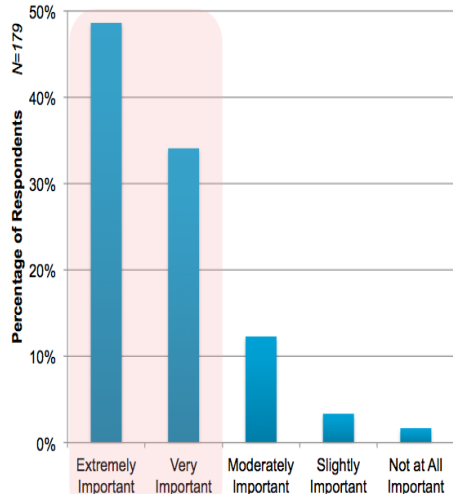
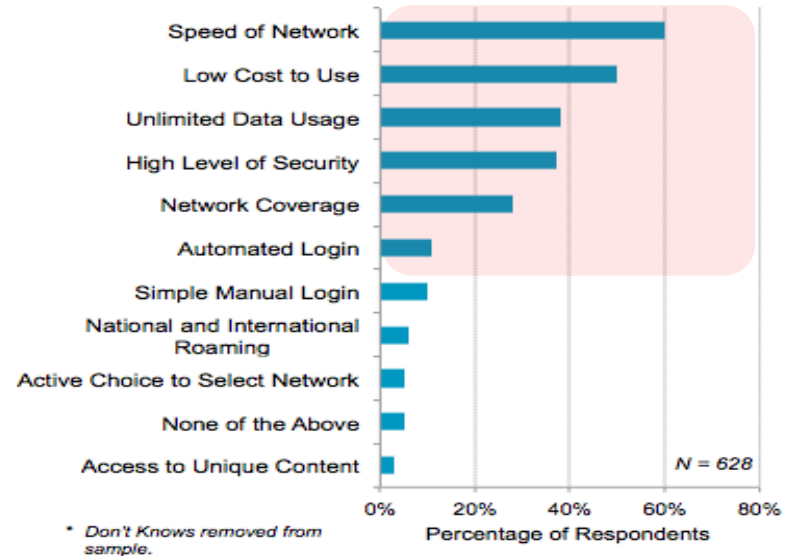80% of consumers believe free public Wi-Fi is a very important criteria when choosing a provider

Changing Broadband Provider for Free Public Wi-Fi

Almost 70% (!) of consumers are likely to **change a provider** in order to have free public Wi-Fi

Most Important Wi-Fi Network Features

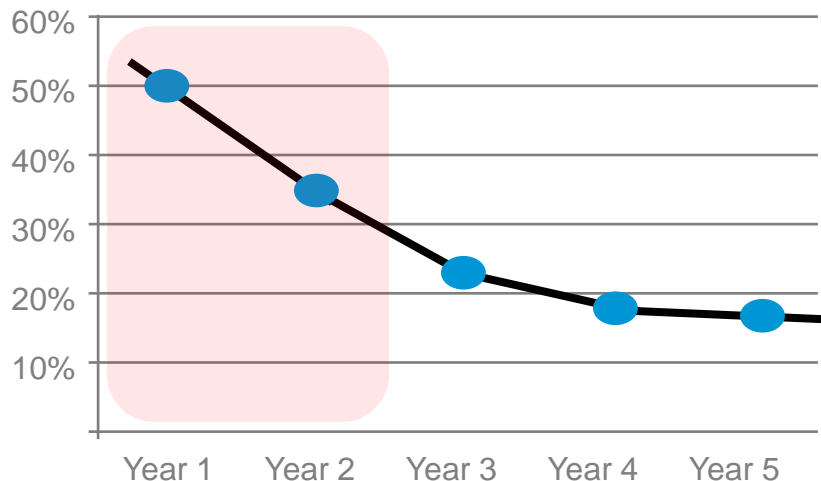Majority of consumers consider User Experience metrics like Speed and Auto-login to be paramount

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Retention & Loyalty:
Helping Operators Fight Customer Flight Churn

Churn Reduction as a result of free public Wi-Fi

💡 Actual results are as high as 50% (!) churn reduction in the first years

💡 Reduction is estimated to remain significant, yet decrease along the years, considering that more operators will offer public Wi-Fi

Chart (vertical axis 10%–60%, horizontal axis Year 1–Year 5):
- Year 1: ~50%
- Year 2: ~35%
- Year 3: ~23%
- Year 4: ~18%
- Year 5: ~17%

Source: Years 1 & 2 based on actual experience of cable operators (Cisco customers) in the US & Canada

ARPU Increase:
Drives Existing Customers Up the Value Chain

1 Associate Wi-Fi rights with premium dual or bundled packages

Who implements it?

SHAW) CABLEVISION COX.

bright house Comcast Time Warner Cable

N=T

2 Offer better experience as customers go up the value chain

A Better speeds while on public Wi-Fi

**B** More devices registered for automatic login

TV only

Dual-Play

Triple-Play

A

B

Select your Shaw internet package	Shaw Exo WiFi Trial download speed*	You can register to automatically connect
High Speed Lite Shaw Exo Internet speed: 1	**1Mbps**	**1** mobile devices to the Shaw Exo WiFi Trial
High Speed 20 Shaw Exo Internet speed: 20	**20Mbps**	**6** mobile devices to the Shaw Exo WiFi Trial
Broadband 50 Shaw Exo Internet speed: 50	**Maximum Speed Available**	**10** mobile devices to the Shaw Exo WiFi Trial

Who implements it? bright house

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Mobile Data Offload:
NET Brazil Outdoor Wi-Fi Used for Claro
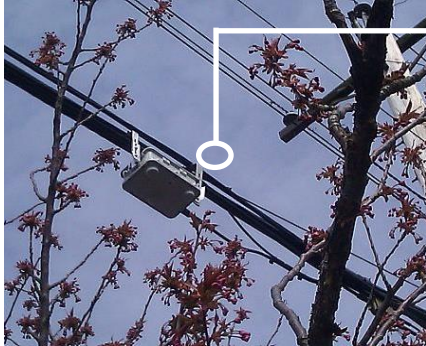
A Cisco outdoor AP 1552C with *CleanAir* technology installed

NET Serviços, Brazil largest cable operator, offers today the largest deployment of outdoor Wi-Fi with thousands of access points already available

A single access point is offering 3 SSIDs, one per service

CLARO SSID is a closed (secured) network; Claro users connect and authenticate automatically

NET broadband clients are eligible for NET free public Wi-Fi through this SSID

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Business Services:
Managed Wi-Fi offerings to Hospitality & Enterprise

Venues and retail owners start using Wi-Fi as a way to improve their business:

- Generates more consumer traffic - attracting more customers

- Increases customer dwell time (more time spent = more money)
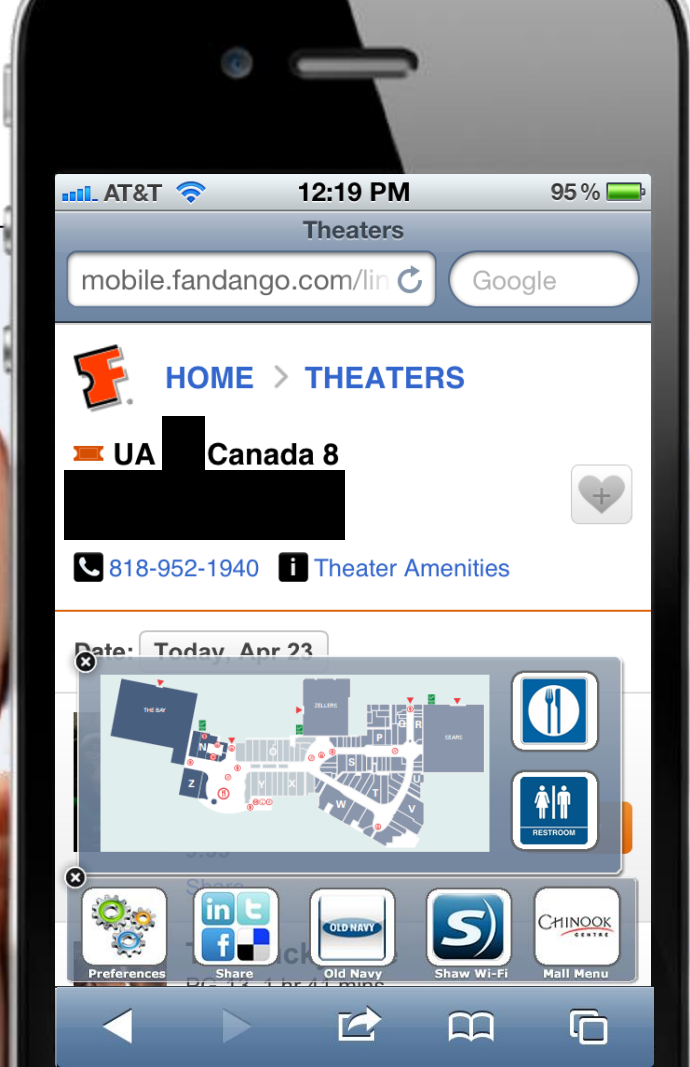
Example:

AT&T partnering with largest US restaurant and coffee chains to provide free Wi-Fi

Normally creates an opportunity for the service provider to provide not only guest access to the public, but also business services to venue / retail owner

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Location-based Services
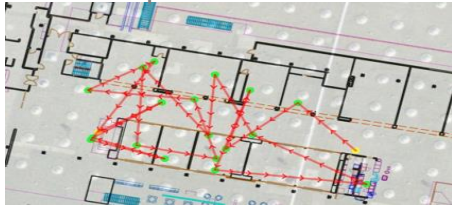
Connected Mobile Experience: Detect, Connect & Engage

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Location Data Analytics:
Measuring Customer Movement Using Wi-Fi

Analyse how customers move, where they crowd, how they spend time
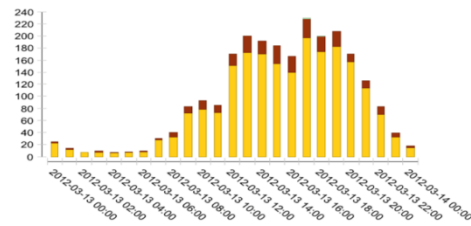
Common paths:

Where people stop first?
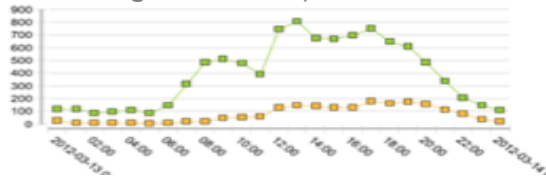
Where customers come from?

Wi-Fi usage
(devices associated)

Opportunity gap analysis (passing vs. entering customers)

Benefits for malls / venues:

- Detailed understanding of customer footprint

- Quantify & justify rental renewal negotiations

- Measure impact of advertisement & signage

- Analyse impact of changes applied to mall

- No applications, hardware or sensors required!

Why Service Provider Wi-Fi?
3 Key Reasons

1. **Optimisation** – increases network capacity and reduce 3G/4G data traffic overload by offloading traffic with SP Wi-Fi

2. **Monetisation** – creates new revenue streams by taking advantage of advanced technology that provides secure delivery of location-based services to mobile devices, new services & increased ARPU

3. **Customer-base Retention & Addition** – expand a physical footprint with a cost-effective Wi-Fi solution to keep customers on the service provider network as they move about and attract new customers
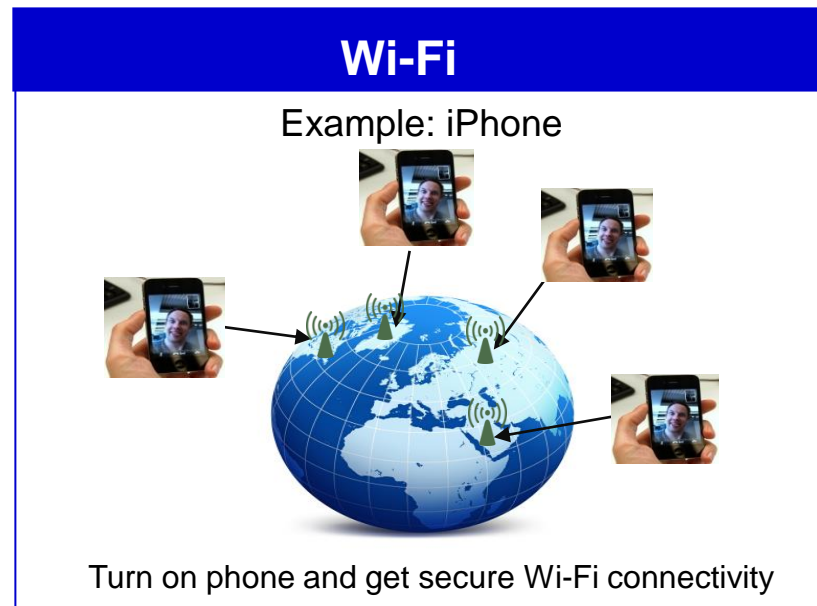
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What are the SP Wi-Fi Requirements?

SP Wi-Fi Vision: End User Perspective

Cellular Mobility Experience on Wi-Fi

Cellular	Wi-Fi
Example: GSM Phone	Example: iPhone
Turn on phone and get secure cellular connectivity	Turn on phone and get secure Wi-Fi connectivity
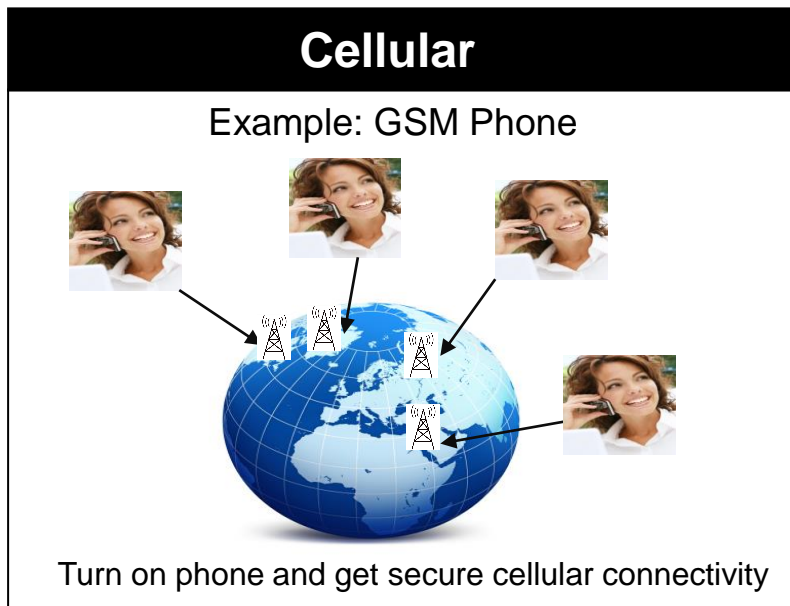
- Roaming anywhere – no logins or passwords
- Automatic Network Selection
- Access anywhere with my profile & services

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SP Wi-Fi: Carrier-class Attributes

Key Requirements

Carrier Grade	Manageability, Network Reliability and Availability 100s of thousands of APs ; Millions (residential); Millions of Clients
Radio Performance	Radio differentiation, Link Budgets, Beamforming, MIMO Interference Management, Radio Resource Management
Mobility	Seamless authentication and Fast Roaming/Handoff Wi-Fi to Wi-Fi (inter and intra-vendor), 3G/4G to Wi-Fi
Roaming	Seamless roaming (with little or no user intervention) Support home and "visited" network scenarios
Standards Compliant	Critical to support Multi-vendor solution 3GPP compliance important to MNOs
Integration	Common Billing, Policy and Subscriber Management Leverage MPC/EPC for Wi-Fi network Parental Control / Lawful Intercept / Local Breakout

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SP Wi-Fi: Common Deployments

One Access Technology, Many Deployment Models

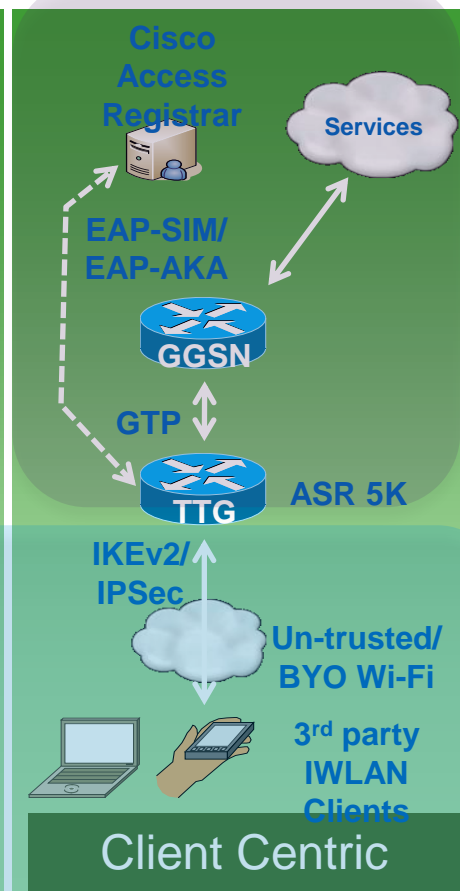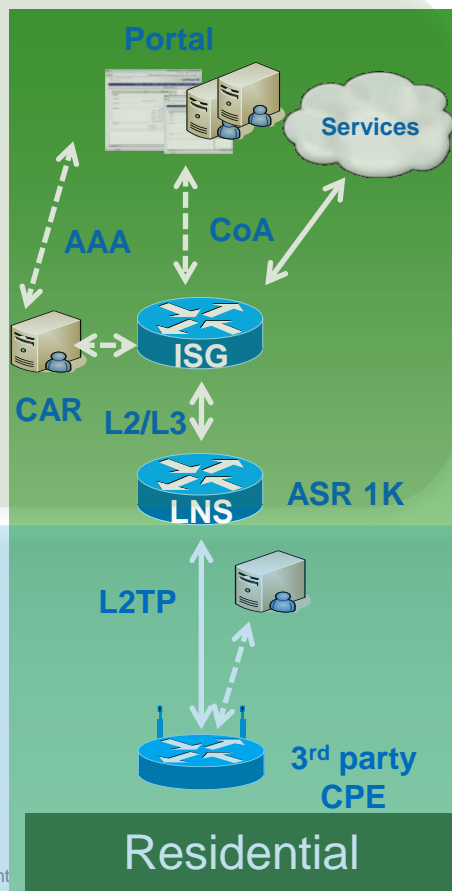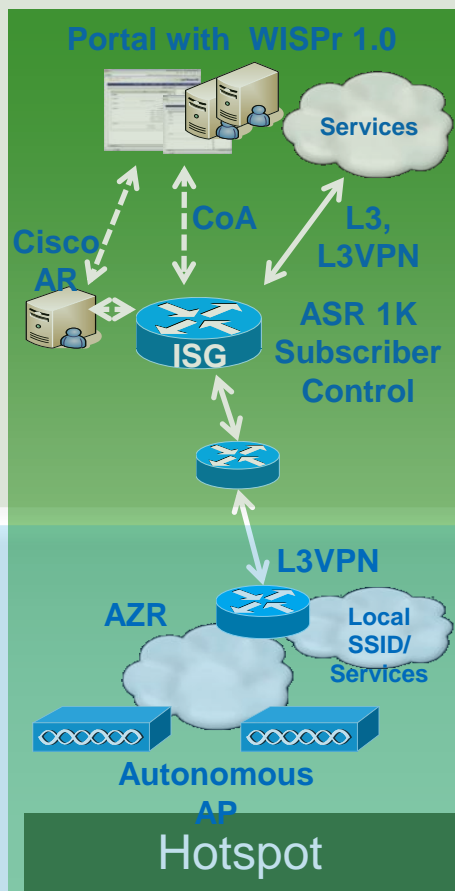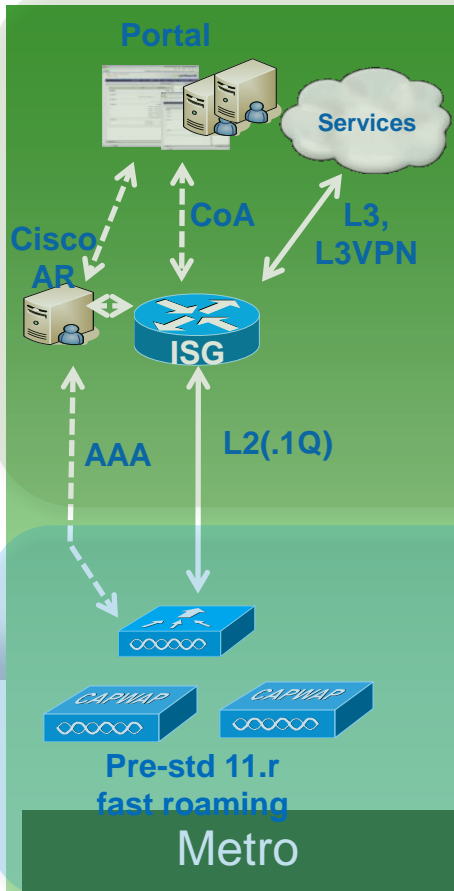|	
Uncontrolled	No SP involvement. User driven offload via unmanaged device.
Home/Soho Dual SSID (Community)	SP provides dual SSID home device. Private and public (community) SSID
Hot Spot / Hot Zone	SP installed and managed hot spots in Malls, restaurants, Hotels,…
High Density Wireless	SP installed and managed hot spots in high density user areas (stadiums,..)
Metro / Mesh	SP install and manages outdoor Wi-Fi for large dense urban areas coverage
Enterprise Guest Access	Enterprise Guest Access managed by SP

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SP Wi-Fi: Evolving From Silo'd Solutions….

…to a Unified Architecture

MSP

3G/4G **Mobile** Packet Core

FSP MSO

Fixed BB Infra

Converged Operator

M

F

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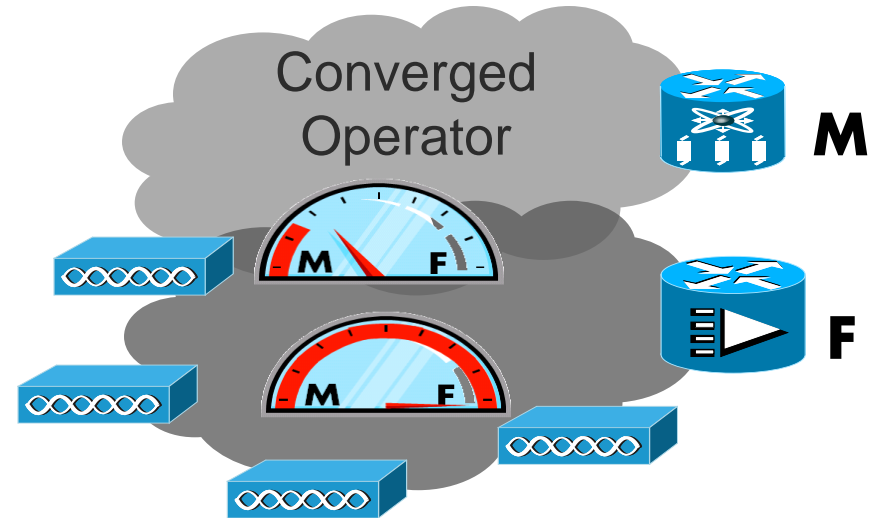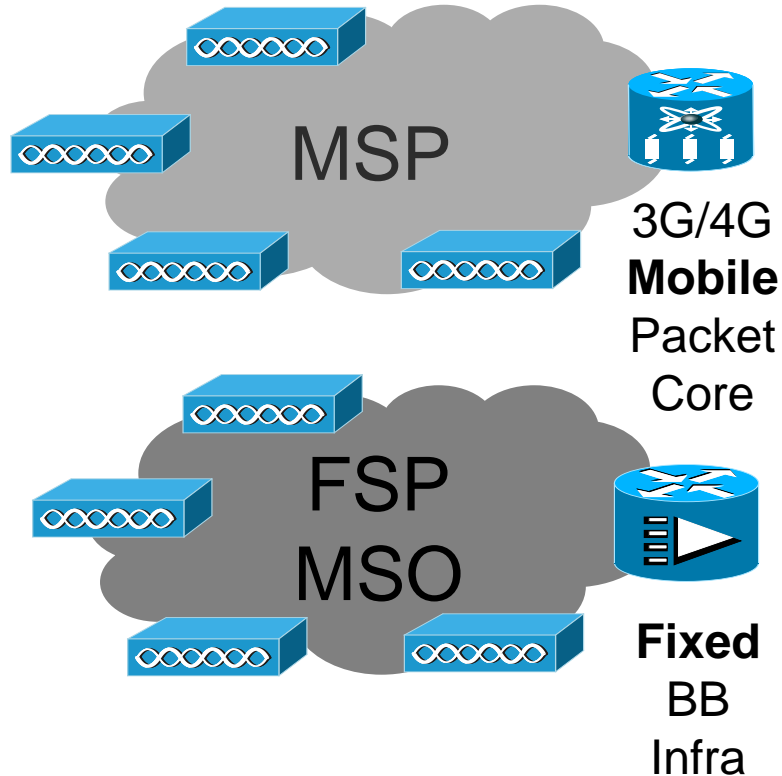
SP Wi-Fi: Unified Architecture

AP= Access Point
MAG=Mobility Access Gateway
WLC= Wireless LAN controller
LMA= Local Mobility Anchor
GTP= GPRS Tunnelling Protocol
IPSG= IP Services Gateway
PMIP= Proxy Mobile IP (v6)
UE= User Entity (mobile terminal)

SP Wi-Fi Converged Architecture

Enabling Seamless Convergence

Cisco SP Wi-Fi Whole Offer

Products
- Indoor AP
- Outdoor AP
- Residential Gateway
- Cisco Wireless Controller
- Cisco Intelligent Services Gateway
- Cisco CAR, CNR, Policy, & NCS
- Cisco Mobile Packet Core

System
- AP
- Residential Gtwy
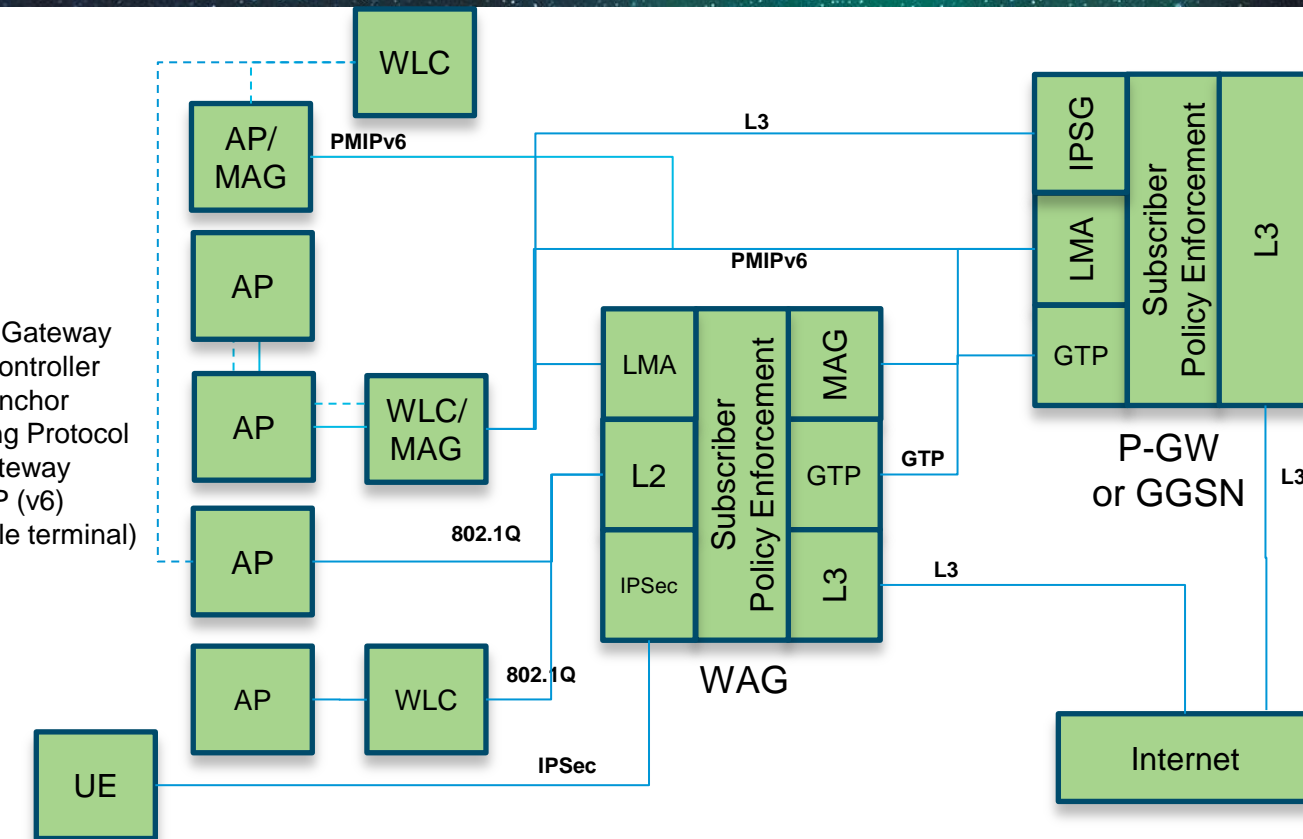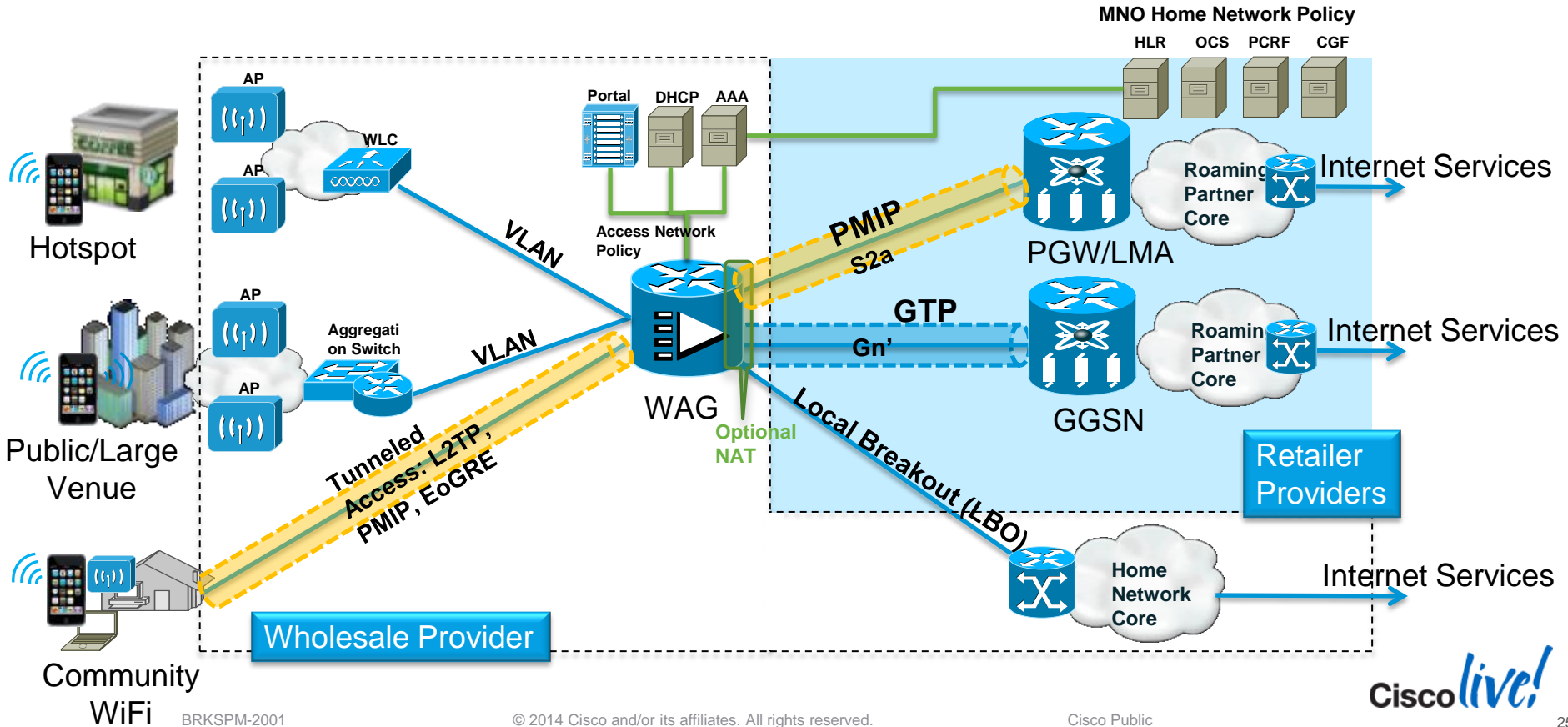- WLC
- ISG
- Cisco Mgmt & Provisioning
- Cisco Mobile Packet Core
- Broadhop

Solution
- Cisco SP Wi-Fi Advanced Services Practice
- Solution Engineering and Customisation

Whole Offer
- Cisco & 3rd Party Products
- Cisco SP Wi-Fi Advanced Services Practice
- Solution Engineering and Customisation
- Cisco Capital
- Customer Business Models & Go-to-Market Packages

Customer Experience
- Fragmented to one stop shop
- Product to solution
- Technology issue to business solution

Customer

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Cisco SP Wi-Fi Solution

Access + Service and Policy + Packet Core Integration

Home Network AAA

HLR **AUC**

Mobile Operator 3G/4G Core **SS7**

IP Transfer Point **MAP**

NMS **AAA**

MPC

Subscriber management
RADIUS authentication
Web Portal
Network policy control

**SUM
PCRF
Portal
AAA**

PMIPv6

3G/4G Mobile Packet Core

Customer's Wi-Fi APs

Internet

Wireless Controllers

CAPWAP

DHCP

ISG/WAG

Intelligent Services Gateway

NAT Firewall

Internet

Wireless LAN policy
RF management
Roaming

Session management
Layer 4 redirection
Transparent auto logon

Usage statistics
Policy enforcement

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Core SP Wi-Fi Functional Components

Authentication Authorisation
AAA / RADIUS
DIAMETER
HLR / HSS
Integration / Roaming
Authentication point
EAP / Web Auth

Address Allocation
Before / After ISG
At LMA
External DHCP
IPv4 / IPv6
Pool depletion
Location based

Session Management
Keep alive
Idle Timeout
Quota enforcement
Policy enforcement
Session differentiation
Session Initiation

Transport Backhaul
CAPWAP
Fragmentation
PMIPv6 (MAG/ LMA)
L2TP (AZR) / GTP
Autonomous AP
MPC integration

Redundancy Load balancing
HSRP/ GLBP
1:1 Redundancy
N:1 Redundancy
ACE based
Single SSID
Multiple SSID

Accounting Billing & Policy
Start and Stop
Records (CDR)
Who sends them
Integration with
Existing billing
Gx / Gy / Gz
Policy definitions

Web Portals
When to redirect
L4 / HTTP 302
Who redirects
Redirection Portals
Web Authentication
Self service Portals
Whitelisting
Location based

Mobility
Wi-Fi only mobility
Hierarchical mobility
Wi-Fi / Macro
Max mobility coverage
Roaming agreements
Mobility events
Anchors / tracking

Network Management
Security
Zero touch rollout
Legal Intercept
Parental Control
Analytics / planning
Asset tracking
Rogue AP's

Subscriber Management
Provisioning
Pre-paid / Quotas
Wi-Fi only users
Transparent logon
Service profiles
Self service portals

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Authentication Options

Two main authentication models

- EAP/802.1x – WLC Authentication / ISG - Authorisation
  - Secure SSID
  - AAA is the authentication server
  - Seamless authorisation but requires client configuration (certificates, username/pwd, etc)
  - EAP-SIM/AKA helps if proper supplicant available on terminal device

- Weblogin – Portal-based Authentication and Authorisation

  - Open SSID
  - Requires no client configuration, completely Web-based
  - Subsequent Logons are transparent using device MAC address
  - Vulnerable to MAC Spoofing

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Address Allocation & Management

Assignment Considerations

- When to assign?
  - Before authentication for Web-auth users
  - Post authentication for EAP / 802.1x
- Where in the network?
  - In the access network or in the core
- Where is the DHCP server ?
  - Local
  - External
  - Relay/Proxy functions
- What to assign?
  - Location based address assignment with option 82
- Subnet size?
  - Lease time
  - Broadcast domain size

Subscriber Session Initiation & Termination

Deployment considerations

- Session creation (First Sign of Life - FSOL)
  - DHCP initiated (L2 connected)
  - Unclassified MAC (L2 Connected)
  - Unclassified IP (L3 routed)
  - RADIUS proxy/accounting start (L3 Routed)

- Session termination options
  - Idle timeouts? Keep alives? How are you billing ?
  - DHCP lease expiry
  - Authentication timeout

Session Management

Service considerations

- Service Differentiation
  - Gold / Silver / Bronze / policy enforcement
  - Parental control / DPI
- Quota enforcement
  - Usage based / Time based
- Location based services
- Free services
  - Open garden
  - Whitelisting

- Dynamic service updates
  - Policy push
- Service Control and Policy
  - DPI
- Targeted Push Advertising
  - Intelligent, Location-aware
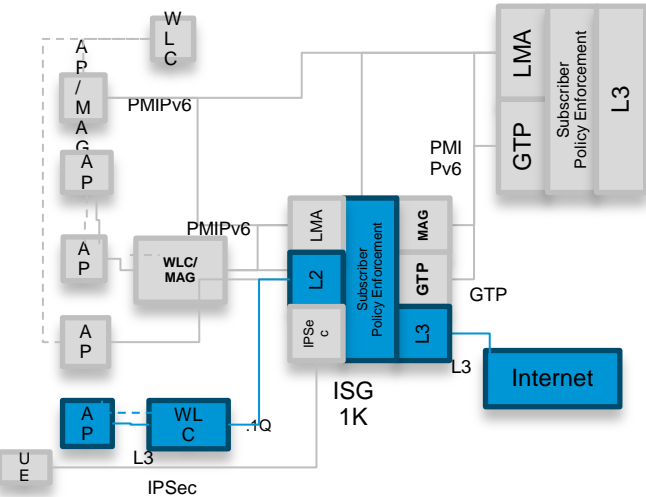- Branding

Mobility Management

Essentials for Mobility

- Common anchor point for all access technologies
- A common subscriber identifier across all access technologies
  - Eg. MAC address, MSISDN…. key for inter-access mobility
- Address allocated from a common DHCP pool
- A common authentication scheme
- Common session identifier
  - For common billing and subscriber service across WiFi/3G/4G
- Ability to track subscriber
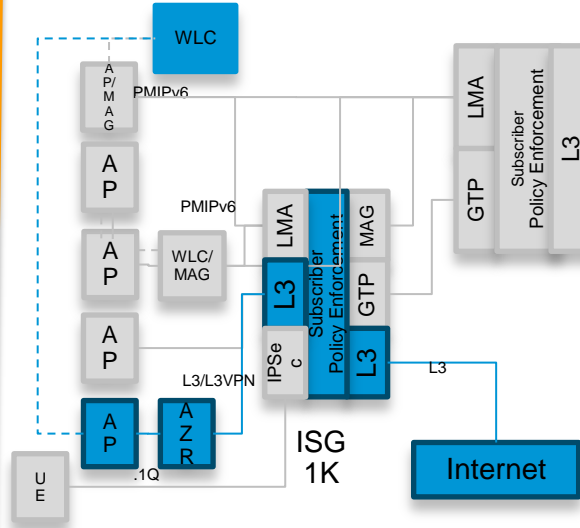- Next Generation Hotspot (Roaming)
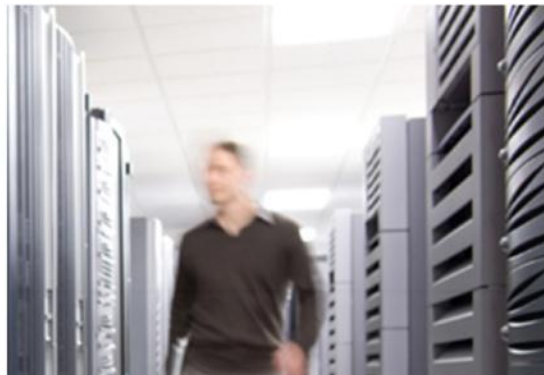
SP Wi-Fi Common Deployment Models

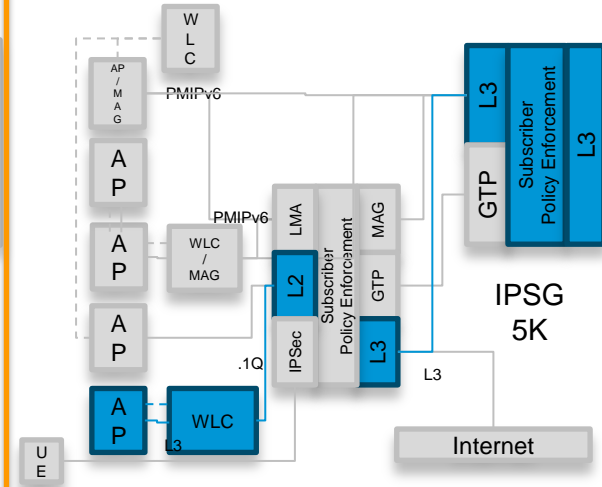# SP Wi-Fi: Deployment Architectures & Use Cases

SP Wi-Fi Deployment Use Cases

Market Segments	Use Case Scenarios
Metro-WiFi Deployment (Layer 2 connected) HotSpot Deployment (Layer3 Routed) Packet Core Integration Deployment	• Open Authentication • Web Authentication (Web-Login) • Web Authentication (One-Click) • WISPr • Voucher-based Authentication • Pre-paid (Time/Quota) • EAP-PEAP • EAP-SIM • Hotspot 2.0 • Open Transparent Auto Logon (TAL) (MAC-based) • TAL (MAC-based with DHCP Lease Query)

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Metro Wi-Fi Offload Deployment

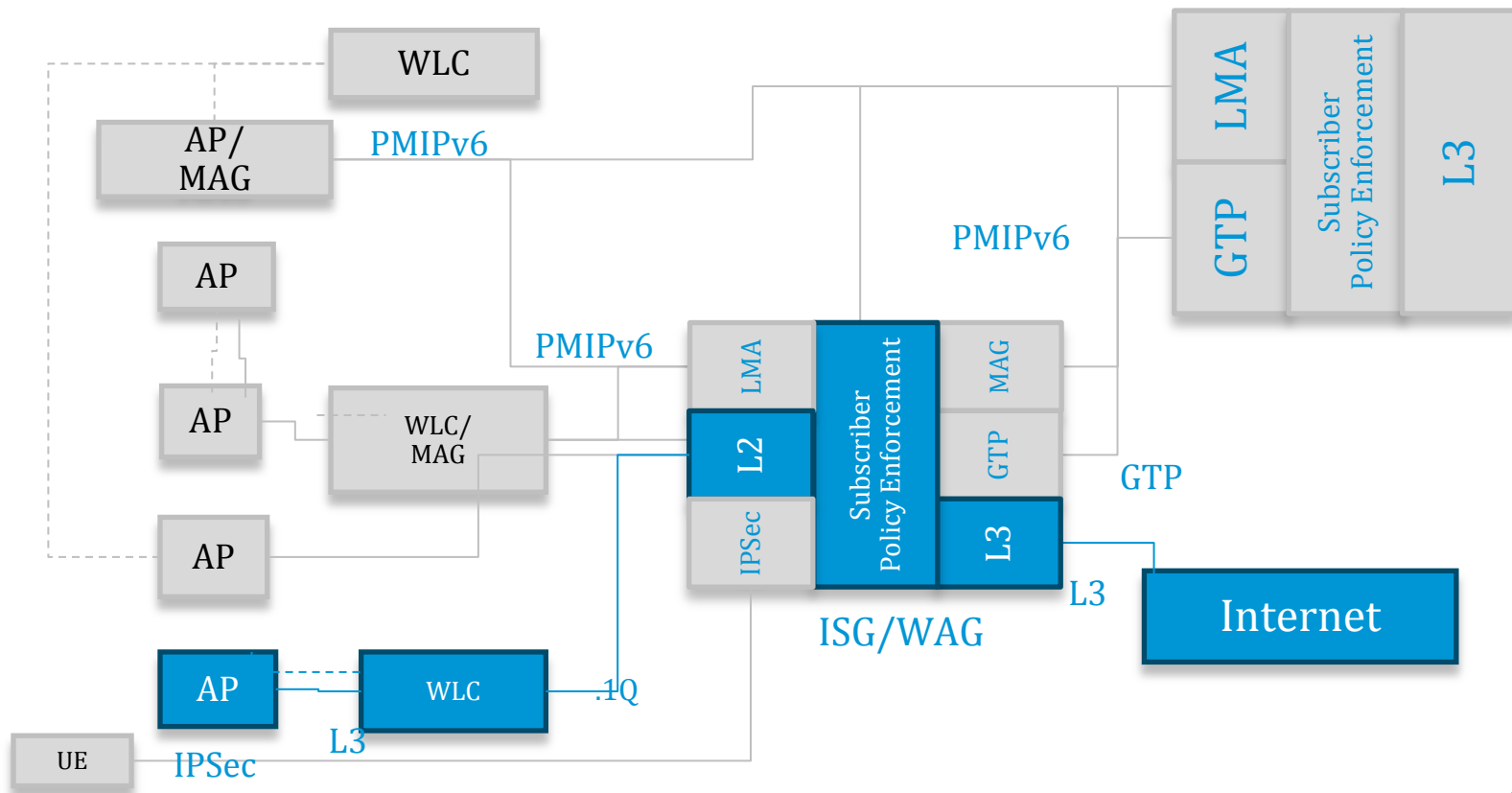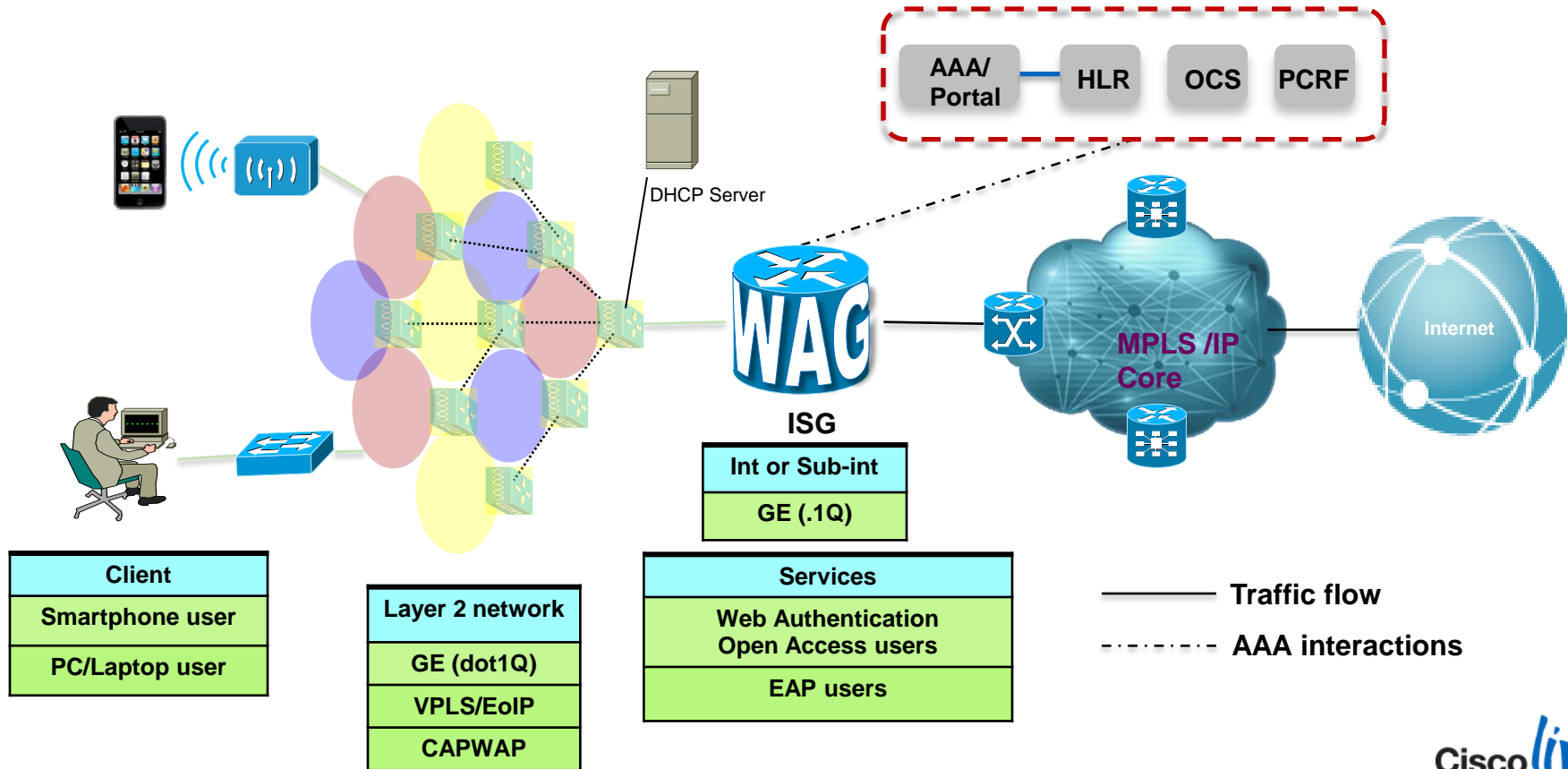| Connectivity	• L2-connected network • Unclassified MAC/DHCP initiator
IP Addressing	• IPv4 Clients • External/Internal DHCP
Services	• Stadium, Metro Station Public Hotspots • Open Access Wi-Fi Services • Web Authentication • EAP-SIM Authentication • Dynamic Service Selection

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Metro Wi-Fi Offload Deployment

Metro Wi-Fi Offload Deployment

DHCP Server

AAA/ Portal — **HLR** **OCS** **PCRF**

MPLS /IP Core

Internet

WAG

ISG

Int or Sub-int
GE (.1Q)

Client
Smartphone user
PC/Laptop user

Layer 2 network
GE (dot1Q)
VPLS/EoIP
CAPWAP

Services
Web Authentication Open Access users
EAP users

——— **Traffic flow**

·—·—·—· **AAA interactions**

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Hotspot Deployment

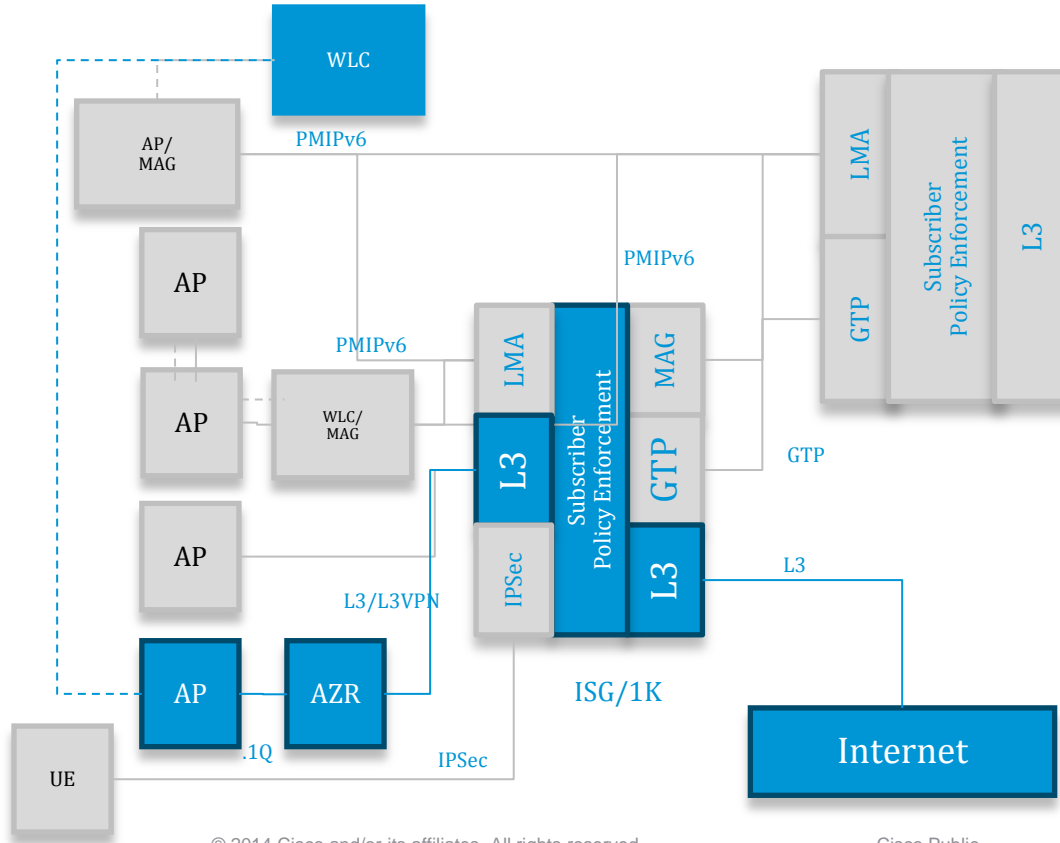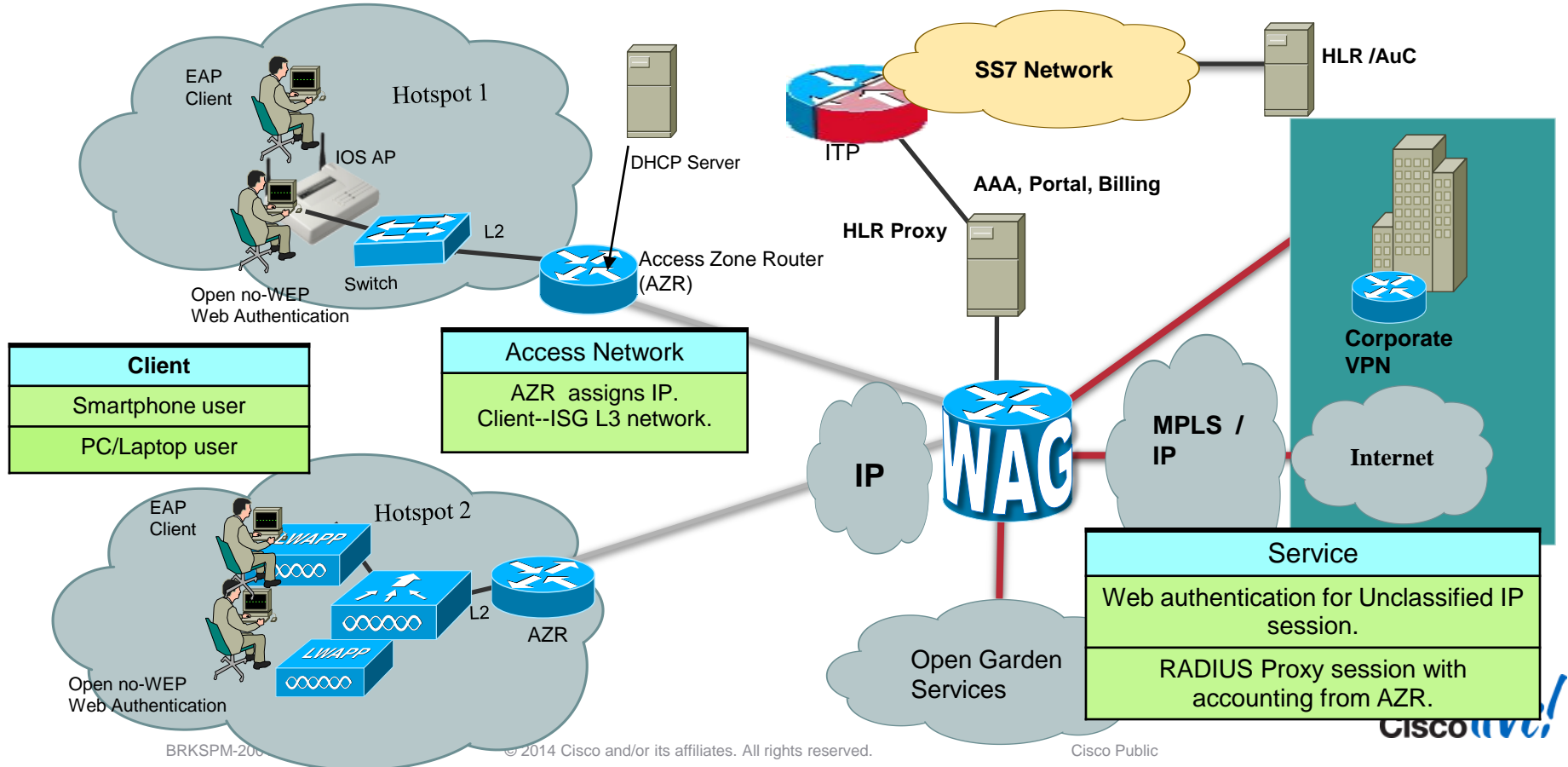|	
Connectivity	• L3-connected network • Unclassified IP OR RADIUS Proxy initiator
IP Addressing	• IPv4 Clients • External DHCP
Services	• Mobile Data Offload • Open Access Wi-Fi Services • Web Authentication • EAP-SIM Authentication • Dynamic Service Selection

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Hotspot Deployment

Hotspot Deployment

EAP Client

Hotspot 1

IOS AP

L2

Switch

Open no-WEP Web Authentication

DHCP Server

Access Zone Router (AZR)

ITP

SS7 Network

HLR /AuC

AAA, Portal, Billing

HLR Proxy

Corporate VPN

Client

Smartphone user

PC/Laptop user

Access Network

AZR assigns IP.
Client--ISG L3 network.

IP

MPLS / IP

Internet

WAG

EAP Client

Hotspot 2

LWAPP

L2

AZR

LWAPP

Open no-WEP Web Authentication

LWAPP

Open Garden Services

Service

Web authentication for Unclassified IP session.

RADIUS Proxy session with accounting from AZR.

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Web Authorisation for SP Wi-Fi Access

Why is it needed?

- Web portal based access continues to be demanded by MNOs and Wi-Fi Access providers

- Many mobile devices do not have SIM cards or SIM-based clients apps
  - Wi-Fi iPAD and iPod touch are two major examples
  - Will every Wi-Fi connected device get a SIM? When?

- BYOD will be a major use case for Wi-Fi access going forward

- Exploit visiting "non-subscribers" – a good "churn" opportunity for you
  - Need a portal login and splash page to offer your service

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WEB Authentication Call Flow
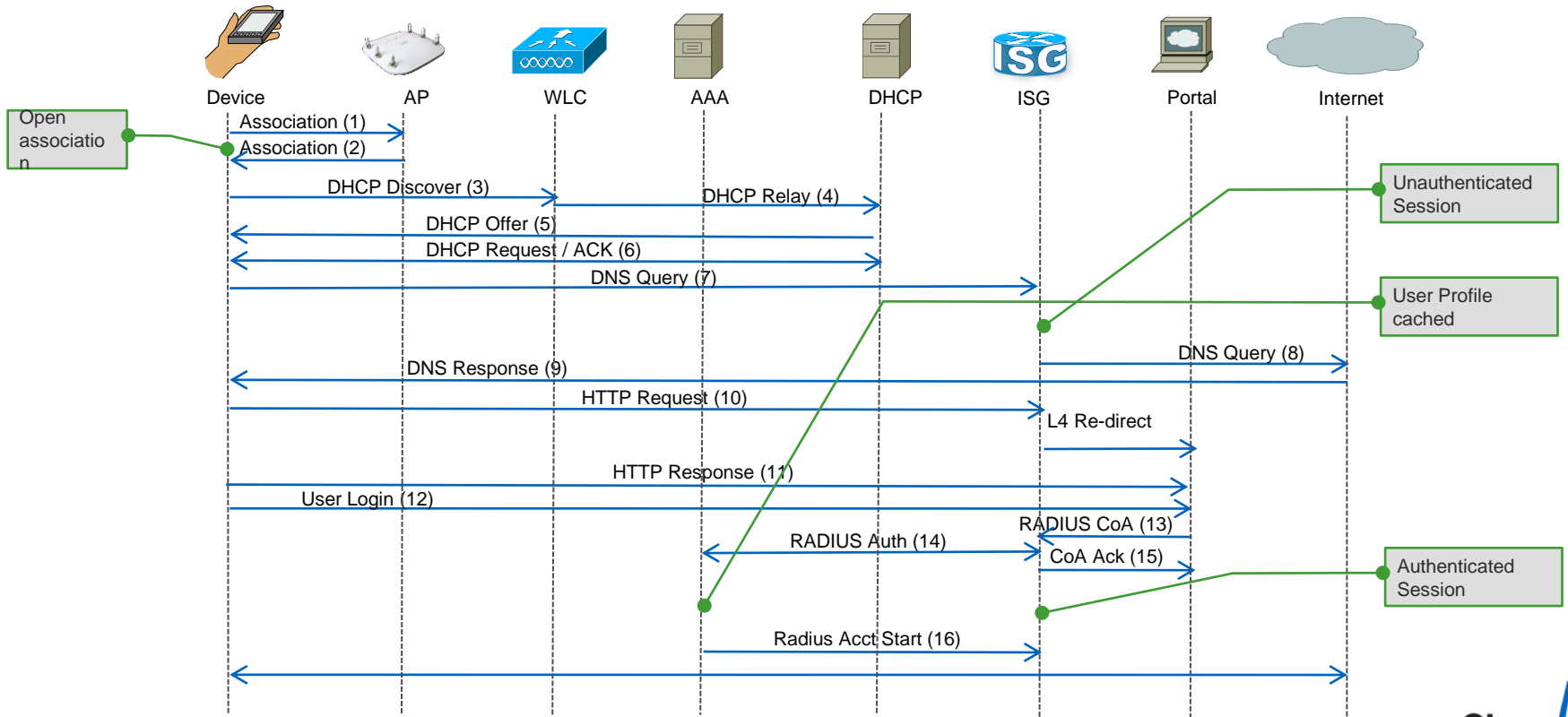
ISG with DHCP Session Trigger
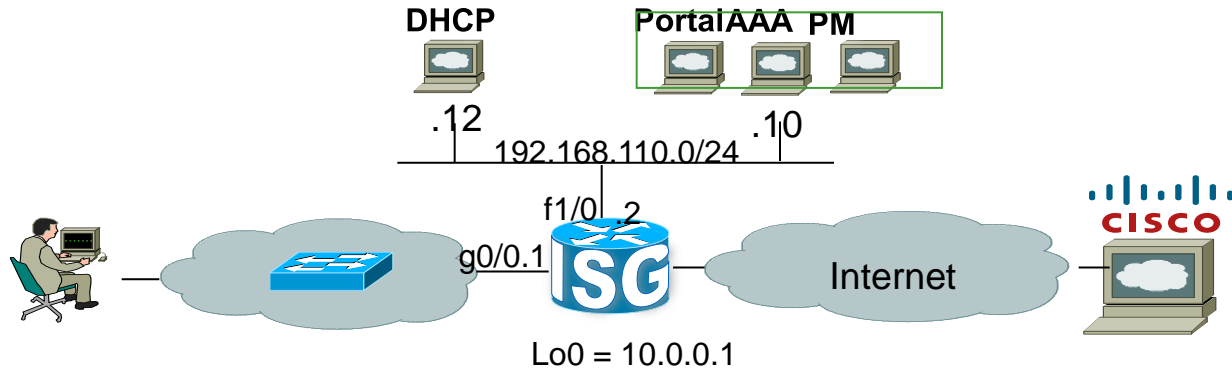
Address Assignm.	Session Initiator	Interface	Authentication
DHCP ISG is DHCP Relay	DHCP	GE (.1Q)	TAL (mac address) w/ Web Logon fall back for Self Subscription

- Client/Subscriber on a smartphone/tablet/laptop associates to a available WLAN SSID on a AP and initiates DHCP DISCOVER
- Once authenticated subscriber will be assigned a Pay Per Use Standard High Speed service

DHCP Session Initiator: Call Flows

1a DHCP Discover

2 ISG session creation

Session-start event posted

3 PBHK service applied (*)

4a Access-Request
username = mac
Access-Reject **4b**

5 OpenGarden and L4R services applied (*)

6 Authentication Timer started

1b DHCP Discover

1c DHCP Exchange

DHCP Portal AAA
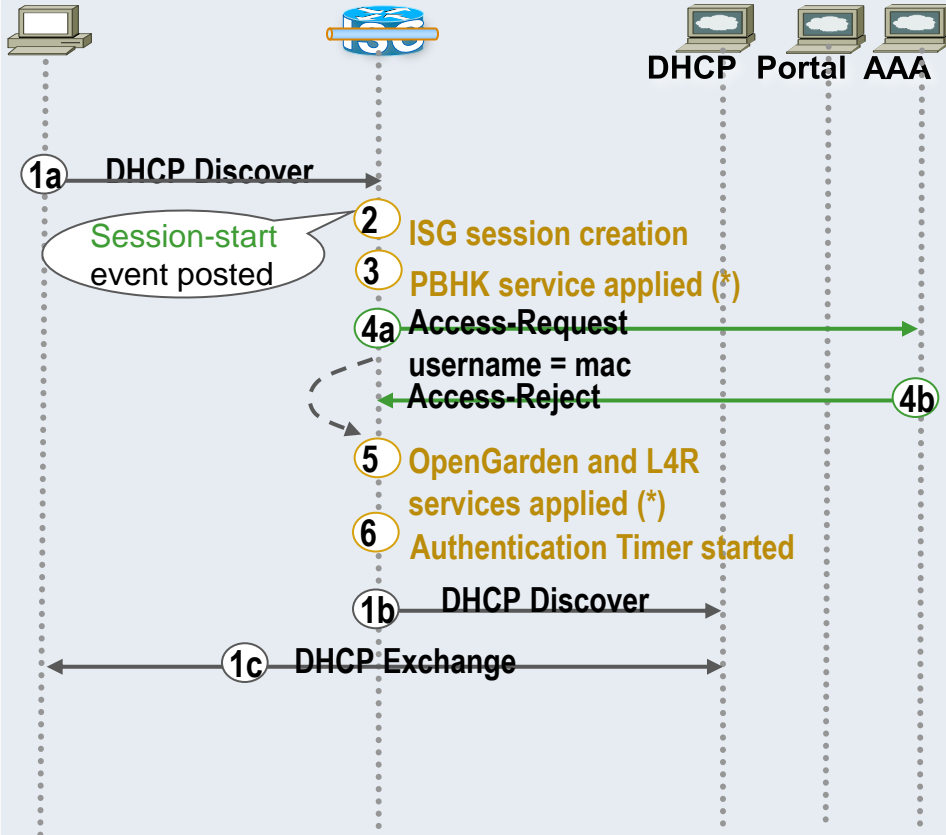
```
interface GigabitEthernet 0/0.1
    encapsulation dot1Q 10
    ip address ...
    service-policy type control IP_SESSION_RULE1    2
    ip subscriber l2-connected
        initiator DHCP

policy-map type control IP_SESSION_RULE1
<snip>                                               2
 class type control always event session-start    3
   10 service-policy type service name PBHK_SRV    4a
   20 authorize aaa list IP_AUTHOR_LIST
        password cisco123 identifier mac-addr      5
   30 service-policy type service name OG_SRV      6
   40 service-policy type service name L4R_SRV
   50 set-timer AUTHEN_TMR 10
```

(*) assumes that the definition
of PBHK, L4R and
OpenGarden are already
available on the ISG

EAP Authentication Call Flow
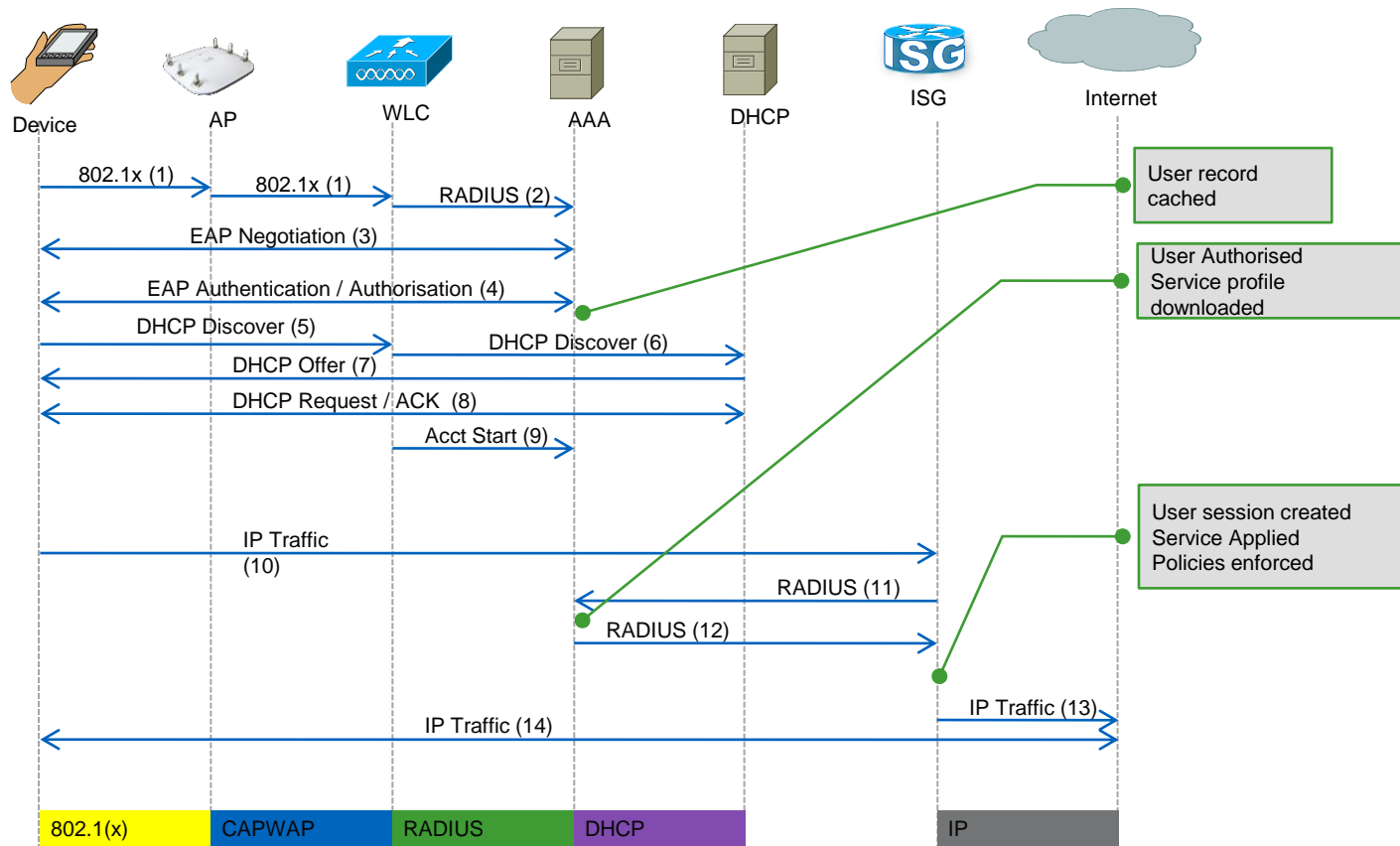
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PMIPv6 Based Deployment for Packet Core Integration

Connectivity
- L2-connected network
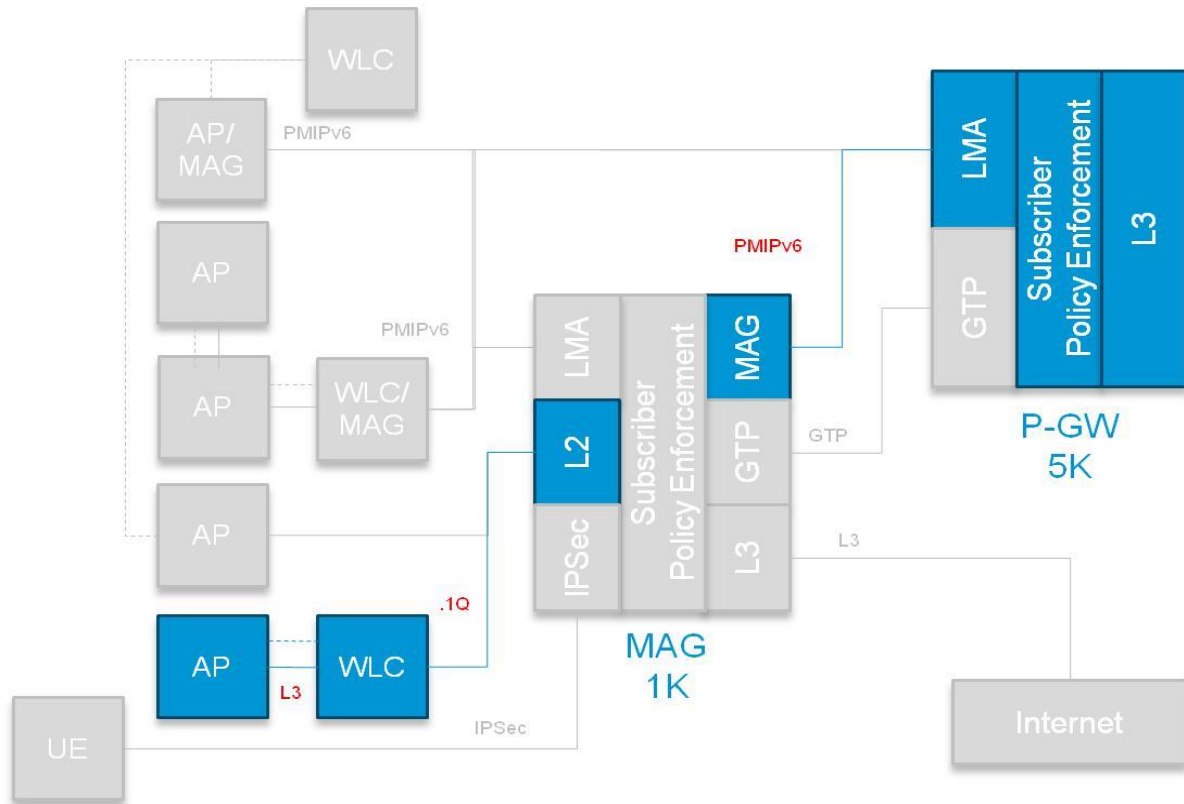- DHCP initiated
- Offload: Unclassified MAC & RADIUS Proxy initiator

IP Addressing
- IPv4, IPv6 or Dual-stack Clients
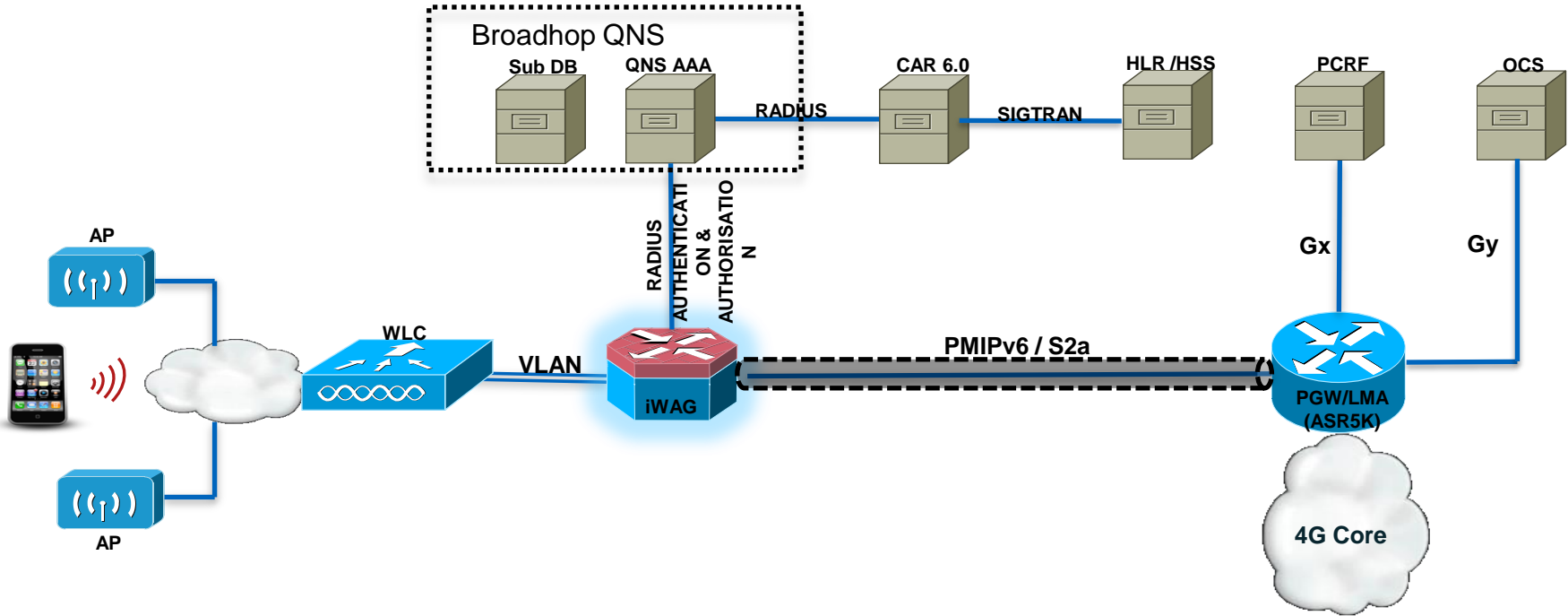- Simple IP User Internal DHCP
- Mobile IP User from LMA

Services
- Open Access Wi-Fi Services (Simple offload)
- Web Authentication, EAP-SIM/AKA
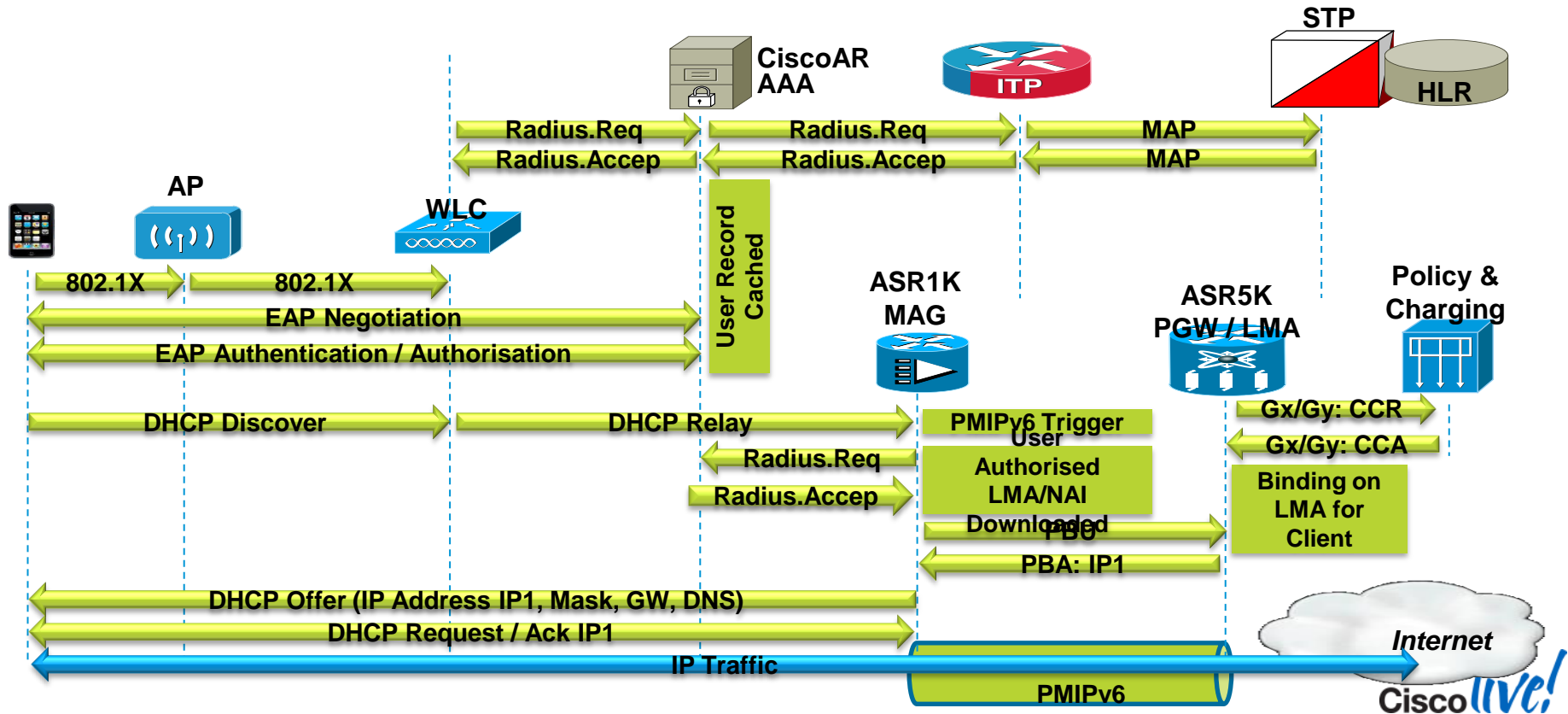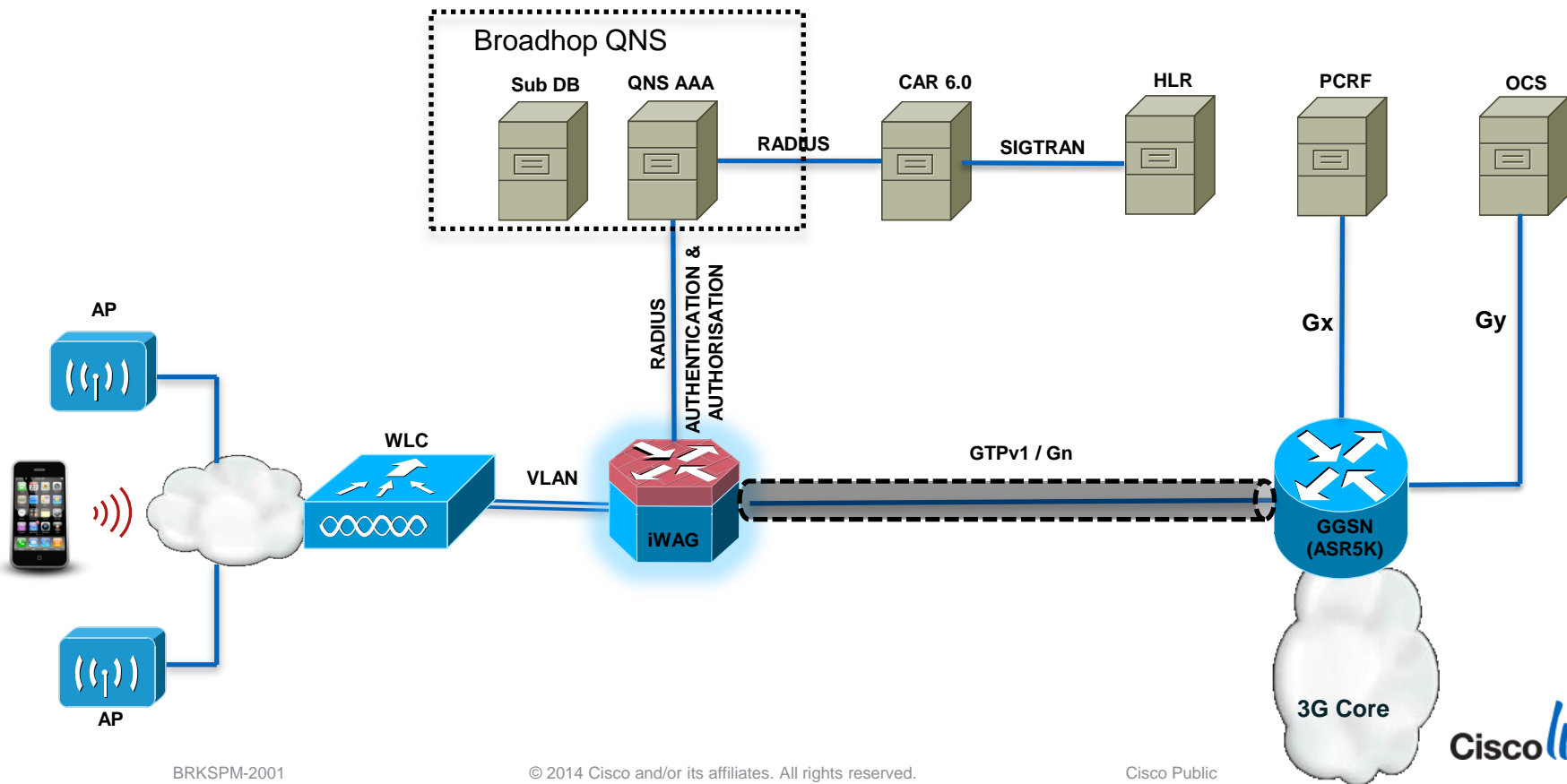- Dynamic Service Selection

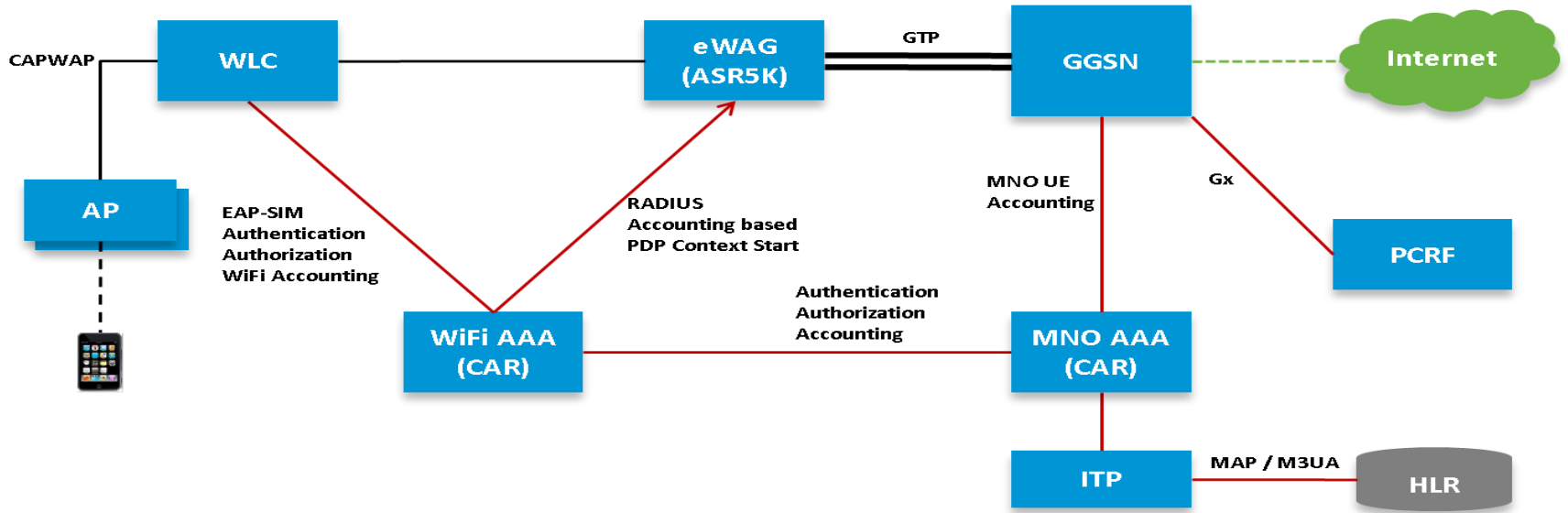# PMIPv6 Based Deployment for Packet Core Integration

# Packet Core: 4G/PMIPv6 Integration into PGW

FSOL : RADIUS/Unclassified MAC , Tunnel Technology PMIPv6

Packet Core: 4G/PMIPv6 Integration into PGW

Call Flow Overview

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Cisco Public

GTP-based Deployment for Packet Core Integration

Connectivity
- L2-connected network
- DHCP initiated
- Offload: Unclassified MAC & RADIUS Proxy initiator

IP Addressing
- Simple IP User Internal DHCP
- Mobile IP User from GGSN

Services
- Open Access Wi-Fi Services (Simple offload)
- Web Authentication, EAP-SIM/AKA
- Dynamic Service Selection

Cisco *live!*

GTP-based Deployment for Packet Core Integration

Cisco Public
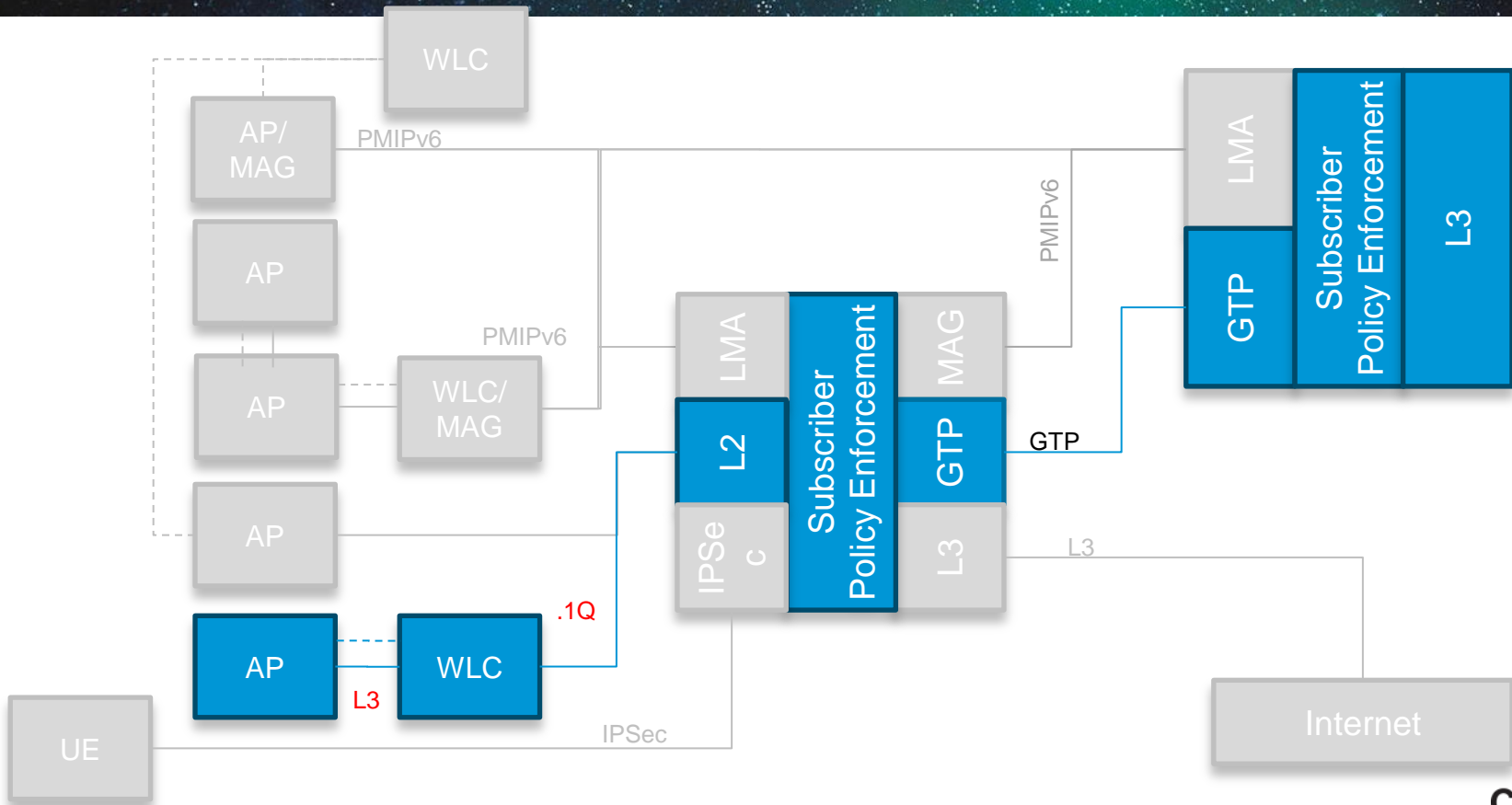
Packet Core: 3G/GTP Integration into GGSN

Packet Core: 3G/GTP Integration into GGSN

Packet Core: 3G/GTP Integration into GGSN

Call Flow Overview
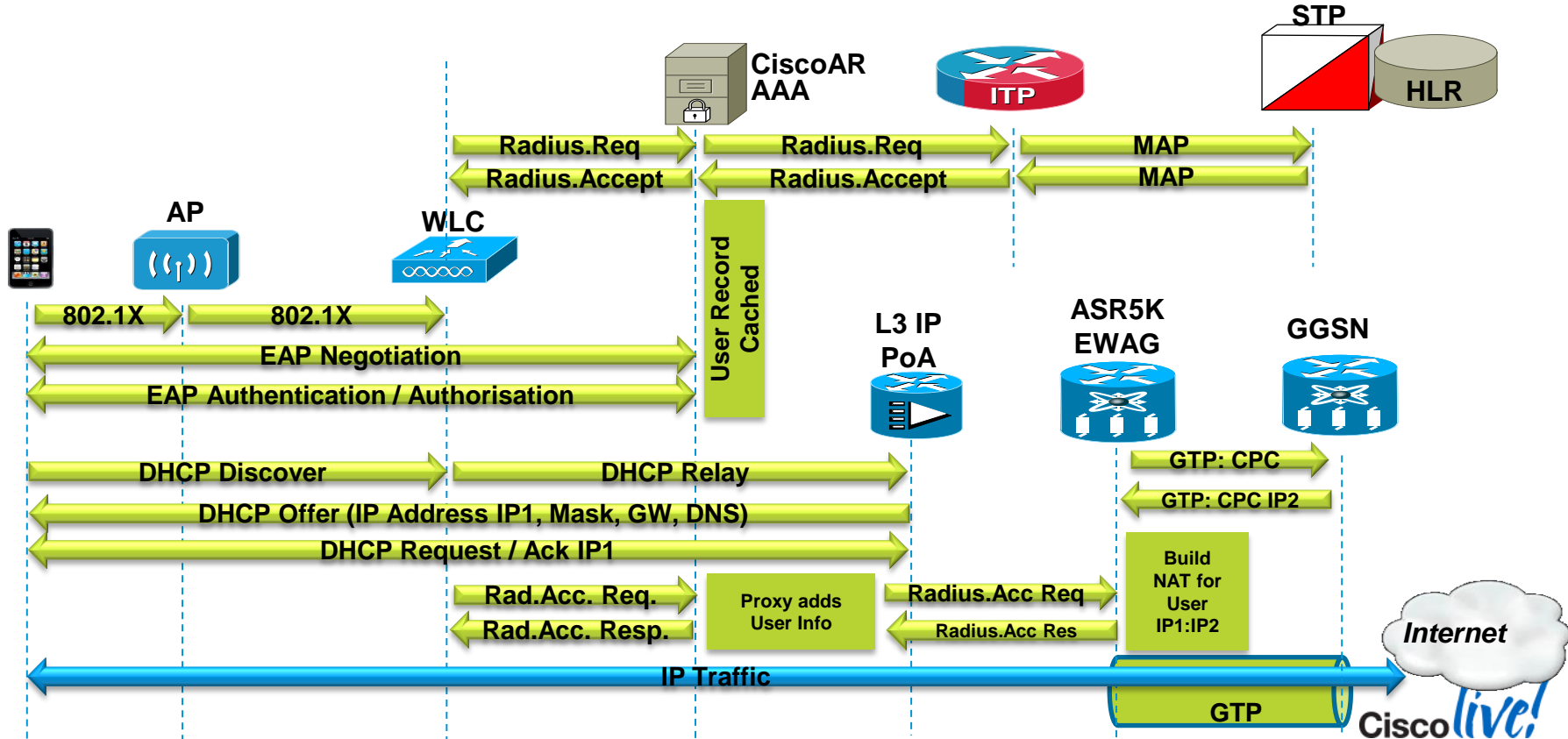
Case Studies and Customer Deployments

Cable/MSO: Cablevision

224,000 Brand Impressions per day
1,000,500 devices detected, 596,000 are iOS

Separate use cases for device categories:
Laptop, Tablet, Phone

Use cases Deployed: Branding, App Promo

- Cablevision Setup

- Serve at beginning of session, every 5 min.

- iOS devices get App promo as first imp

- Average serve rate of 1-3 impressions per day per surfing device.

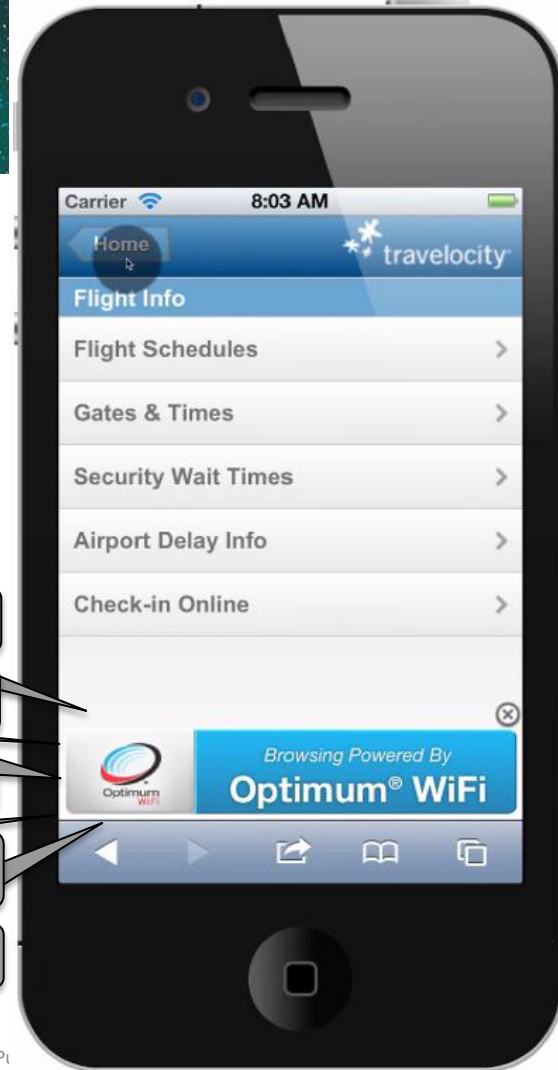- Workdays are 30-40% more active than holidays, snow days or weekends.

Scales for device

Animation effects

Anchor to any corner

Supports transparency

Timed entry and exit

Carrier 8:03 AM

Home — travelocity

Flight Info

Flight Schedules >

Gates & Times >

Security Wait Times >

Airport Delay Info >

Check-in Online >

Browsing Powered By
Optimum® WiFi

Connected Stadium – Super Bowl XLVI

- *Fan facing Wi-Fi access for Super Bowl activities*
- *Carrier-neutral Wi-Fi access – free to all fans*
- *Provided by Verizon wireless*
- *Objective: enhanced fan experience and 3G offload*
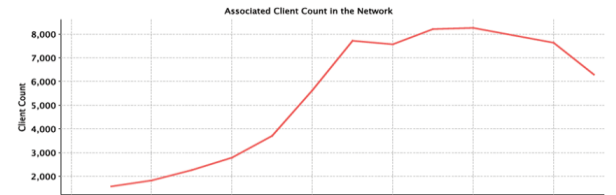- *High speed data as well as Voice & SMS worked well*
- *604 in-stadium Access Points*
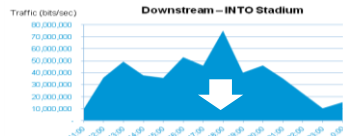
Downstream
Peak: 75 Mbps
Total: 225.3 GB

Upstream
Peak: 42 Mbps
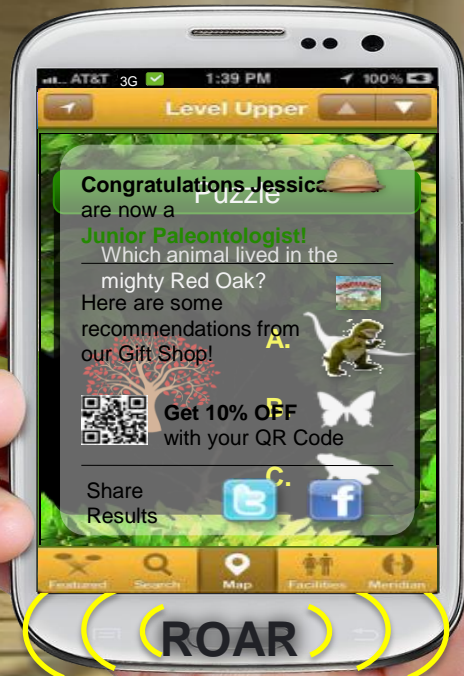Total: 144.6 GB
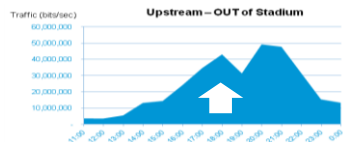
Total attendance:
68,658

Unique Associations:
12,946 (19%)

Simultaneous access:
8,260 (12%)

63

Venue: Fernbank Museum with AT&T

Transforming Visitor Experience with Personalised, Managed Wi-Fi

- Personalised Tour Guide
- Location-based context help / Analytics
- Promotions / Attractions

Copenhagen Airport
Aid Travellers through Wi-Fi Services

What's New

- Location Analytics with ThinkSmart

Security Personnel ✓

Check-In Personnel ✓

Customs Personnel ✓

Traffic Flow ✓

Advertising Placement ✓

Congestion Detected

Copenhagen Airports

Summary & Takeaways

Key Take-away: SP Wi-Fi is all About Optimising/ Monetising for Providers

- Mobile wireless data is exploding

- SPs are looking at Wi-Fi as a way to optimise their network, reduce customer churn and increase revenue opportunities

- SP Wi-Fi access is a business reality today for ALL providers

- Rich service management needed for subscriber differentiation and monetisation

- There is no single solution for all access types, but all types of access should be supported at the service layer

- An end to end architecture must provide services for different deployment models

- The results of a good deployment will deliver outstanding user experience

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Cisco e2e Product Portfolio for SP Wi-Fi

WAG, GGSN, PGW, ePDG, TTG:
Cisco ASR5K

WAG & ISG:
Cisco ASR1K/9K

Indoor Access Points:
Cisco Aironet 3600 Series

Outdoor Access Points:
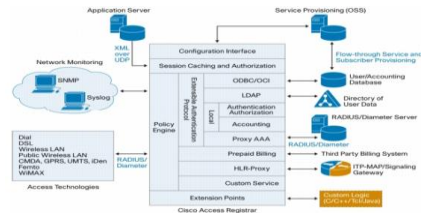**Cisco Aironet 1550 Series**

Wireless LAN Controllers:
Cisco 5500/8510 WLC
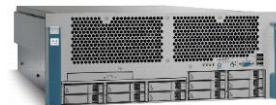

WLAN Management:
Cisco Prime (NCS)

AAA:
Cisco Access Registrar (CAR)

Server:
Cisco UCS

Q & A

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