



*TOMORROW
starts here.*

Service Provider WiFi and
Small Cell

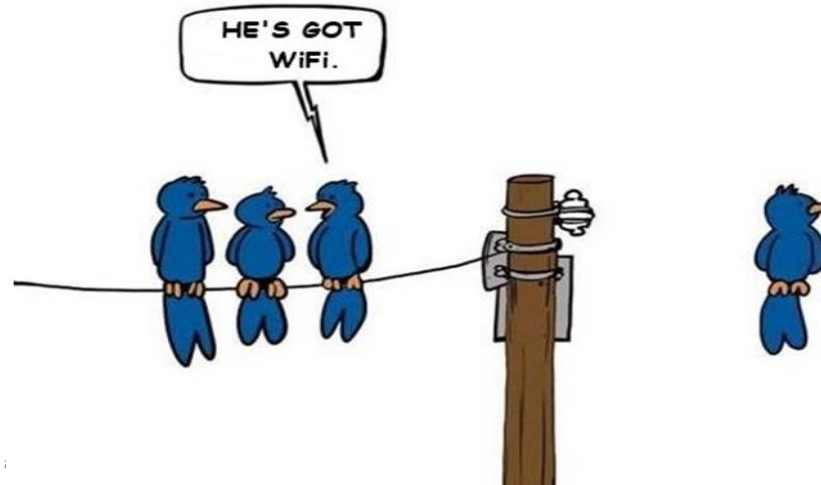
Derick Linegar
Technical Solutions Architect



House Keeping Notes – Wednesday April 16, 2014

Thank you for attending Cisco Connect Toronto 2014, here are a few housekeeping notes to ensure we all enjoy the session today.

- Please ensure your cellphones are set on silent to ensure no one is disturbed during the session
- Please hold all questions until the end of these session to ensure all material is covered
- **Let's Have some fun:**



Service Provider WiFi and Small Cells

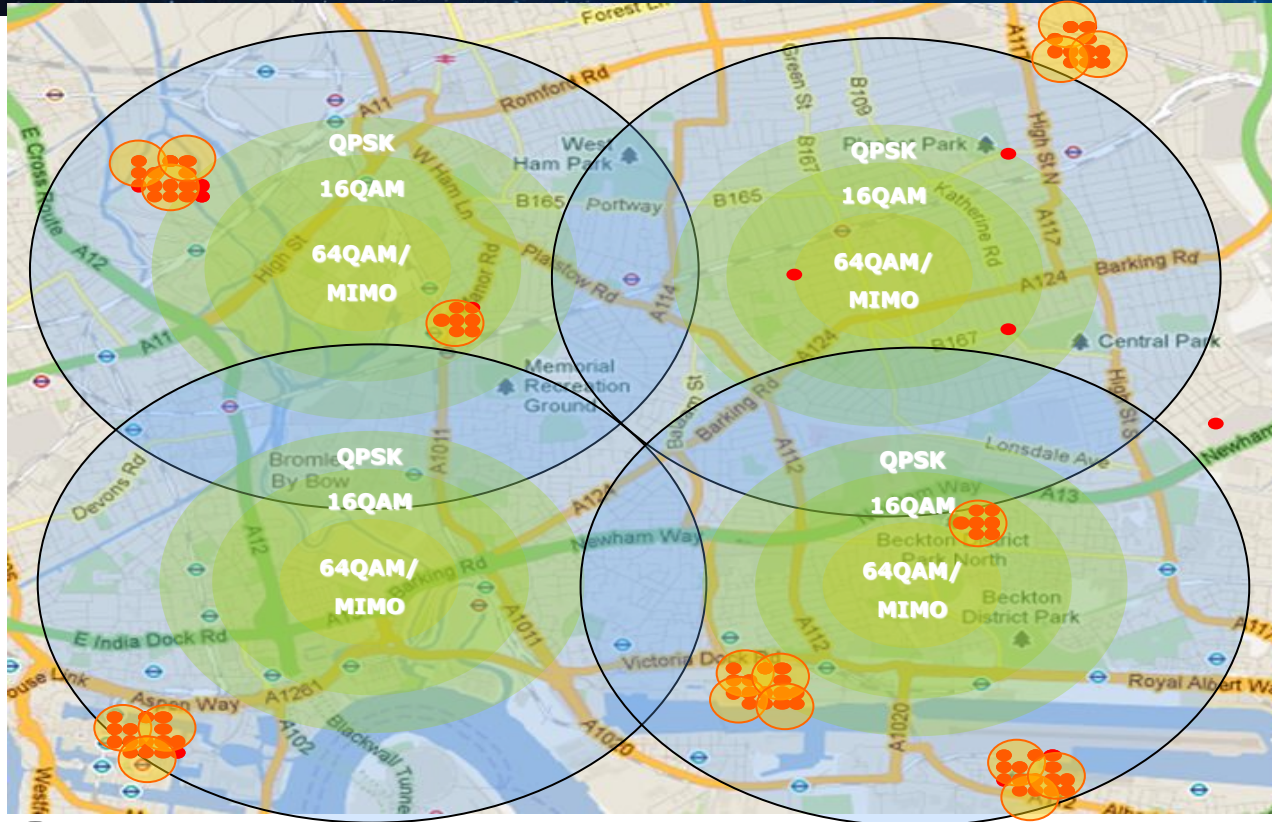
Agenda

- SP-WiFi Solution Architecture Update
- Passpoint Certified WiFi Update
- Small Cell Overview
- Packet Core Integration options for SP-WiFi
- Practical Examples of SP-WiFi Integration
- Questions?

A blue-tinted image of Earth from space, showing the curvature of the planet and a bright sun in the upper left corner. The sun is a bright white star with a blue lens flare effect. The Earth's surface is visible in shades of blue and white, with some cloud cover. The background is a dark blue space.

SP-WiFi Solution Architecture Update

Dealing with non uniform coverage



Macrocell (3G/4G)

- Voice coverage with uniform bandwidth, but not always where people are
- Reduced data capacity edge of cell
- Sub-optimal delivery of high BW to POPs
- High CapEx/OpEx: \$400K
- Poor spectral efficiency

Wi-Fi/Femto/Pico

- Delivers targeted coverage and capacity
- Support high-capacity data
- Precision delivery of high BW to POPs
- Lower CapEx/OpEx
- Good spectral efficiency



Macro cell

SP WiFi & Small Cell



Small cell

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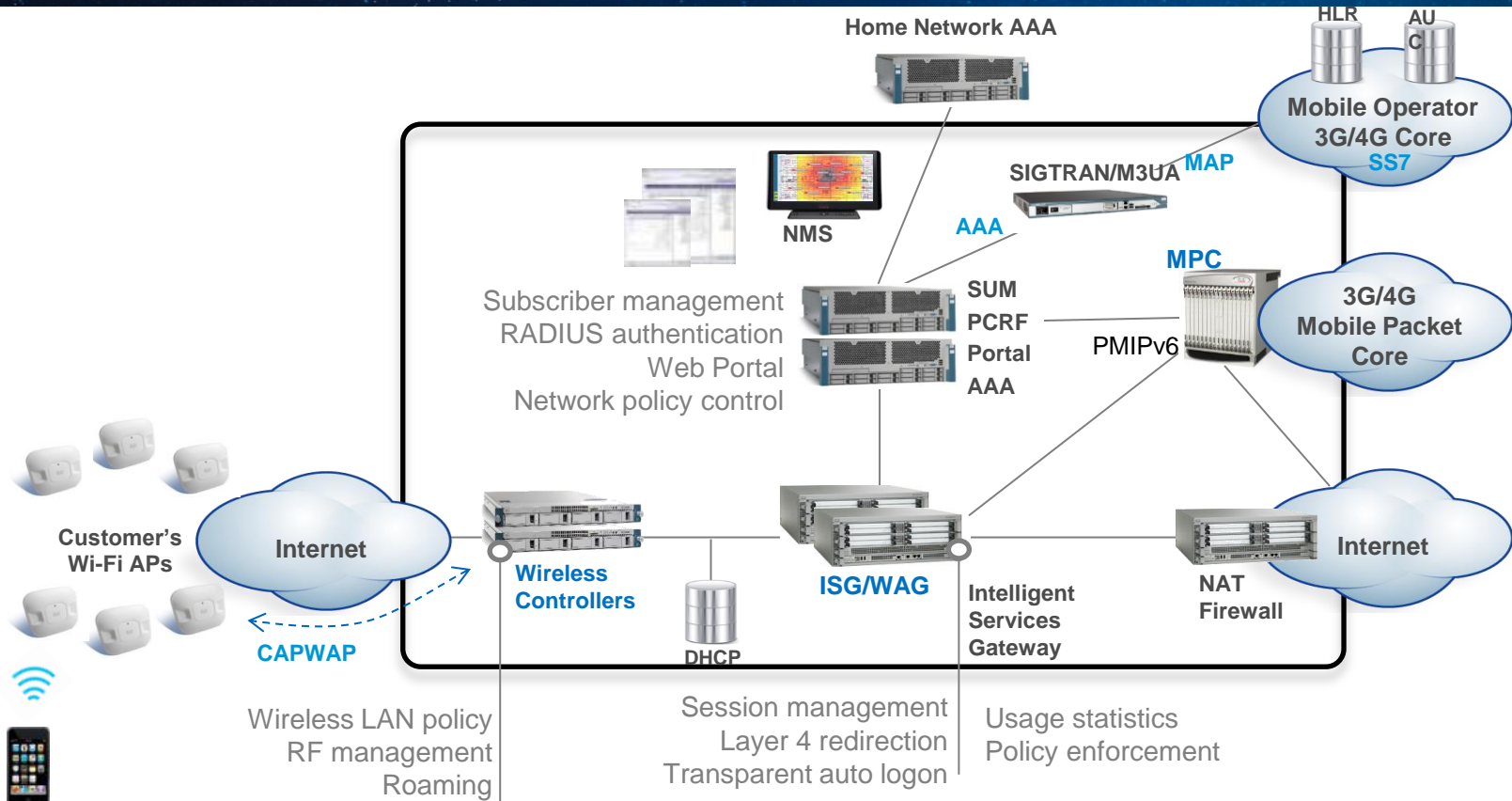


High data users

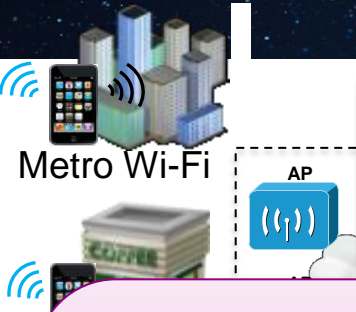
Cisco Public

Cisco SP Wi-Fi Solution: Primer

Access + Service and Policy + Packet Core Integration



SP Wi-Fi Solution: Converged Architecture



Metro Wi-Fi



Metro Wi-Fi

- Cellular Data Alternative
- MSO/MNO Partnerships
- Walkby user management
- Architecture cadence across

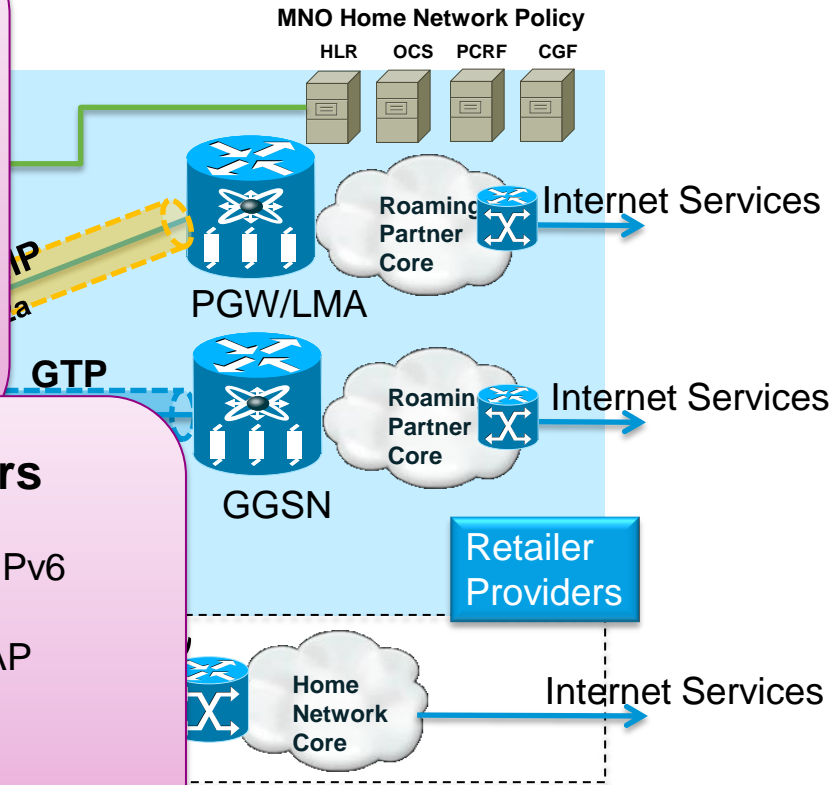
Cellular Integration

- 3G/4G Offload
- GTP – 3G Integration
- PMIP – 4G Integration
- Small Cell Integration
- Use cases:
 - Web-Authentication and TAL met non-SIM based devices
 - EAP-SIM/AKA for SIM-based dev
 - Open web Auth and MAC TAL
 - WISPr
 - Location-based Portals
 - Passpoint

Web-Login, One-Click
 o Logon (TAL) (MAC-

Leading Enablers

- Location Analytics
- Resi/Comm Wi-Fi – PMIPv6
- AVC/DPI
- QoS – Per client/SSID/AP
- Use cases:
 - CMX – Wayfinding
 - Whitelisting/Blacklisting
 - Parental Control



Cisco SP Wi-Fi Solution Components

Core

- L2/L3 MAC 40K → 2M
- ISG 32K → 384K
- LBO+3G+4G → iWAG
- ASR5K Packet Core: LMA, eWAG, DeWAG, SaMOG
- Scale & HA

Access

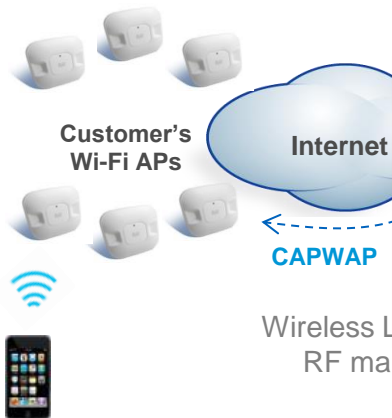
- Client Scale 7K → 64K
- AP scale 500 → 6000
- PMIP Mobile Integration (MAG)
- New APs: indoors /outdoors
- Client & AP SSO
- Flexconnect CP/DP split
- vWLC
- 11ac and

Policy/AAA

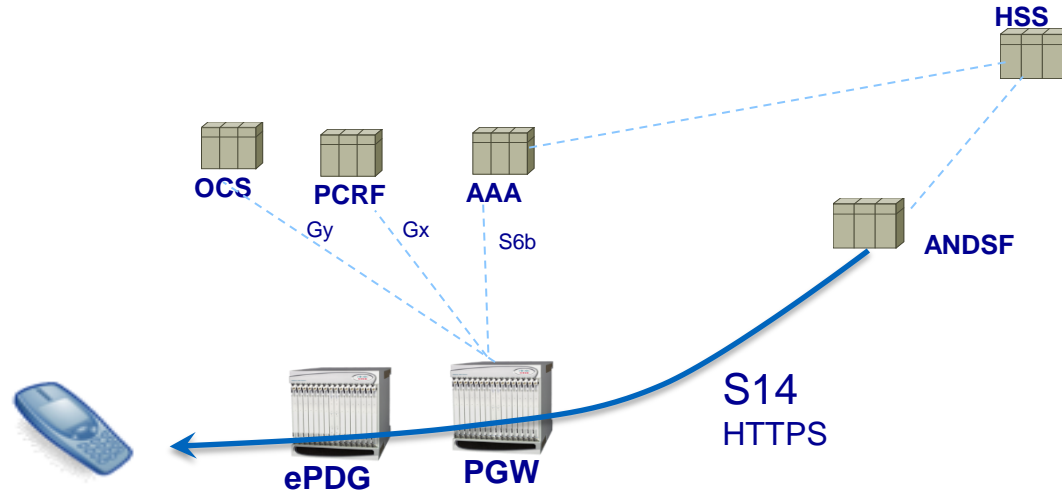
- BH SME/QNS
- QNS 5.3 → QPS 6.0
- ASR 1K/5K & WLC Integration with QPS
- Scale, Performance & HA
- CPAR use case support

NMS

- Appliance to Virtual
- CPI 1.0 → 2.x
- New AP Support
- Scale & Performance
- Reporting & Mapping enhancements
- CPM & PPM ASR5K

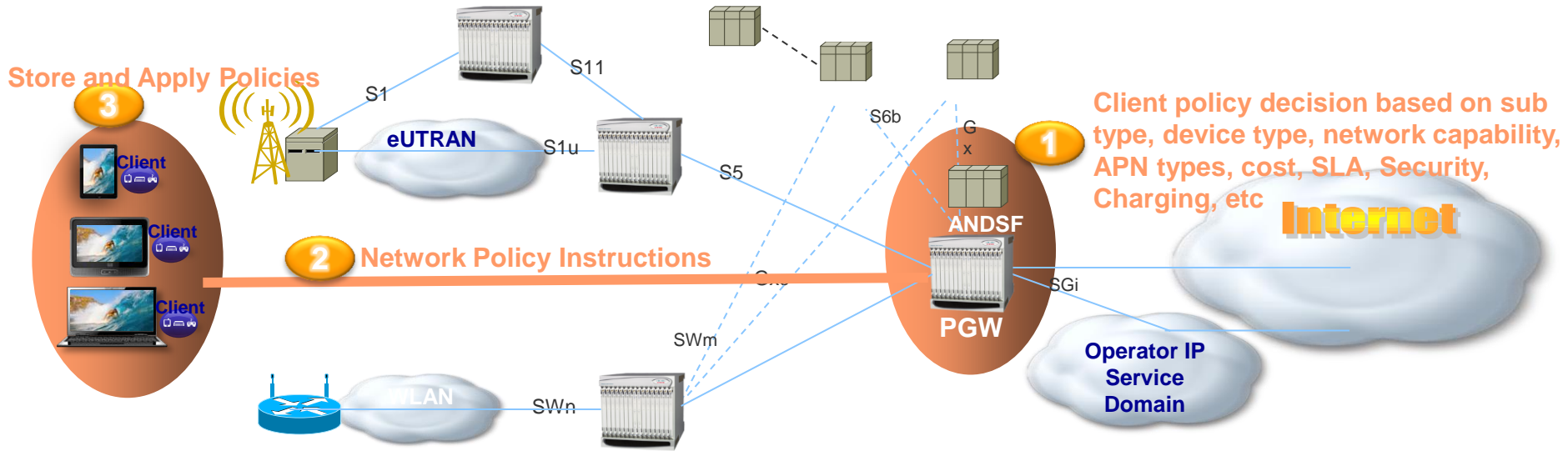


3GPP Policy Architecture for WiFi: ANDSF



- 3GPP release 8 introduced ANDSF in LTE reference architecture to convey policies to the device
- ANDSF concepts can be also applied to UMTS architecture

ANDSF Network Control Points – Policy Control



Client functions are extended to support dynamic policies hence providing network control point

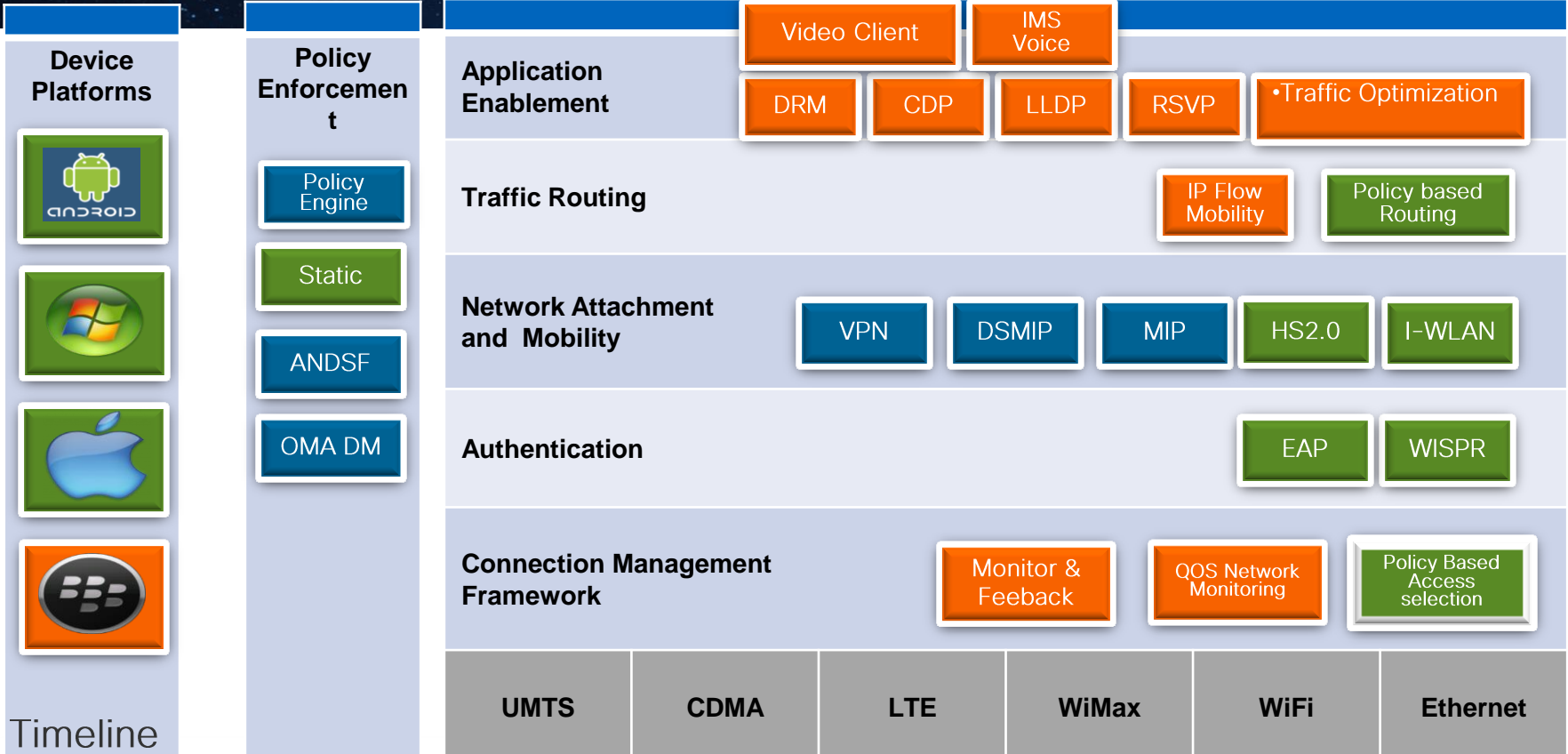
ANDSF Solution Approach

- Off-load UMTS/LTE traffic to WiFi provided that user experience on WiFi will be equivalent to microcellular
- Device client is critical in solving the problem
 - Client enables managed WiFi offload where SP controls criteria and conditions for traffic offload
 - **Access type**
 - **Access and network conditions**
 - **Location**
 - **APN**
 - **Device**
 - **Roaming status**
 - **Time**
 - **Data usage**
 - **Application**
 - **Subscriber status/service**
 - **TFT (5 tuple filters)**
 - **The client can also expose info required to collect analytics**
- **Network needs to provide necessary triggers to enable these policies**

ANDSF List of Usecases

1. Standard ANDSF and S14 interface
2. Initial policy download including filtering based on location
3. New SSID list based on location change
4. Connection fallback on poor access conditions
5. Control of WiFi access for roamers
6. WiFi access for over the quota prepaid users
7. Selective traffic routing
8. Analytics

Client Technology Roadmap



Timeline

Available (Green) | 6 months (Blue) | 12 months (Orange)

A blue-tinted image of Earth from space. The sun is visible in the upper left corner, creating a bright starburst effect. The Earth's surface is shown in the lower right, with a thin white atmosphere layer. The text "Passpoint Certified WiFi Update" is overlaid in white on the left side of the image.

Passpoint Certified WiFi Update

Imagine a World...

- You Enter a Venue...
 - ...and get onto the Wi-Fi network as simply, seamlessly, and securely as cellular
 - no SSID, no username, no password, no Web Auth, etc.
 - a new customer can immediately sign-up online at the venue
- You are Automatically Notified of Special Services
 - pre-installed apps automatically launch upon notification (or can download new apps as needed from a local server)
- You have Instant Access to cool venue specific services and content
 - Indoor Maps, Product Finder, Call for Help, Product Reviews, Loyalty info, etc.
- This is the Promise of Hotspot 2.0



Sample Scenario

Manual Setup

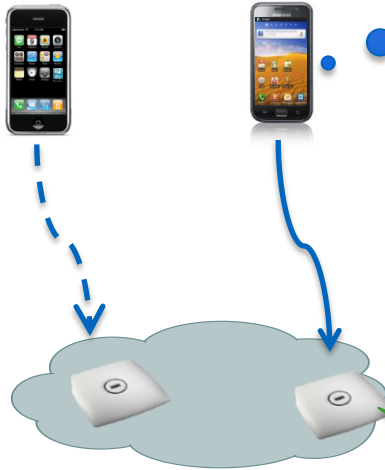
1. Power-on or unlock the phone
2. Select Wi-Fi network
(vulnerable to rogue AP)
3. Go to WebAuth
4. Browse webpage and enter right credential, usually ID/PWD
5. Choose roaming plan
6. Start Internet

- **Makes Wi-Fi easy-to-use and secure (like cellular)**
- **802.11u enabled network is compatible with non-11u devices!**

Regular Client



Hotspot 2.0 Client



Can you tell me your network info...
...before I associate?

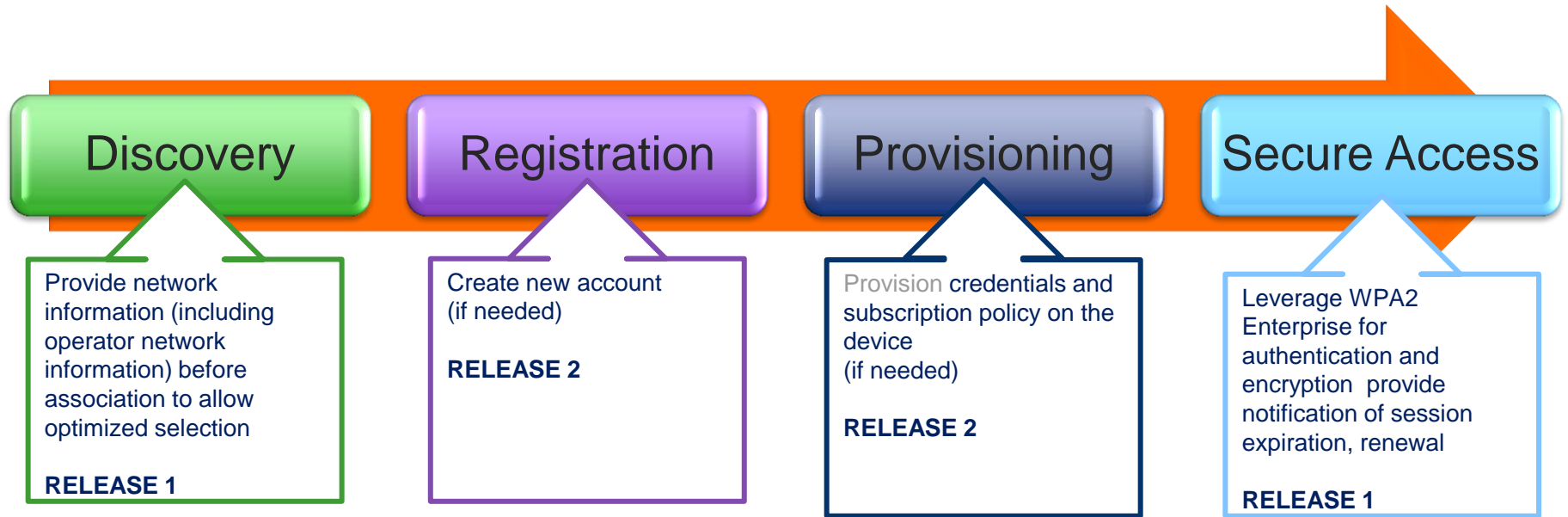
Automatic Setup

1. Power-on or unlock the phone
2. Handset automatically validates network and initiates connection

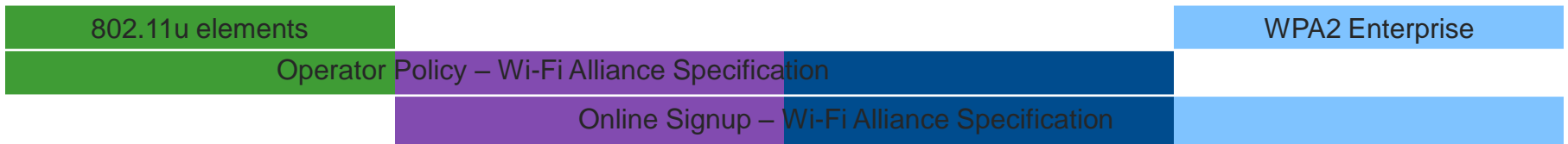
Yes! Here it is!
Realm Name = operator.com
Auth Type = EAP-SIM

Wi-Fi CERTIFIED Passpoint™

Program Scope



Technical elements of certification



Passpoint™ Releases

- **Release 1: Network Selection and Security (*Launched June 26, 2012*)**
 - WPA2-Enterprise with agreed credentials/EAP methods
 - AP and mobile certified for IEEE 802.11u GAS and ANQP interoperability
 - Mobile certified for network selection algorithm for roaming, applying user preferences and preferred association to Home SP's hotspot
 - AP certified for implementing peer-to-peer traffic inspection and filtering (for user protection via firewall) including ...
 - Blocking of local peer-to-peer traffic attempting to traverse AP (TDLS, DLS and Wi-Fi Direct)
 - IPv4 Proxy ARP and IPv6 Proxy Neighbor Discovery
- **Release 2: Online Signup and Policy Provisioning (*anticipated in 2014*)**
 - Mobile certified for enhanced network selection using operator policy
 - Mobile certified for operator policy provisioning providing preferred and blacklisted hotspots
 - Mobile certified for in-venue, secure online signup and credential provisioning
 - User can get a subscription in any Hotspot when needed
 - Username/password and certificate provisioning
 - Supports provisioning credentials & policy for an existing subscription to a new / un-provisioned mobile device
- **Release 3: (program requirements under development)**

WFA Passpoint™

Certified Information Elements

Beacons - Broadcasted

Interworking Info.

- Venue Group,
- Venue Type
- HESSID
- Access Network Type
- Internet Service
- WebAuth Required

Advertisement Protocol Info

- ANQP

Roaming Consortium Info

- OIs Info

BSS Load Element

Other Network Features

- 802.11v BSS Transition
- Proxy ARP
- Multicast/Broadcast Filter
- Peer-to-Peer block

ANQP info - Query based

802.11u Std

- Venue Name
- Roaming Consortium list
- Network Authentication Type
- NAI Realm list
- 3GPP Cellular Network Info.
- Domain Name list
- IP address type

HotSpot 2.0 ANQP element

- HS Query list
- HS Capability list
- Operator Friendly name
- WAN Metrics
- Connection Capability
- Operating Class Indication
- NAI Home Realm Query

Information Element Configuration

Handset Policy



Operator Policy
(Subscription MO)

Access Point Attribute



Venue Info

- Venue Name*
- Venue Group
- Venue Type

WLC Attribute



802.11u IE

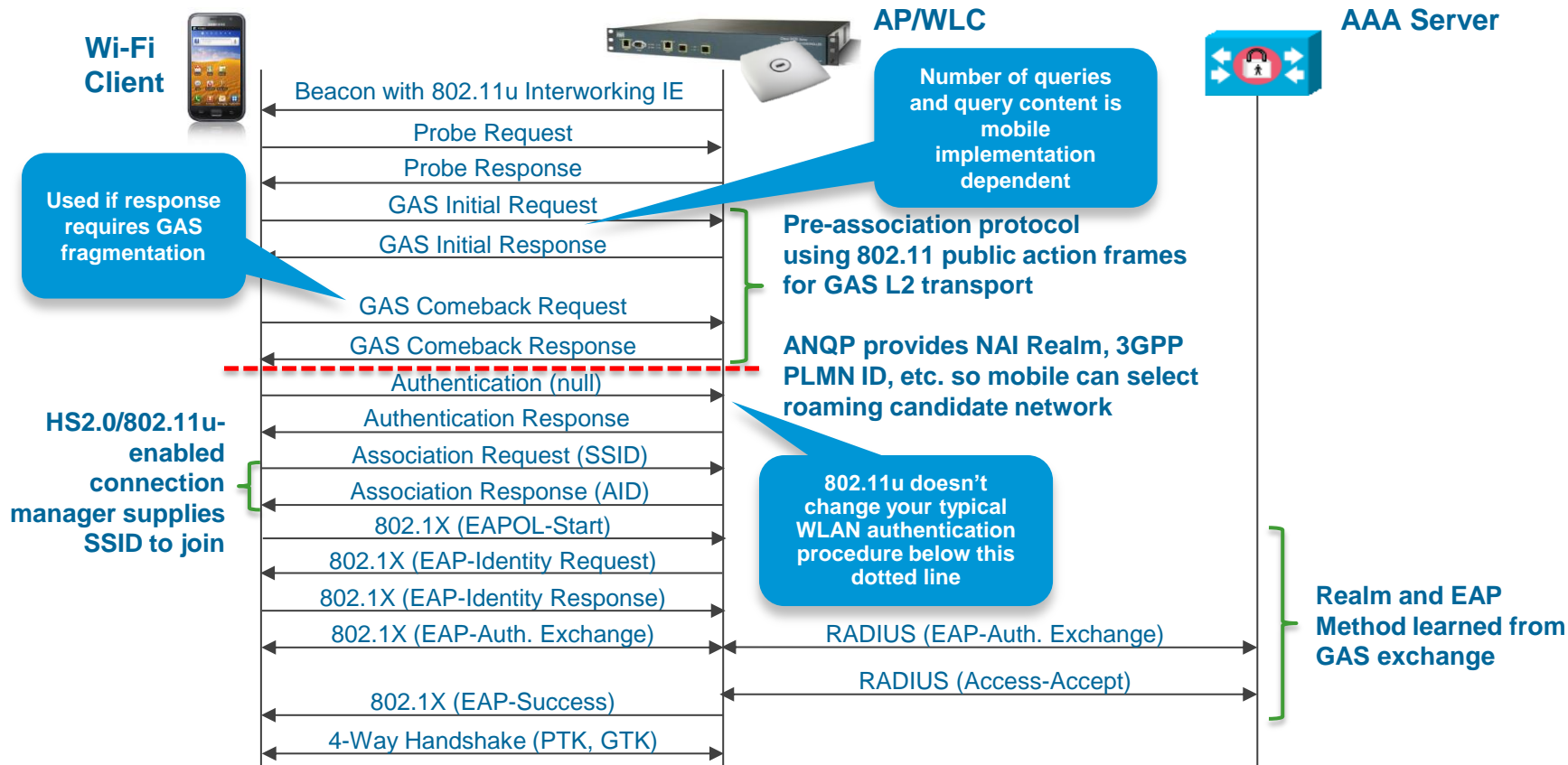
- Internet Access indicator
- Network Types
- Network Authentication Types (WebAuth)
- HESSID
- OUIs
- Realm list (EAP-Type info)
- Cellular Information list
- Domain list

HotSpot 2.0 IE

- Operator Name*
- WAN Metrics
- Connection Capability
- Operating Class

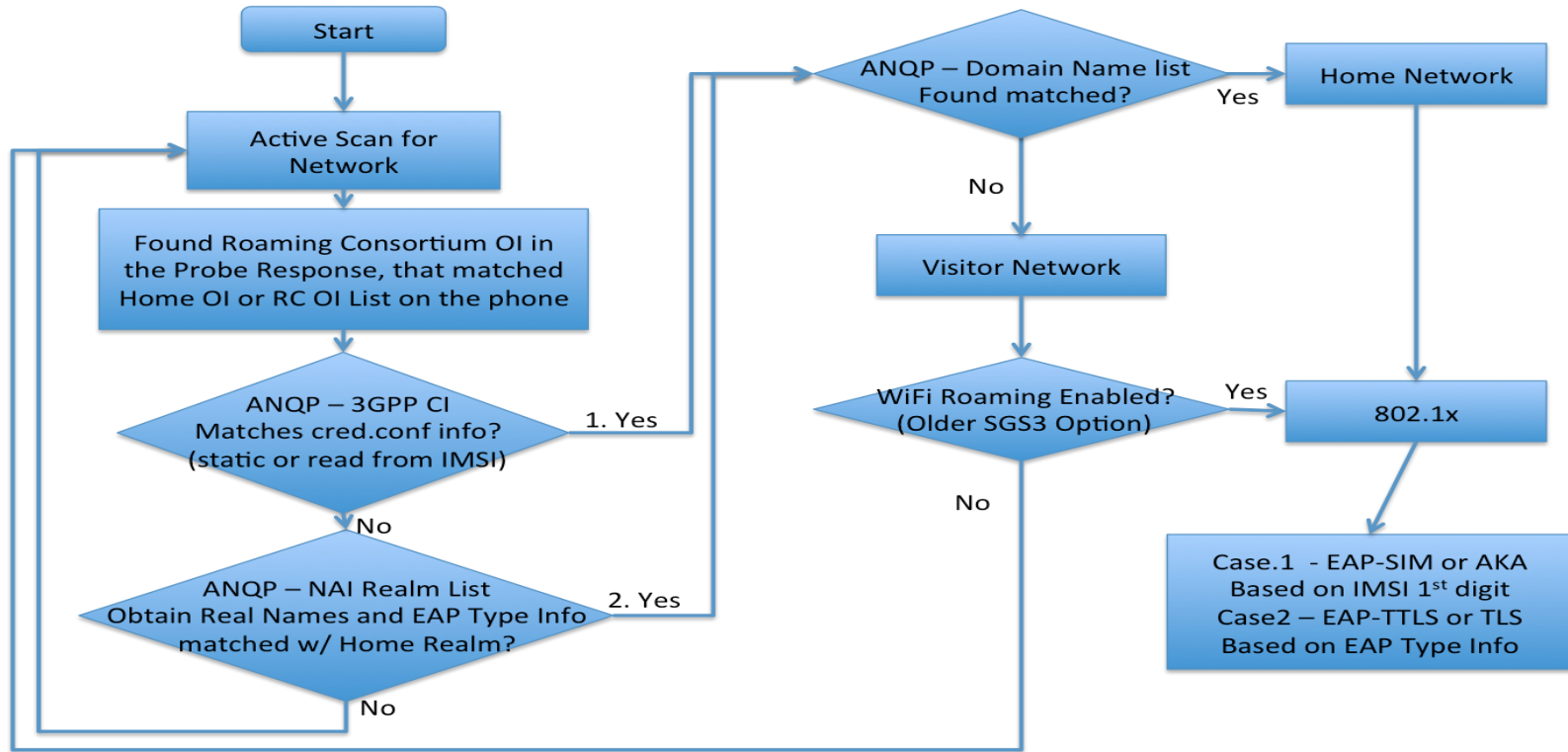
AP/WLC can sets all the IE parameters but handset connection policy may only use a subset of it

Packet Flow



Samsung WLAN

Join decision-making process



A blue-tinted image of Earth from space. The sun is visible in the upper left corner, creating a bright starburst effect. The Earth's horizon is visible on the right side, showing the curvature of the planet and some surface details like clouds and landmasses. The text "Small Cell Review" is overlaid on the left side of the image.

Small Cell Review

Cisco Mobility Portfolio Innovations



Access

SP Wi-Fi

3G Small Cell
Converged Small Cells
Mobile Backhaul Solution
with ASR 901, 901S, 903



Transport

ASR9000, CRS-1/CRS-3

Core

ASR5000, ASR5500
With Enhanced Services



Software

Quantum™

- Network Abstraction Suite
- Policy Suite
- Analytics Suite
- RAN Optimization Suite
- WAN Orchestration Suite

Cisco Mobility Solutions

Cost Effective
Coverage &
Capacity

Persistent &
Seamless
Connectivity
while
Managing
Traffic Growth

Increase Service
Creation Velocity
&
Deploy New
Service

AT&T 3G MicroCell

- AT&T 3G MicroCell launched April 2010
<http://www.wireless.att.com/learn/why/3gmicrocell/>
- Largest 3G femtocell deployment worldwide
- True zero-touch provisioning
 - Over 90% of femto installations done without customer care intervention
 - Fully automated provisioning and management control



BEST COMMERCIAL FEMTO LAUNCH

AT&T's 3G MicroCell National Deployment


“AT&T's 3G MicroCell deployment with Cisco caught the judges' eyes for two crucial reasons. First and foremost, it emphasized the importance of the customer at the heart of the femtocell experience, positioning technology very much as an enabler, rather than an end in itself. Secondly, the deployment is on a national scale, which given the US market's size adds an additional layer of complexity”, agreed the judges.




London, England - June 23, 2010

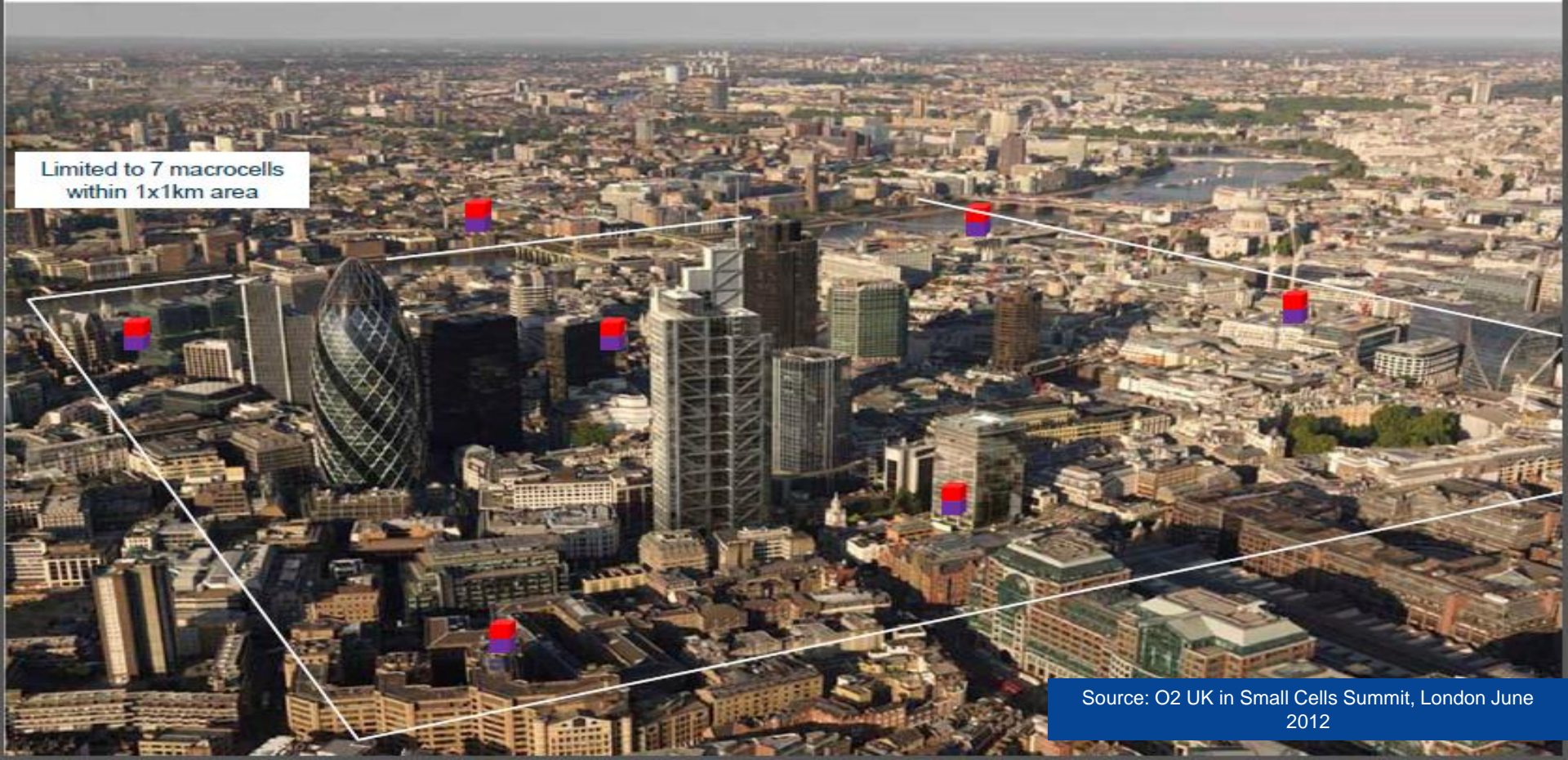
Network 2011

 3G Macrocell

 2100 MHz (1) – 1st carrier

 2100 MHz (2) – 2nd carrier

Limited to 7 macrocells
within 1x1km area

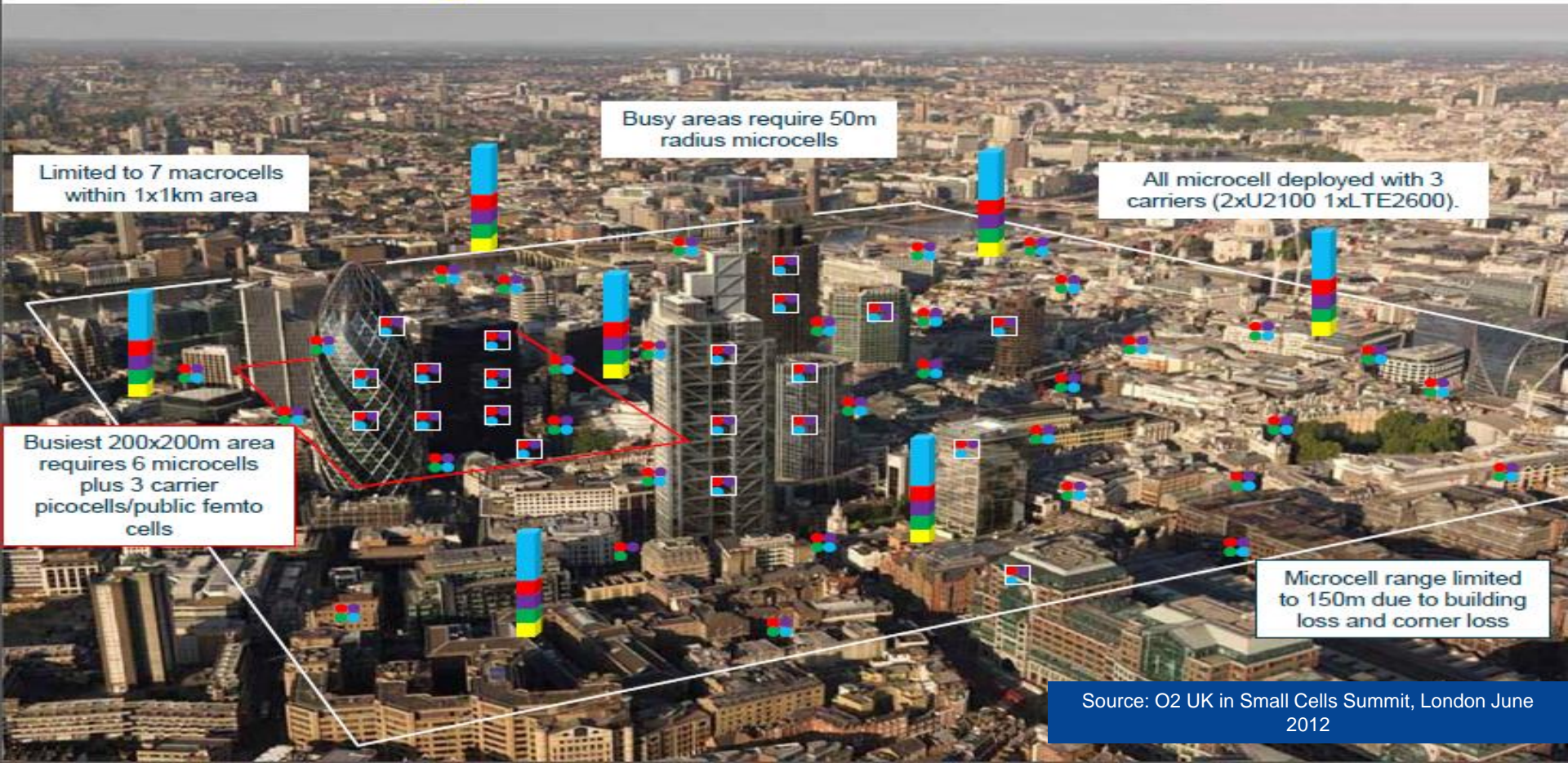


Source: O2 UK in Small Cells Summit, London June 2012

Network 2015



- 2100 MHz (1)
- 2100 MHz (2)
- 800/1800/2600 MHz
- 900 MHz (1)
- 900 MHz (2)



Limited to 7 macrocells within 1x1km area

Busy areas require 50m radius microcells

All microcell deployed with 3 carriers (2xU2100 1xLTE2600).

Busiest 200x200m area requires 6 microcells plus 3 carrier picocells/public femto cells

Microcell range limited to 150m due to building loss and corner loss

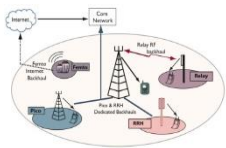
Cisco Small Cell Solution



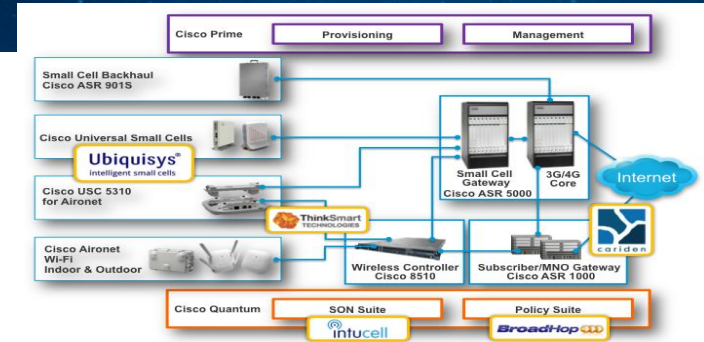
Comprehensive,
Intelligent 3G/LTE/Wi-Fi
Small Cells



Minimize deployment
OPEX with zero/low
touch provisioning

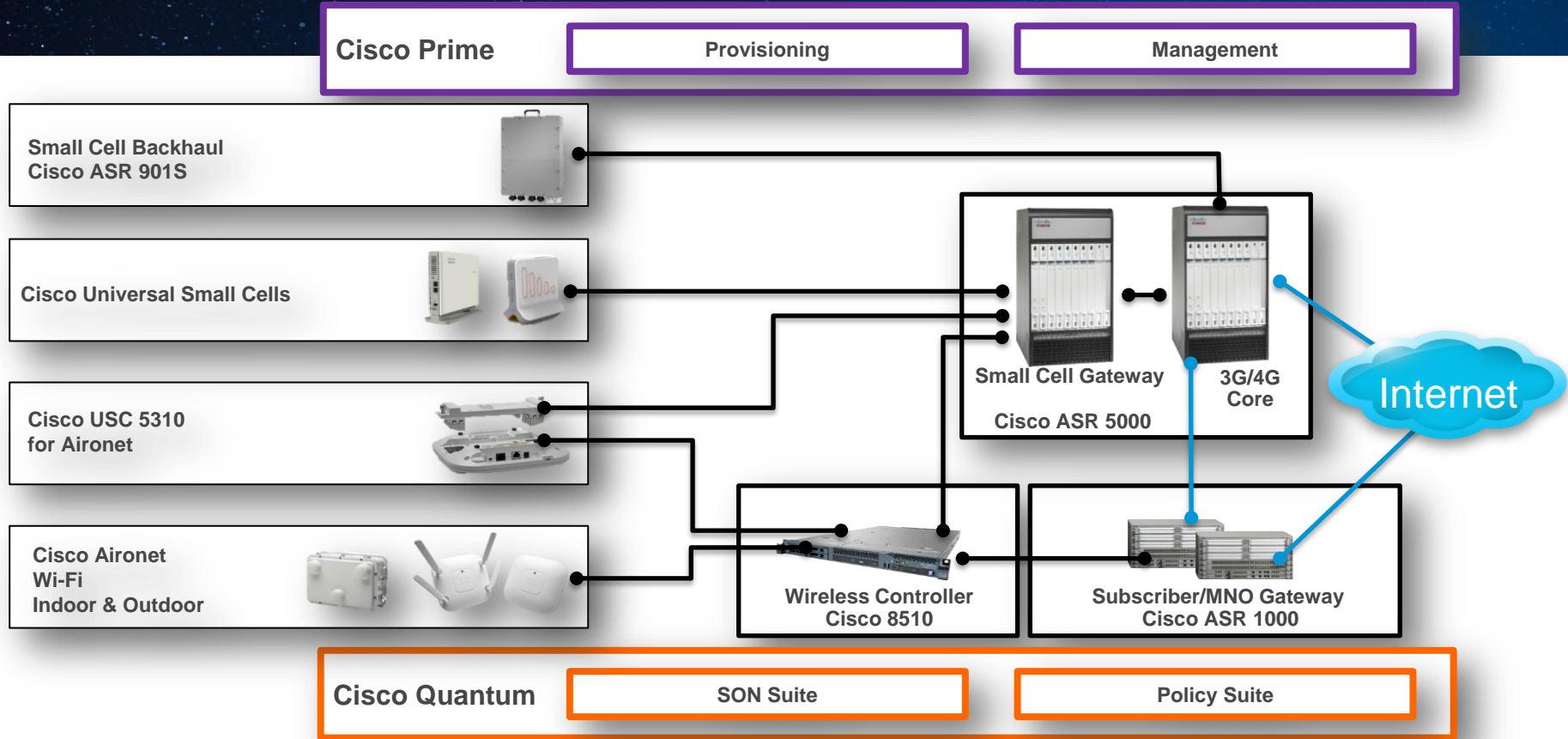


Best of breed SON solution
ensuring Macro radio co-
existence



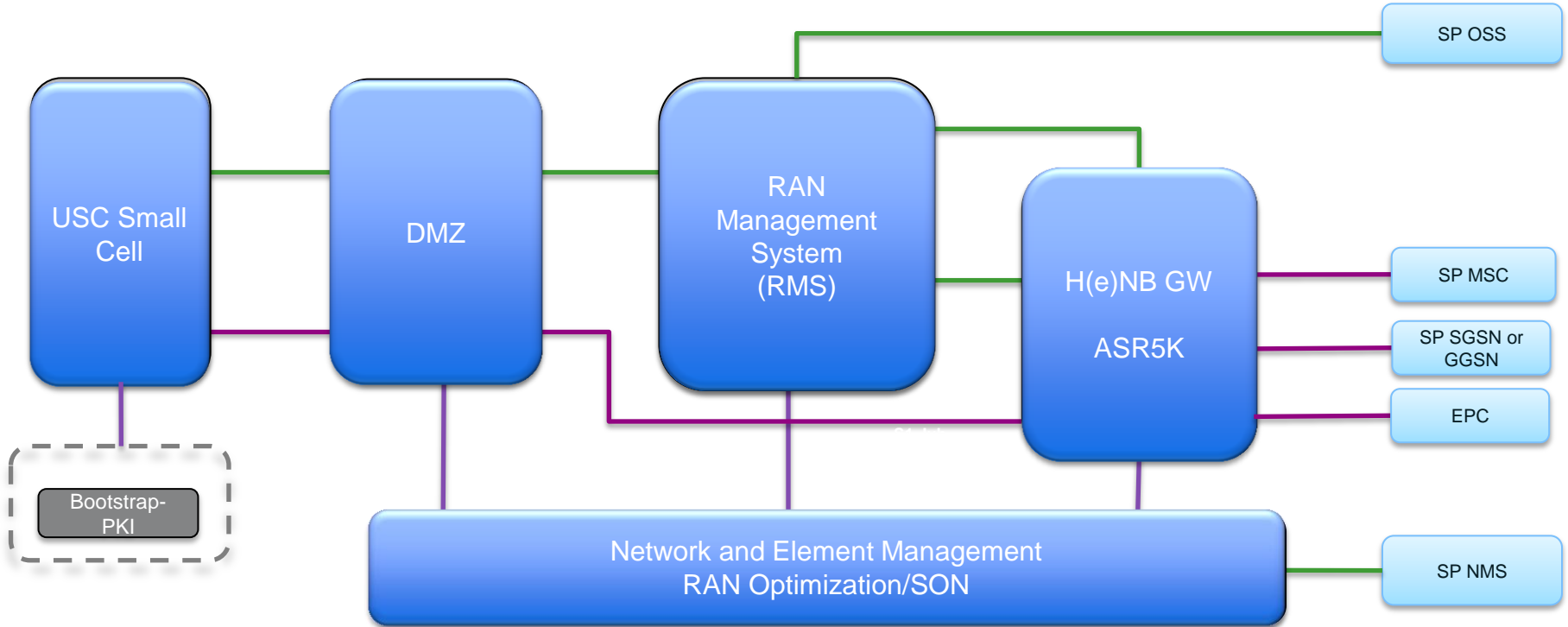
- Built on industry standards; 3GPP architectures
- Innovative features and capabilities solving coverage & capacity challenges
- Proven optimization & monetization models with robust Policy & Subscriber services
- End-to-end, validated, carrier-grade network solutions (radio, access, backhaul, core, policy/charging)

Cisco Small Cell Architecture

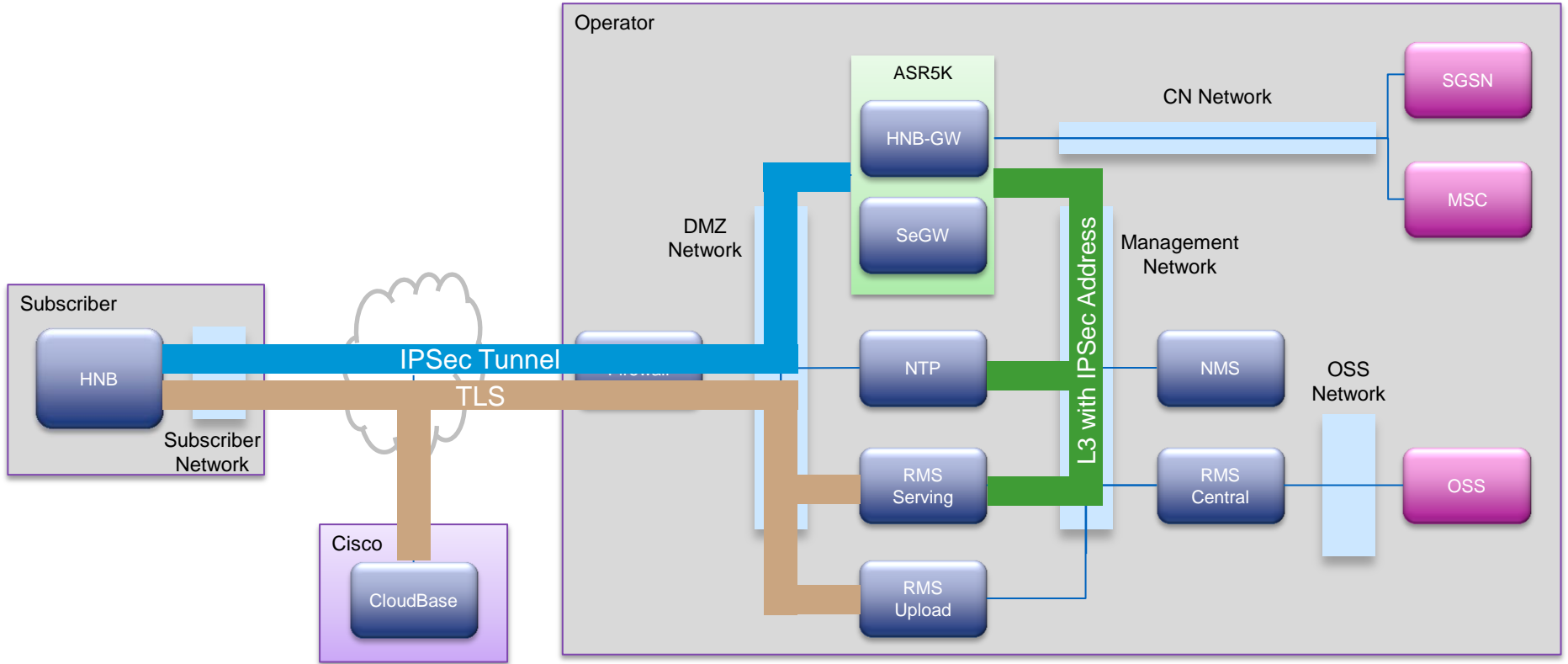


Small Cell Solution

Reference Solution Architecture



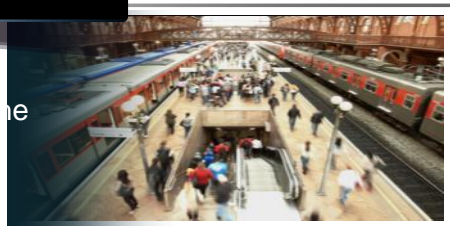
Small Cell Typical Connectivity



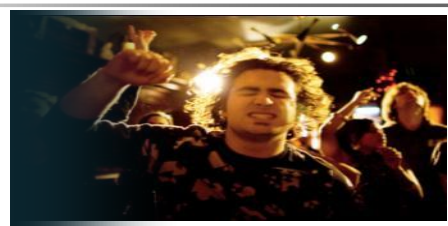
Cisco Universal Small Cell Series

USC 7000 Series

Concourse

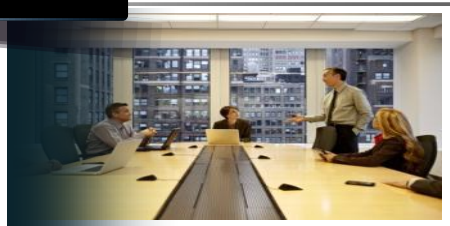


Venue



USC 5000 Series

Enterprise



Hotspot



USC 3000 Series

Home



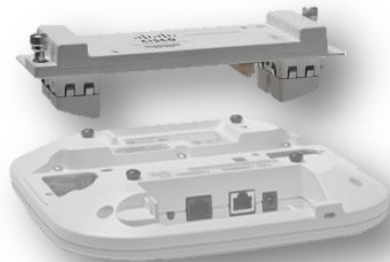
Small Office/
Home Office (SoHo)



3G Small Cell Module for Aironet AP3600 Series

USC5310 Product Description - 3G/HSPA+ Plug-in Module

Available
Today!



AIRONET 3600

3G HSPA+ -
21Mbps/5.7Mbps
<100mW/20dBm EIRP
16 Active Users

- 16 User 3G Open Mode Module
- <100mW Transmit Power (same as ETSI 802.11)
- Compatible with 3600i/3600e Wi-Fi
- Power provided by the Aironet through PoE+ (IEEE 802.3at) or external PSU.
- R99 WCDMA Voice Calls
- HSDPA+ 21Mbps / HSUPA 5.76Mbps (Peak Rates)*
- Available in 3GPP I (Rest of World) and Band II/V (USA/LATAM)

Product Offer – 3G + Wi-Fi	
Capability	3G/HSPA + 802.11n
RF	Band II/V or I 802.11n 2.4/5GHz
RF Power	100mW at Ant. Port
Antenna	1x1 SISO 802.11n 4x4 3SS / Beamforming
RF BW	5 MHz
Base Platform	USC Software Platform
3G Throughput	21/5.7 Mbps HSDPA+ (peak rate)*
3G Feature Set	16 Active users; 200 idle ;3GPP R99 & R8 HSDPA+ ; Iuh / TR-069, TR-196v1, Open Mode
Mobility	3G Active CS/PS and Idle Mode Reselection
SON / HetNet	3G : Network Listen 802.11 : Clean Air
Power Supply	Provided by the Aironet Product
Size / Weight	1.5L ; 1.4kg (complete unit)
Deployment	Desk/Wall/Ceiling

* SCS 2.0 Supports 14 codes = ~15 Mbps Peak Rate

USC 5030 Dual Module Holder

Available
Next Month!



Target FCS – May 2014

22 x 22 x 6 cm; ~1kg

- Module holder only
 - 1x GbE RJ45 ports
- Provides 2x10W via Cisco module connector
- Module Configurations
 - 1x3G
 - 1xLTE (When available)
 - 2x3G (Planning)
 - 2xLTE (When available)
 - 1x3G + 1xLTE (When available)
- Power PoE+ and/or 48V DC
- Compatible with USC 5310 and USC 541x

USC5416 LTE Module

Available
December!



- Partner to USC 5310 Module
- Module supports (auto-selects)
 - 1x1 SISO with 6W PSU (AP3600/AP3700)
 - 2x2 MIMO with 10W PSU (USC5030)
- LTE FDD
 - Upto 20 MHz iBW
 - 16 Active Users
 - 128 RRC Connected Users
- 100mW Output Power

Target FCS – December 2014

	USC5416 Americas	USC5416 Rest of World	USC5416 Global	USC5426 TD-LTE
LTE	Band 4	Band 3	Band 1/3/7	Band 38
NWL LTE NWL 3G NWL GSM	Band 4/7/12/13 Band 2/5 GSM 850/1900	Band 1/3/7/20 Band 1/8 GSM 900/1800	Band 1/3/7/20 Band 1/8 GSM 900/1800	Band 1/3/7/20 Band 1

Standard Module Size; ~500g

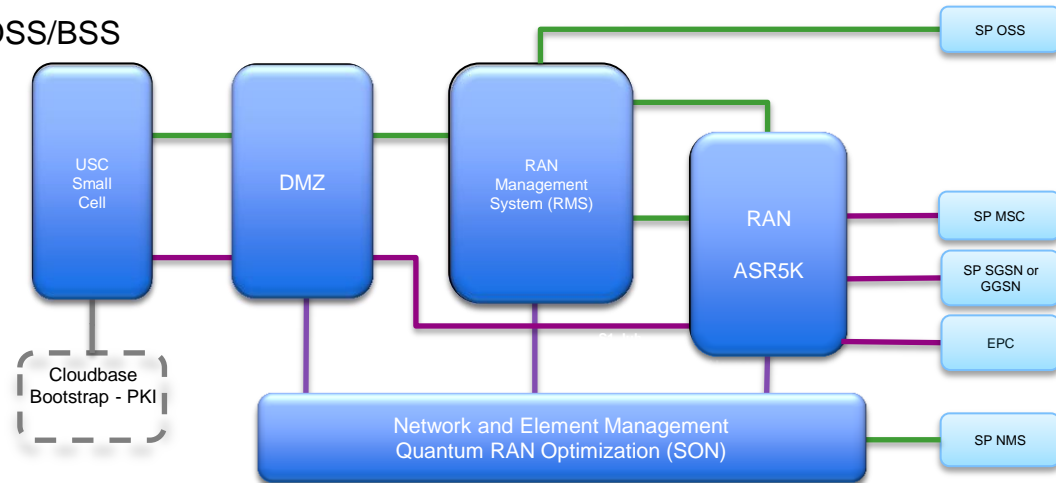
RAN Management Solution (RMS)

RMS provides a standard based, scalable solution for Cisco Universal Small Cell Solution

- Lower time to deployment and OPEX
- Provides a centralized management entity for the small cell network
- Easy to use graphical applications in user interface
- Based on Commercially available HW
- Provides interfaces and integration API for OSS/BSS

Key Functions of RMS

- Activation of Access Points
- Configuration of Access Points
- Software upgrade of Access Points
- Status monitoring of Access Points
- Collection of raw AP KPI data
- Access to AP alarm data
- Troubleshooting of Access Points
- RADIUS service for AP auth on HNB-GW and whitelist
- DHCP service for allocating IPsec addresses



Cisco Small Cell AP-SON Capabilities

Self-Configuring

Zero-Touch Activation

Self-Optimising

Cognitive RRM Algorithms

Self-Healing

Advanced System Monitoring

Cisco AP-SON Capabilities

Device Activation & Automatic Network Connectivity

Network Listen Mode

Automatic Carrier & PSC/PCI Selection

Initial Power Settings

Automatic Neighbour Relations Generation

IP Timing/Macro Synchronisation

SW Upgrade & Initialisation

Configuration Profiles

Backhaul DL/UL Bandwidth Determination

Continuous Network Listen

Optimisation of Carrier & PSC /PCI Selection

Dynamic DL/UL Power Adaptation

Automatic P-CPICH/Common Reference Signal Power Tuning

UE Targeted DL/UL Power Overshoot

Automatic Neighbour Relations Management

Backhaul DL/UL Bandwidth Tracking

Adaptive UL Traffic Shaping

HW & SW Fault Detection

SW Process Restarts

Chip Restarts

Factory Recovery

Adaptation of Power Settings & Neighbour Relations

Determination of, & Fast Restart Following Backhaul Failures

Load Control/Balancing in Response to Available Backhaul Bandwidth

ActiveRadio® In Action

Self-Configuration & Self-Optimisation

- 1 Power on**
Load correct software & basic connectivity parameters from CloudP...



2

- (Optional)
Location locking
Initial environment scan & optional GPS location



3

- (Optional)
Local spectrum license
Management boot inform & further provisioning



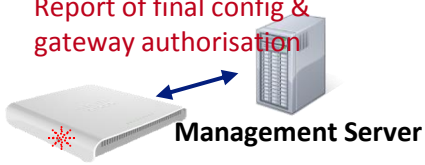
4

- Full environment scan & configuration**
Select frequency, PSC/PCI & initial power. Populate neighbour list & configure cell stickiness



5

- System authorisation**
Report of final config & gateway authorisation



6

- Enable radio & operational for calls**



7

- Auto power & rate adaptation**
Using information gathered from UEs



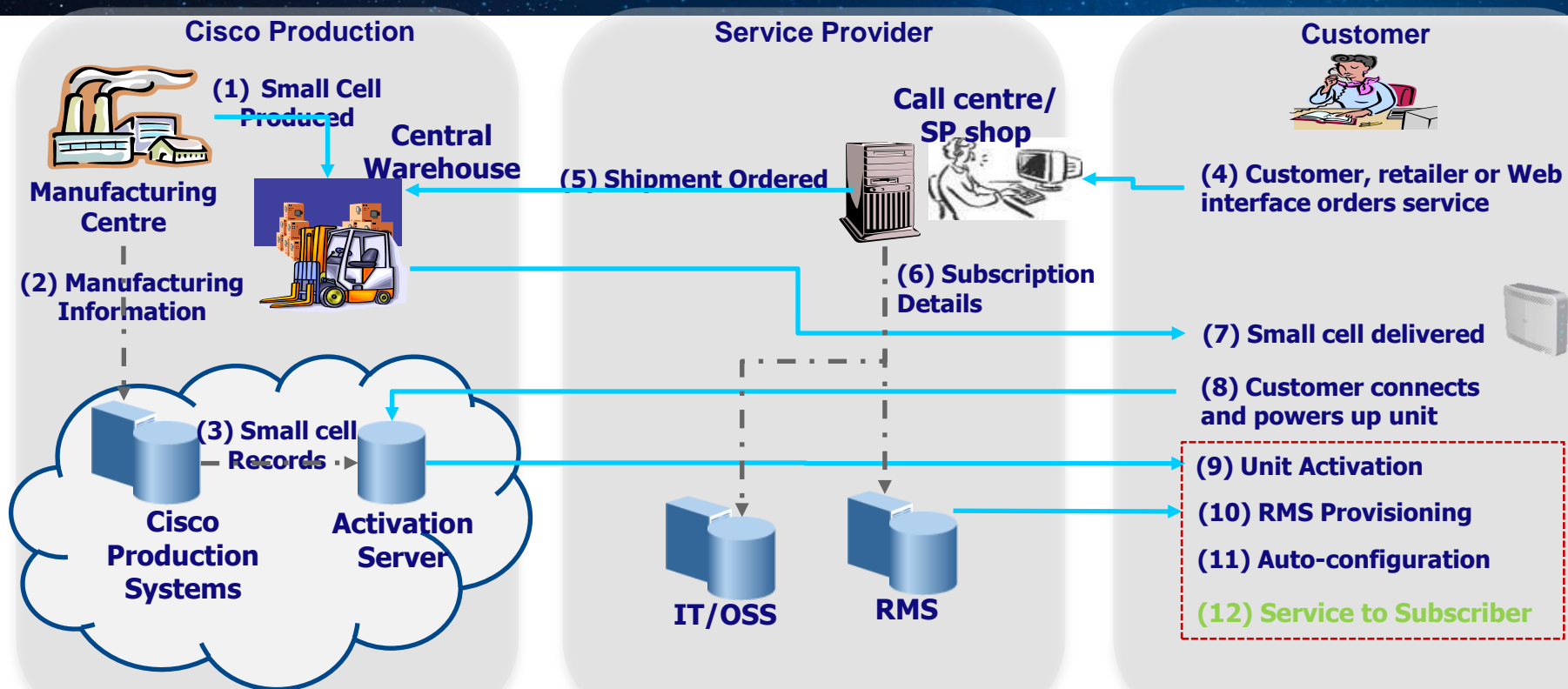
8

- Continuous network listen**
Periodic interference level checks. Ongoing environment adaptation whilst in service



Cloudbase® Activation

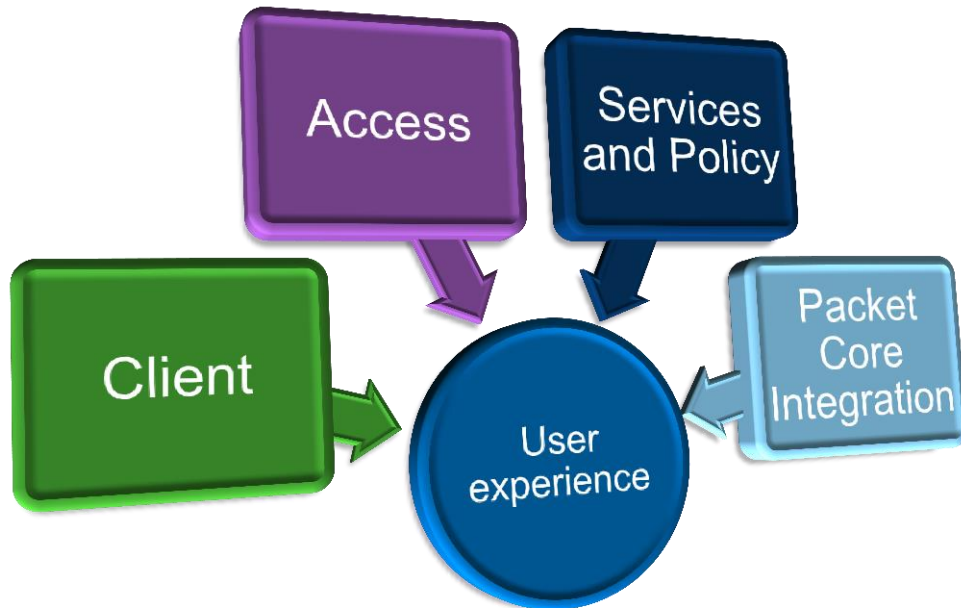
- from factory to subscriber service



A blue-tinted image of Earth from space, showing the curvature of the planet and a bright sun in the upper left corner. The sun is a bright white star with a blue lens flare effect. The Earth's surface is visible in shades of blue and white, with some cloud cover. The background is a dark blue space.

Packet Core Integration Options for SP-WiFi

Building a User-centered Solution



SP Wi-Fi Experience - User Endpoint (UE)

User Endpoint is a subscribers carrier experience

Coverage, Performance, Ease of use

Seamless

Authentication
Network Roaming
Session Roaming
Policy Roaming

Goals:

- Seamless Roaming across many providers networks (HS 2.0)
- Zero Configuration (ANDSF)
- Zero footprint (Client Less)
- Support no-UE devices





Authentication Options

EAP-SIM
EAP-AKA
WISPr
Web Logon
MAC TAL

Standards

ANDSF
HS 2.0

WiFi Passpoint vs. ANDSF

	WiFi Passpoint	ANDSF
Using		
What	Operator Roaming(11u) Network Quality & Info(HS20) WiFi enhancement Security enhancement	Operator Roaming Network Quality & Info WiFi enhancement
How	.11u Probe Scanning ANQP Combine 802.1x supplicant	3G-to-WiFi Offload based on Location (GPS Co-ordination) 802.11 SSID (BSSID,ESSID,HESSID)
By	WiFi Alliance, Passpoint Certification	3GPP Passpoint Certification

Cisco SP Wi-Fi Services & Policy Enforcement



Identify



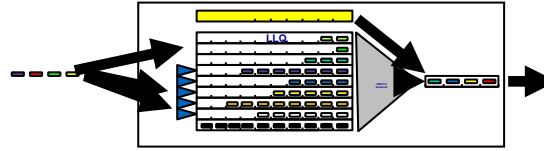
Policing



Forwarding



Authorize



QoS



Accounting

Wireless Access Gateway (WAG) Routers



ASR5K



ASR9K



ASR1K



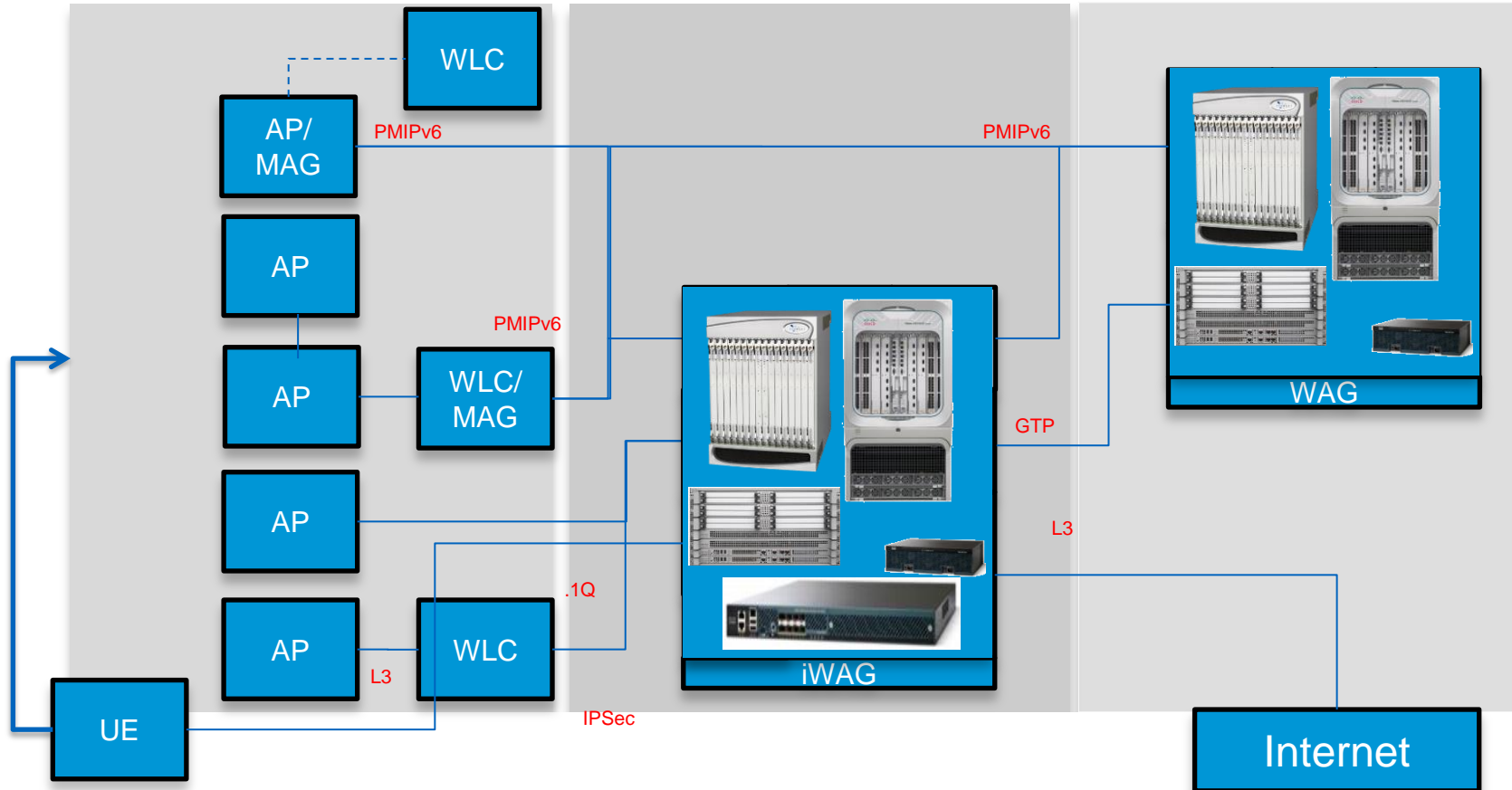
Carrier-Grade

Cisco SP WiFi xWAG – Family of Products

Access

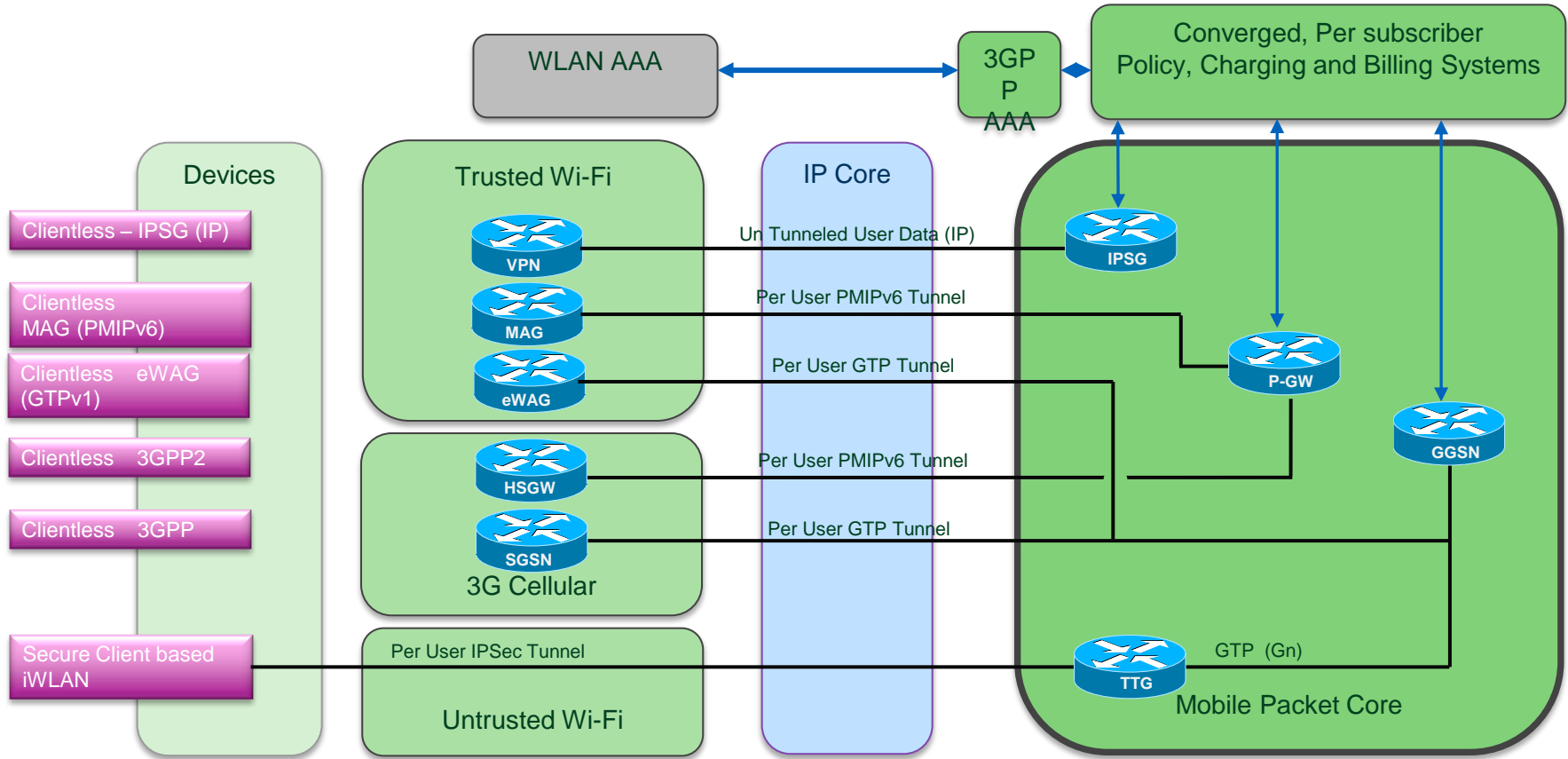
Service Edge

Mobile Core



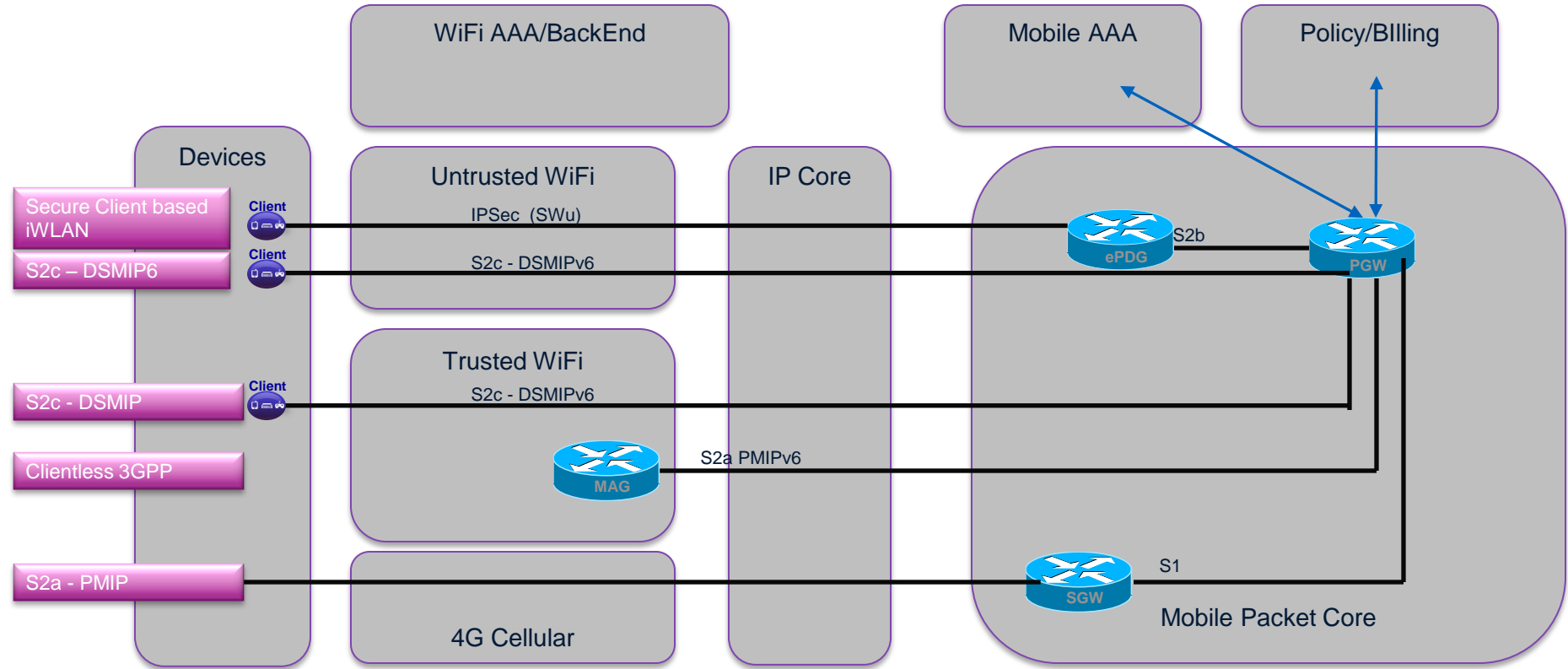
Mobile Packet Core Integration: WiFi into 3G Packet Core

All Client-less and Client-based configurations supported

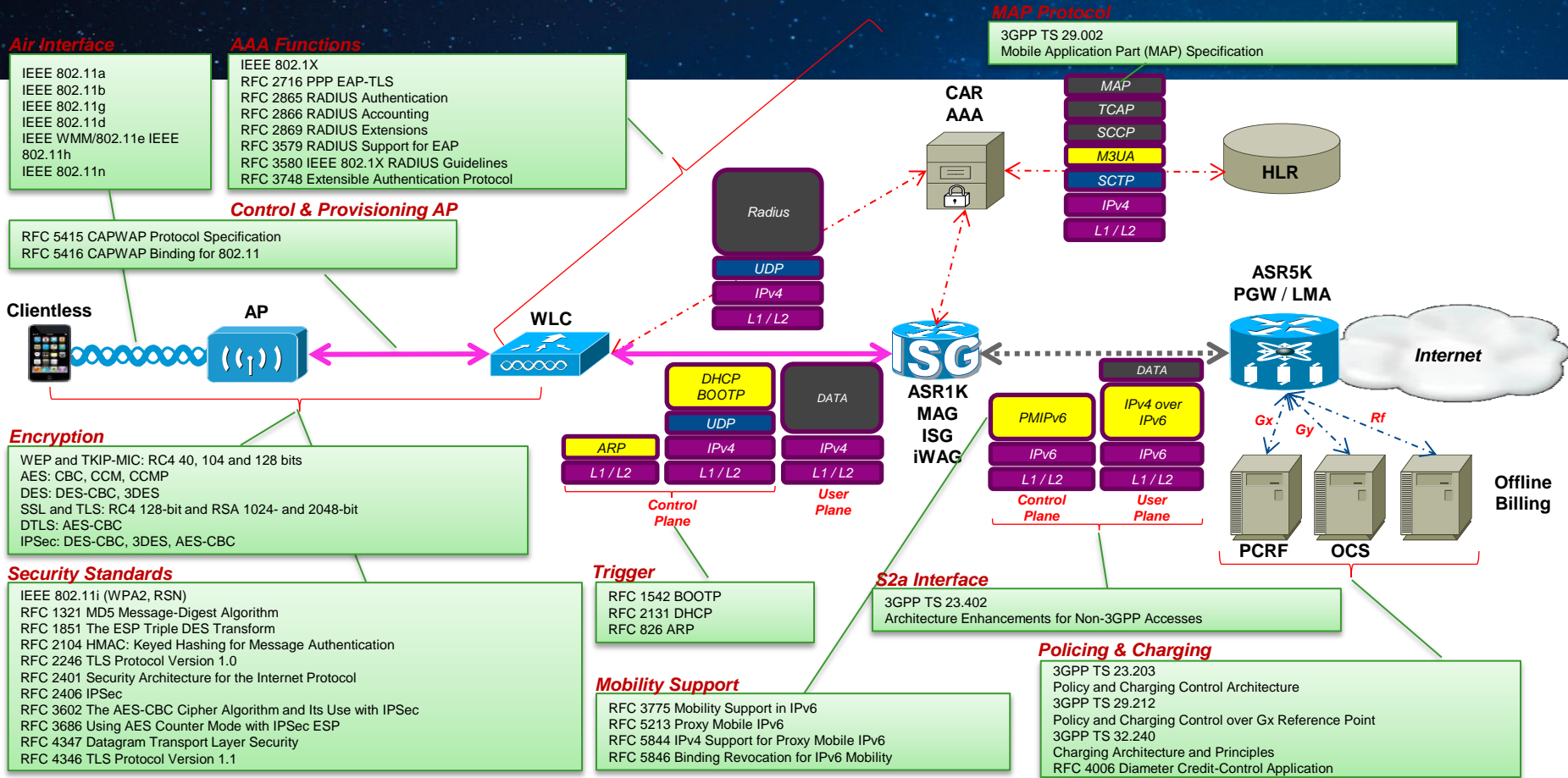


Mobile Packet Core Integration: WiFi into 4G Core

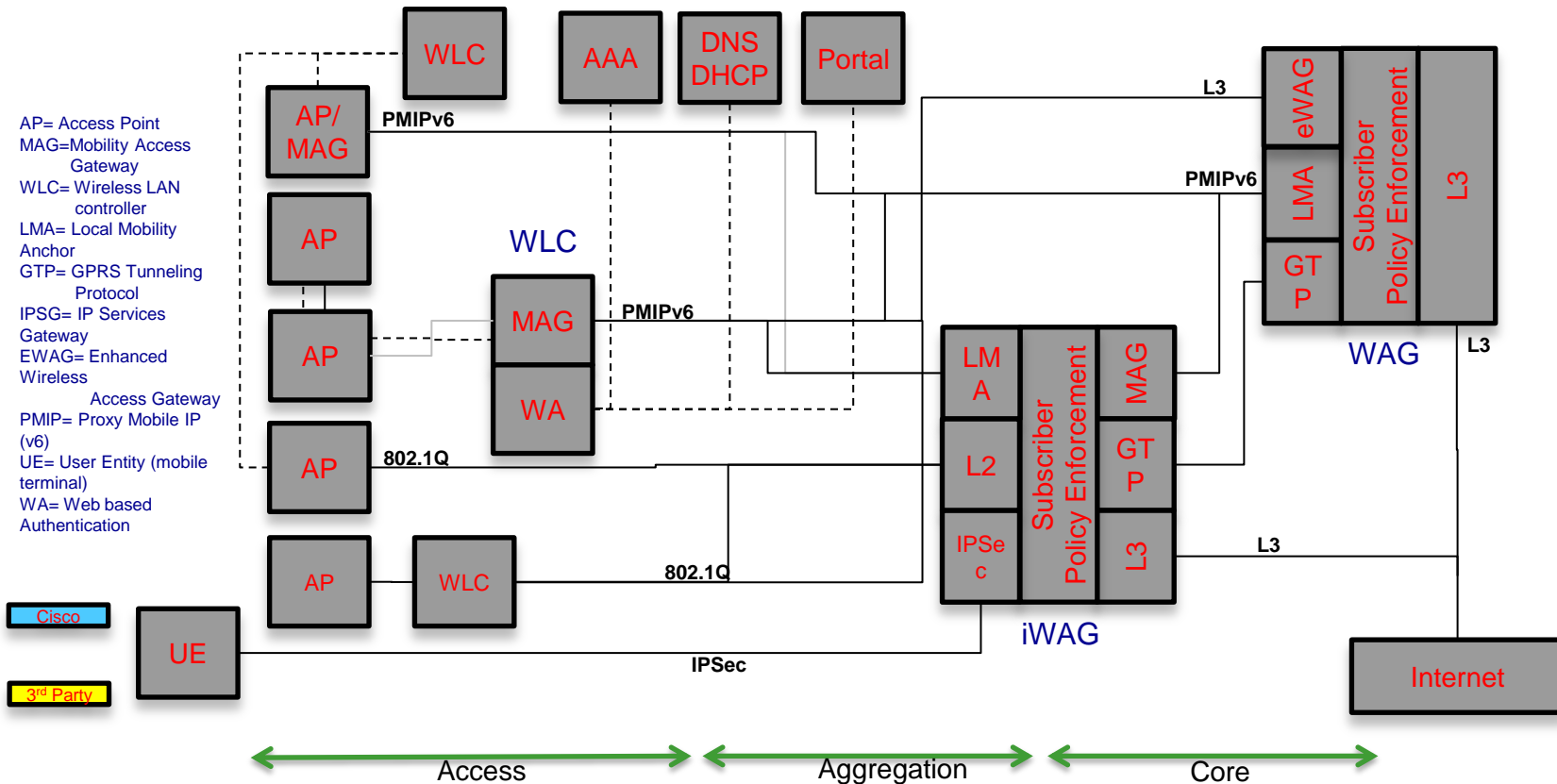
All Client & Client-less options supported



Cisco SP Wi-Fi Solution Standards



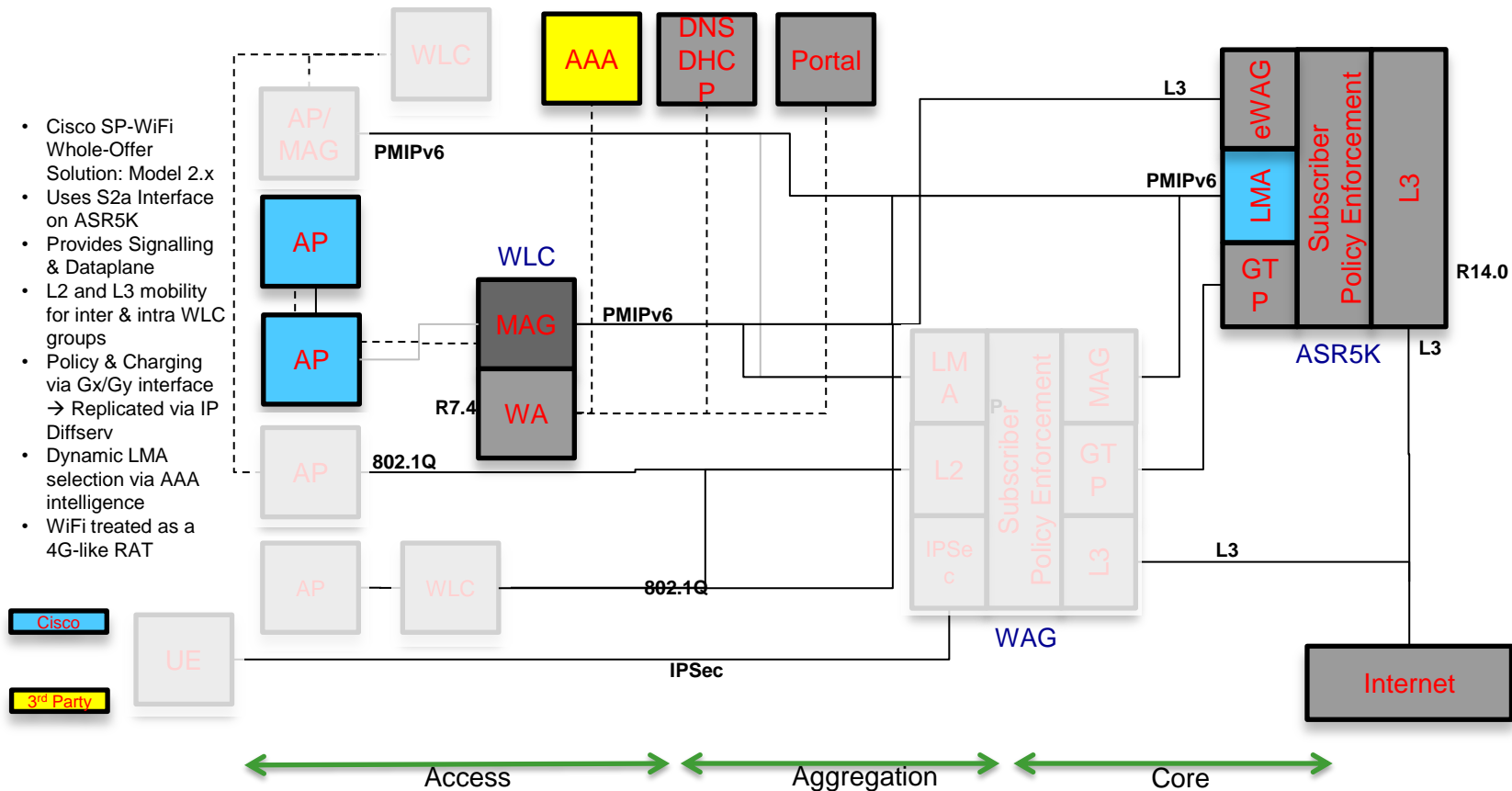
Cisco SP WiFi Functional Building Blocks



Use-Case 1: S2a access for 4G

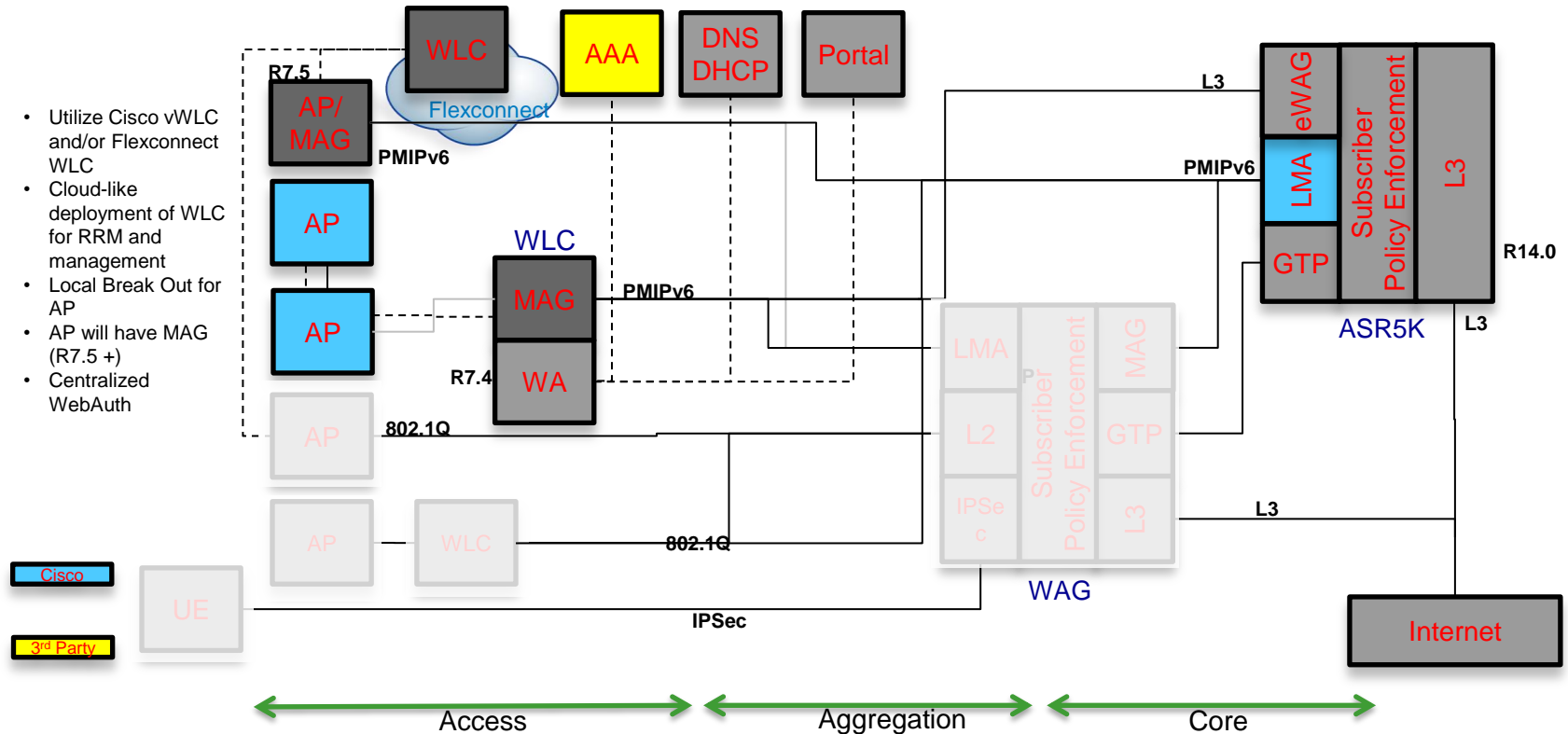
MAG on WLC, LMA on ASR5K: architecture for S2a

- Cisco SP-WiFi Whole-Of-Fer Solution: Model 2.x
- Uses S2a Interface on ASR5K
- Provides Signalling & Dataplane
- L2 and L3 mobility for inter & intra WLC groups
- Policy & Charging via Gx/Gy interface → Replicated via IP Diffserv
- Dynamic LMA selection via AAA intelligence
- WiFi treated as a 4G-like RAT



Use-Case 1.5: S2a access for 4G

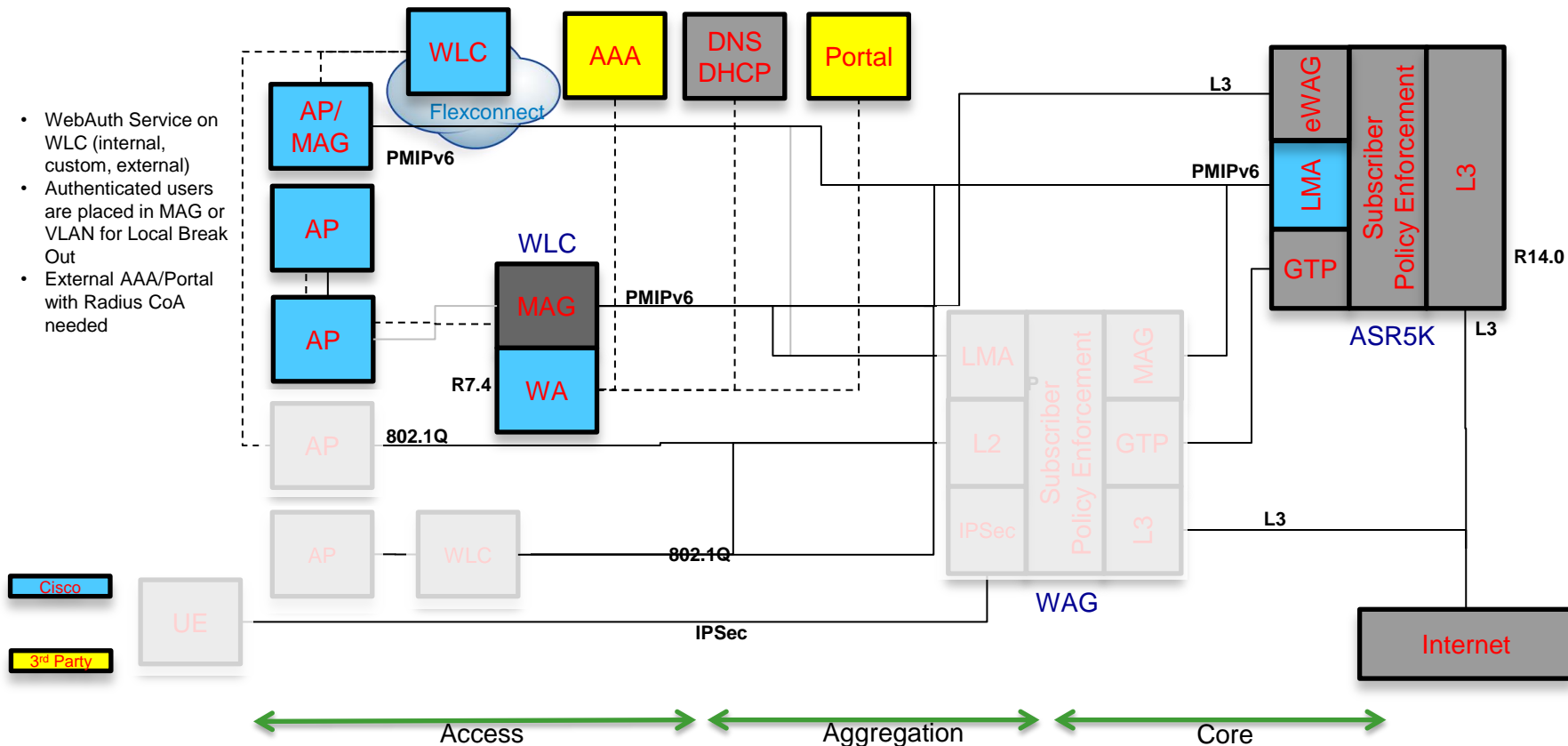
MAG on AP, LMA on ASR5K: architecture for S2a



Use-Case 1.7: WebAuth + S2a access for 4G

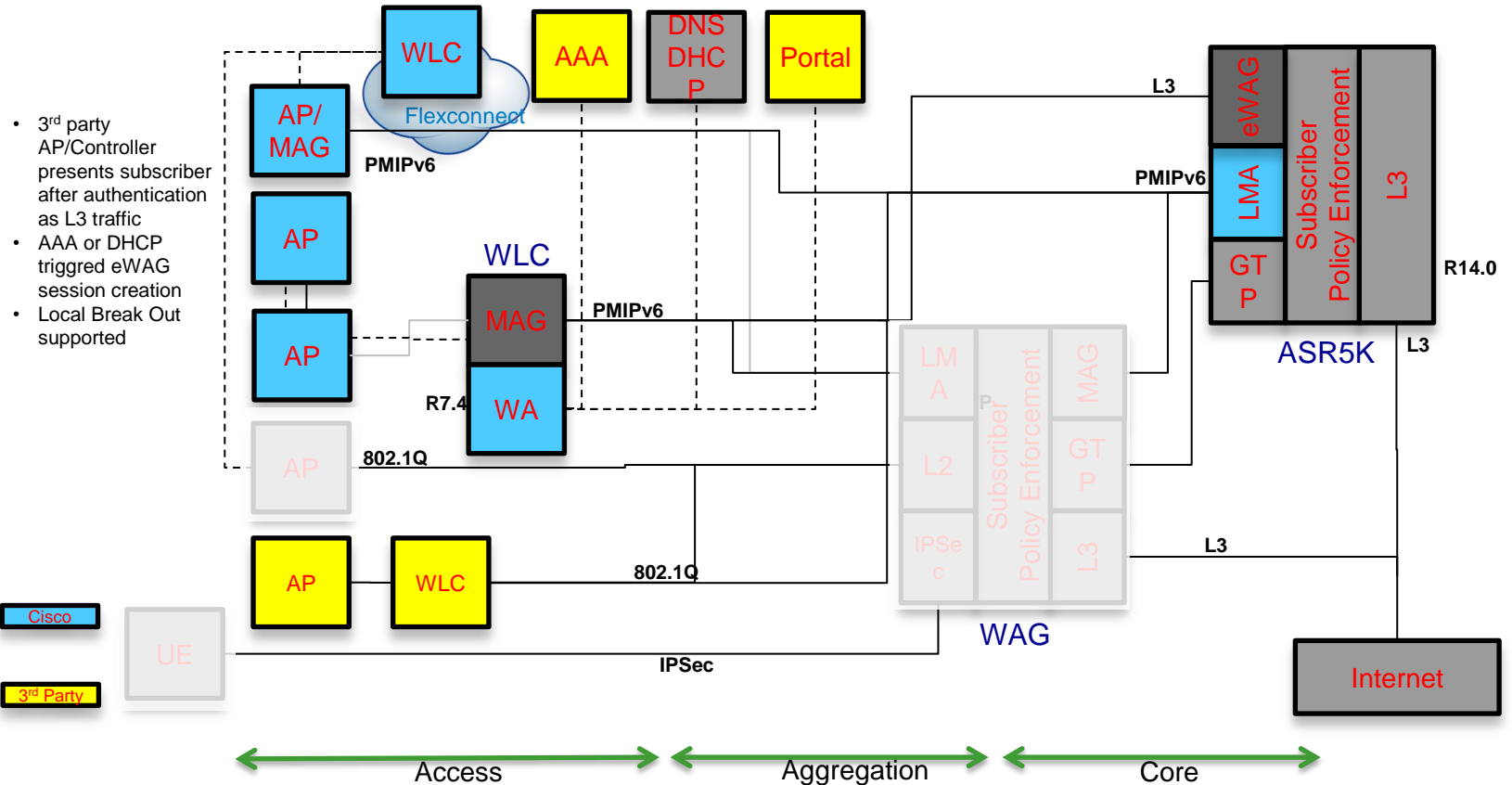
MAG & WebAuth on WLC, LMA on ASR5K: architecture for S2a

- WebAuth Service on WLC (internal, custom, external)
- Authenticated users are placed in MAG or VLAN for Local Break Out
- External AAA/Portal with Radius CoA needed



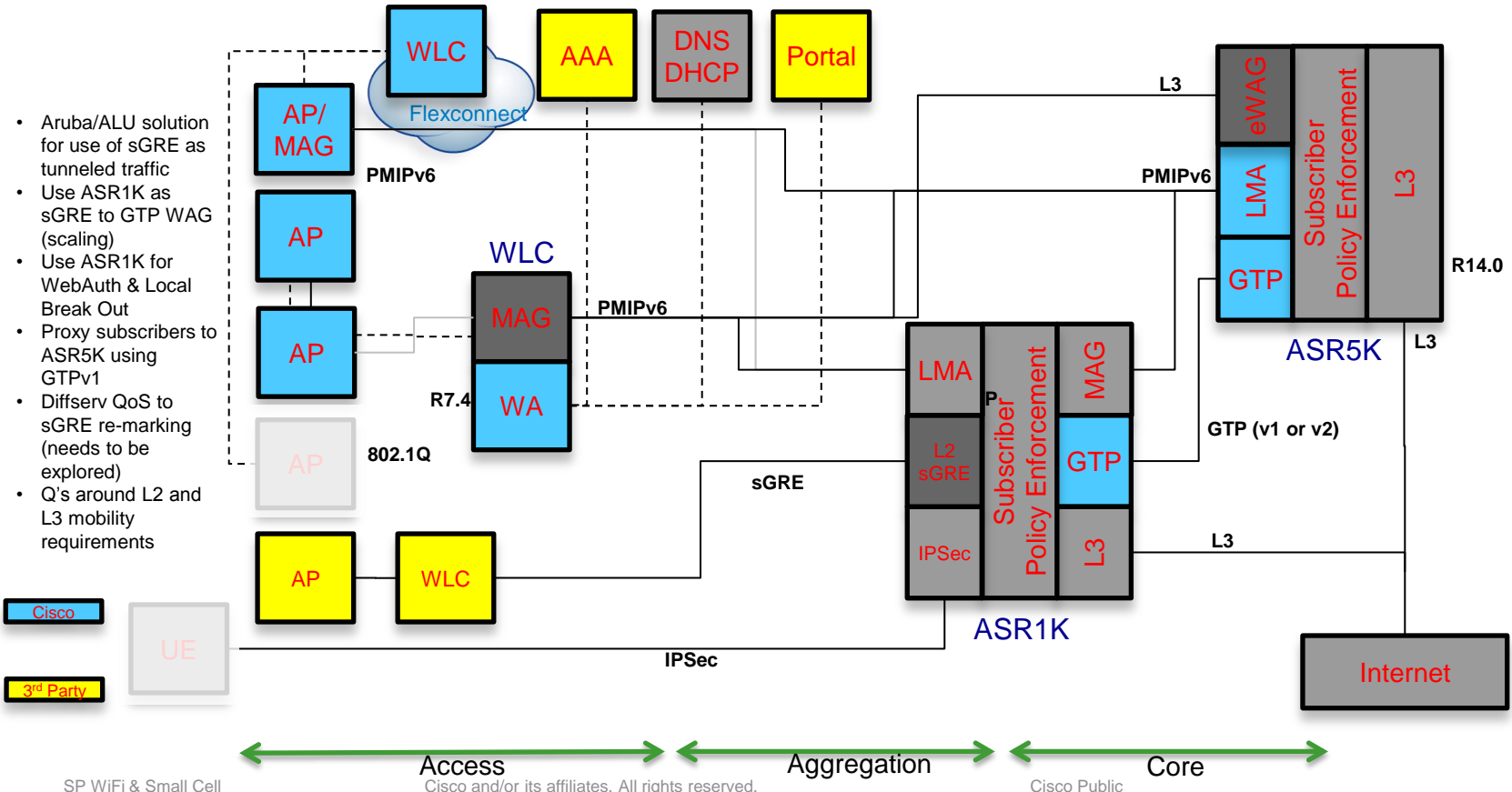
Use-Case 2.1: eWAG for 3rd Party WiFi

IP Native on 3rd Party WLC, eWAG on ASR5K



Use-Case 2.2: sGRE, GTP for 3rd Party WiFi

sGRE 3rd Party WLC, ASR1K, GTPv1 on ASR5K

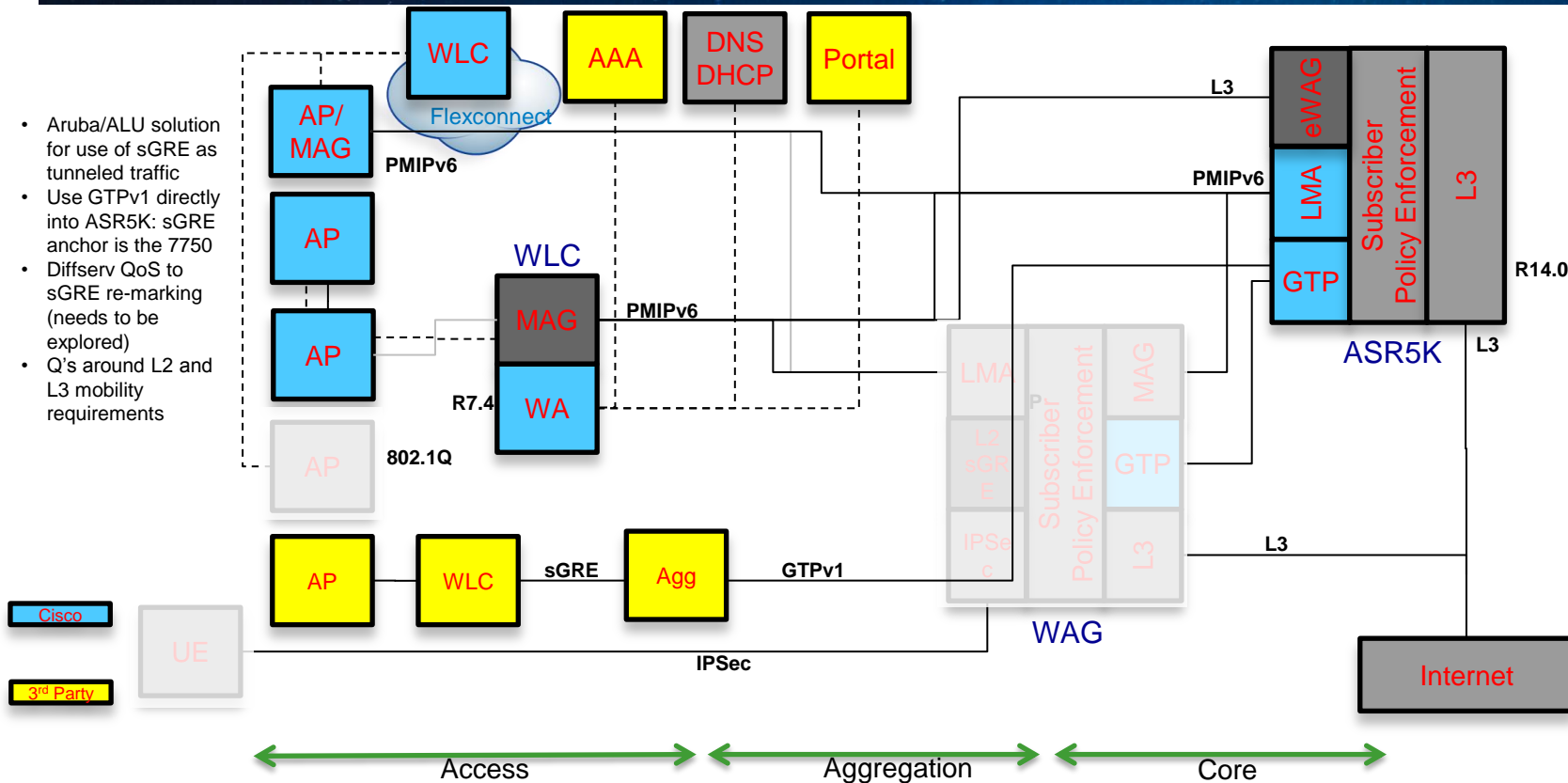


- Aruba/ALU solution for use of sGRE as tunneled traffic
- Use ASR1K as sGRE to GTP WAG (scaling)
- Use ASR1K for WebAuth & Local Break Out
- Proxy subscribers to ASR5K using GTPv1
- Diffserv QoS to sGRE re-marking (needs to be explored)
- Q's around L2 and L3 mobility requirements

Use-Case 2.3: GTP for 3rd Party WiFi

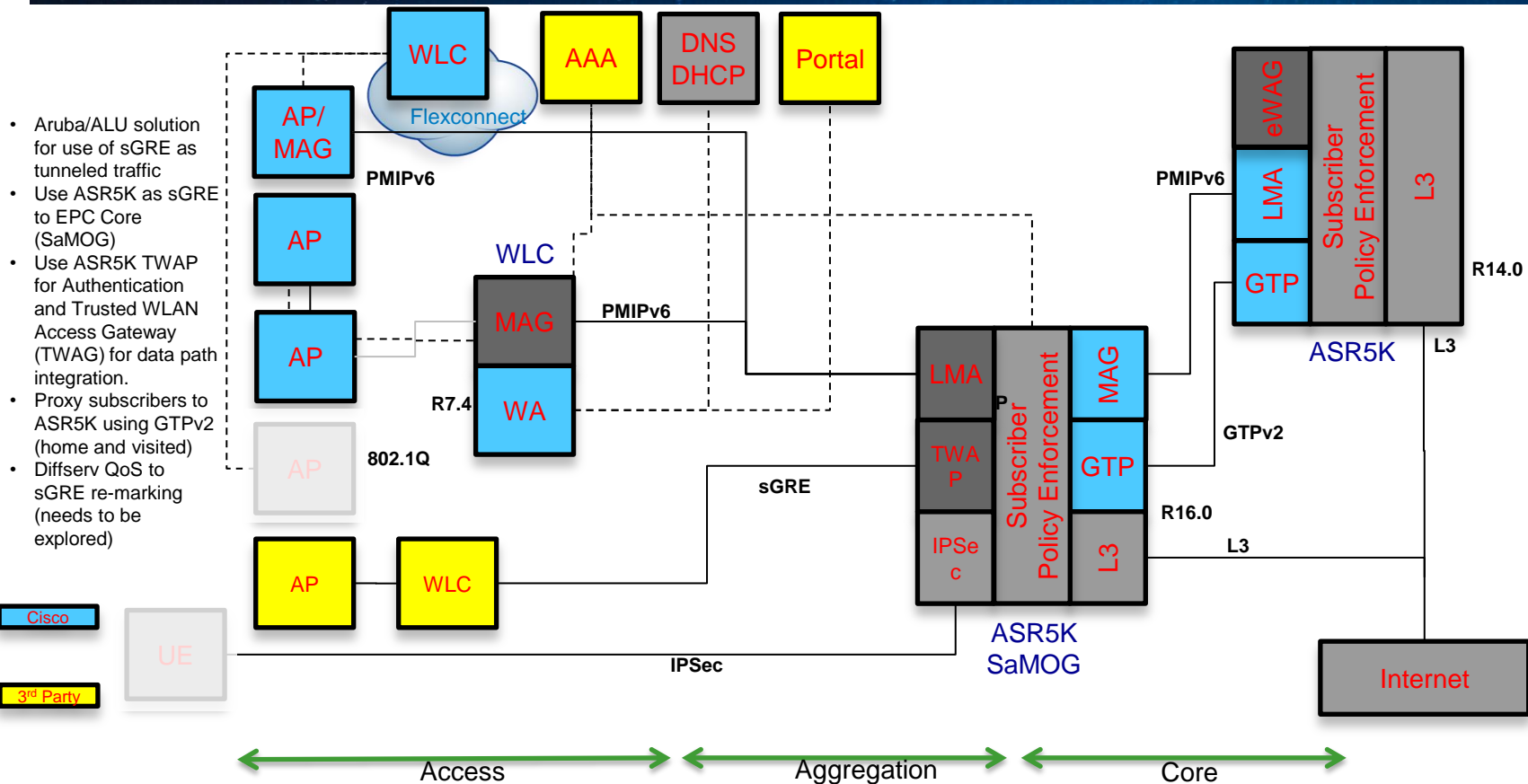
GTP via 3rd Party ePDN, ASR1K, GTPv1 on ASR5K

- Aruba/ALU solution for use of sGRE as tunneled traffic
- Use GTPv1 directly into ASR5K: sGRE anchor is the 7750
- Diffserv QoS to sGRE re-marking (needs to be explored)
- Q's around L2 and L3 mobility requirements



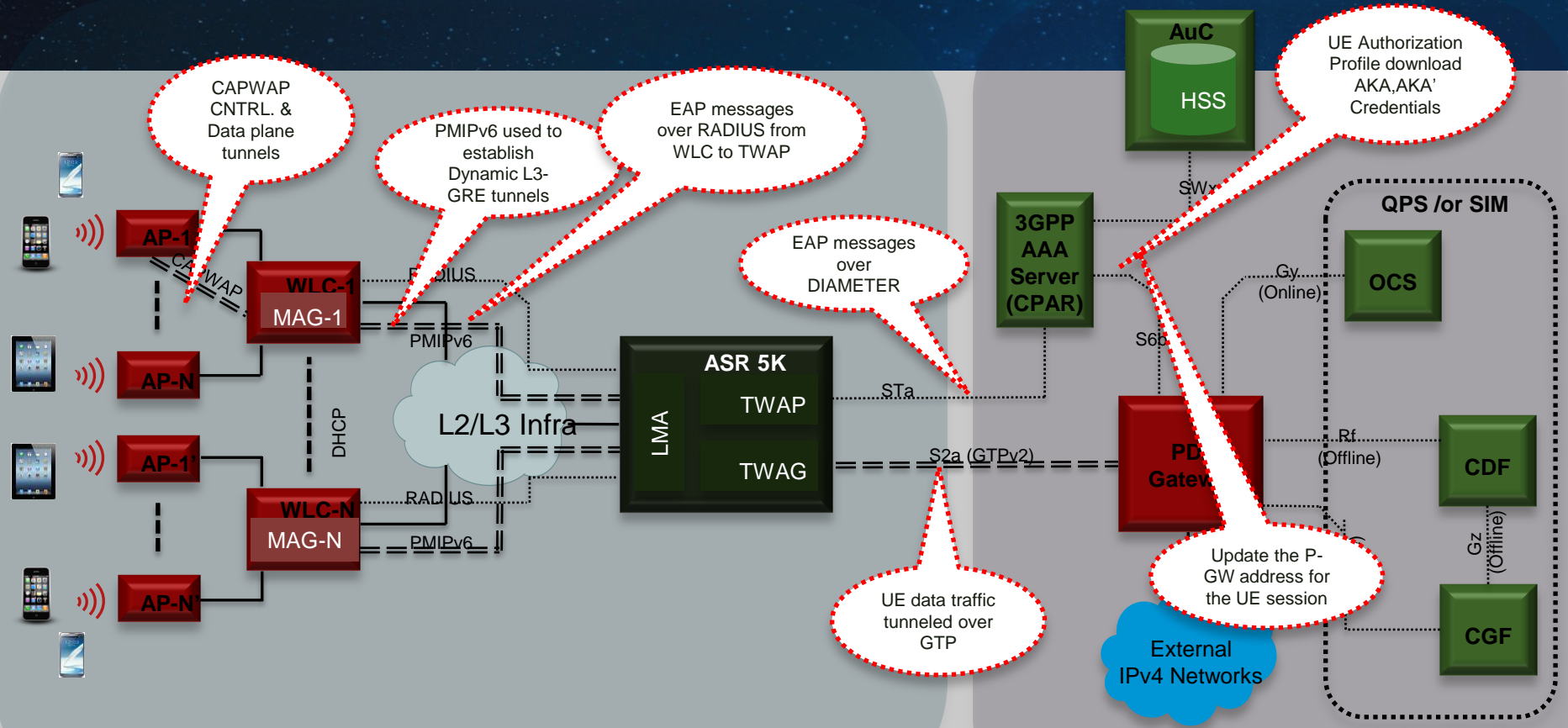
Use-Case 2.4: SaMOG, Inter-Carrier Roaming

PMIPv6 & 3rd Party WLC via sGRE, SaMOG on ASR5K towards Home/Visited



- Aruba/ALU solution for use of sGRE as tunneled traffic
- Use ASR5K as sGRE to EPC Core (SaMOG)
- Use ASR5K TWAP for Authentication and Trusted WLAN Access Gateway (TWAG) for data path integration.
- Proxy subscribers to ASR5K using GTPv2 (home and visited)
- Diffserv QoS to sGRE re-marking (needs to be explored)

ASR5K SaMOG based SP Wi-Fi EPC Integration



A blue-tinted image of Earth from space. The sun is a bright starburst in the upper left. A satellite is visible in the upper right. The Earth's surface shows land and water. The text "Practical Examples of SP-WiFi" is overlaid in white.

Practical Examples of SP-WiFi

Operators Adopting Wi-Fi & Integrating ...

as an Essential Complement to Mobile Services



Wi-Fi as a **hotspot** technology: a wireline service

Wi-Fi as a mobile **offload** technology: a cellular network optimization tool



2009

2010

2011

2012

Wi-Fi as a **platform** for:

- Service innovation
- Revenue growth
- Experience transformation

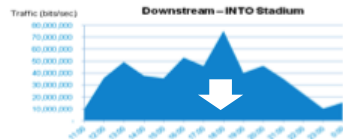


Example: Super Bowl XLVI

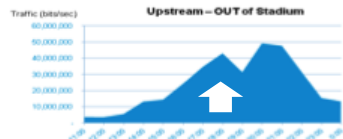
Connected Stadium



- Fan facing Wi-Fi access for Super Bowl activities
- Carrier-neutral Wi-Fi access – free to all fans
- Provided by Verizon wireless
- Objective: increased 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

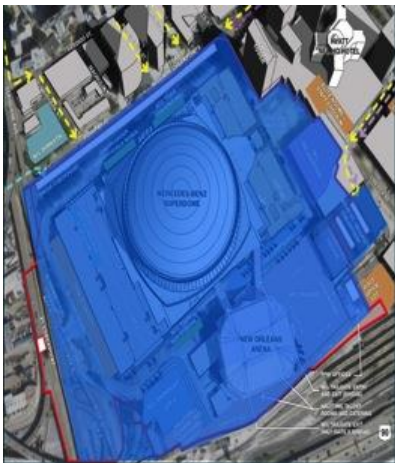
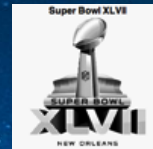
Unique Associations:
12,946 (19%)

Simultaneous access:
8,260 (12%)

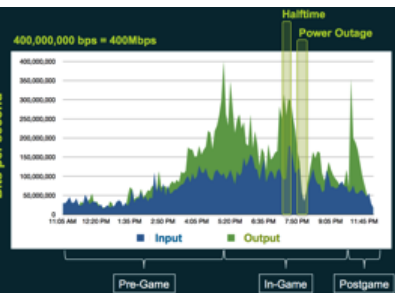


Use Case: Super Bowl XLVII

Connected Stadium



- Fan facing Wi-Fi access for Super Bowl activities
- Carrier-neutral Wi-Fi access – free to all fans
- Provided by Verizon wireless
- Objective: increased fan experience and 3G/LTE offload
- High speed data as well as Voice & SMS worked well
- 1229 in-stadium Access Points



Downstream
Peak: 185 Mbps
Total: 442 GB

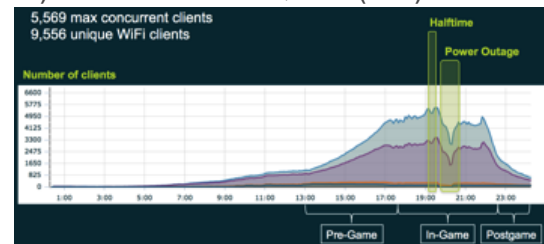
Upstream
Peak: 400 Mbps
Total: 683 GB

Total attendance:
71,024



Unique Associations:
9,556 (13%)

Simultaneous access:
5,569 (8%)



Example: Montreal Formula 1 Event

WiFi Network Observations



- Cisco worked with a Canadian Telecom Service Provider to install and operate a WiFi network for the Montreal F1 event
 - The network covered 2 bleachers, 2 VIP areas; roughly 50 K Square feet
 - 50 APs (3600 and 1552 from Cisco)
 - Fiber backhaul – 200Mbps
- Network statistics over 3 days:
 - Just under 3,300 users at peak (race day)
 - Peak Upstream Bandwidth = 52Mbps (race day)
 - Peak Downstream Bandwidth = 28 Mbps (race day)
 - Total traffic over three days 144Gb
 - Average users at the same time = 2,200



A blue-tinted image of Earth from space, showing the curvature of the planet and the atmosphere. A bright starburst is visible in the upper left corner. The text "Questions?" is overlaid on the left side.

Questions?



**Check out our SP-WiFi and Small Cell Solution setup
at our
World of Solutions Showcase**

A blue-tinted photograph of Earth from space. The sun is in the upper left, creating a bright starburst effect. The Earth's horizon is visible, showing the curvature of the planet and the blue atmosphere. The landmasses are visible in shades of blue and white. The text "Thank you" is overlaid in the lower left area.

Thank you

Complete Your Paper Session Evaluation – Wednesday April 16

Give us your feedback and you could win 1 of 2 fabulous prizes in a random draw.

Complete and return your paper evaluation form to the Room Attendant at the end of the session.



Winners will be announced today at the end of the session. *You must be present to win!*

Please visit the Concierge desk to pick up your prize redemption slip.



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Breakout Session Survey

Session Detail

Name of Session: _____

Speaker: _____

Session Date & Time: _____

The information we collect is used exclusively to facilitate event services we provide to you. We value your privacy and will take all necessary steps to protect it. Names will not be associated with your answers and the information collected will NOT be used for a sales call.

Please rate the session on the following:

Session overall	[5]Very Good
	[4]Good
Content	[3]Average
	[2]Below Average
	[1]Poor

Please rate the Speaker on the following:

Presentation Skills	[5]Very Good
	[4]Good
	[3]Average
	[2]Below Average
	[1]Poor
Subject Matter Expertise	[5]Very Good
	[4]Good
	[3]Average
	[2]Below Average
	[1]Poor

Additional Feedback: _____



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