March 28, 2016

Delivering the "Big Game" for AT&T's customers
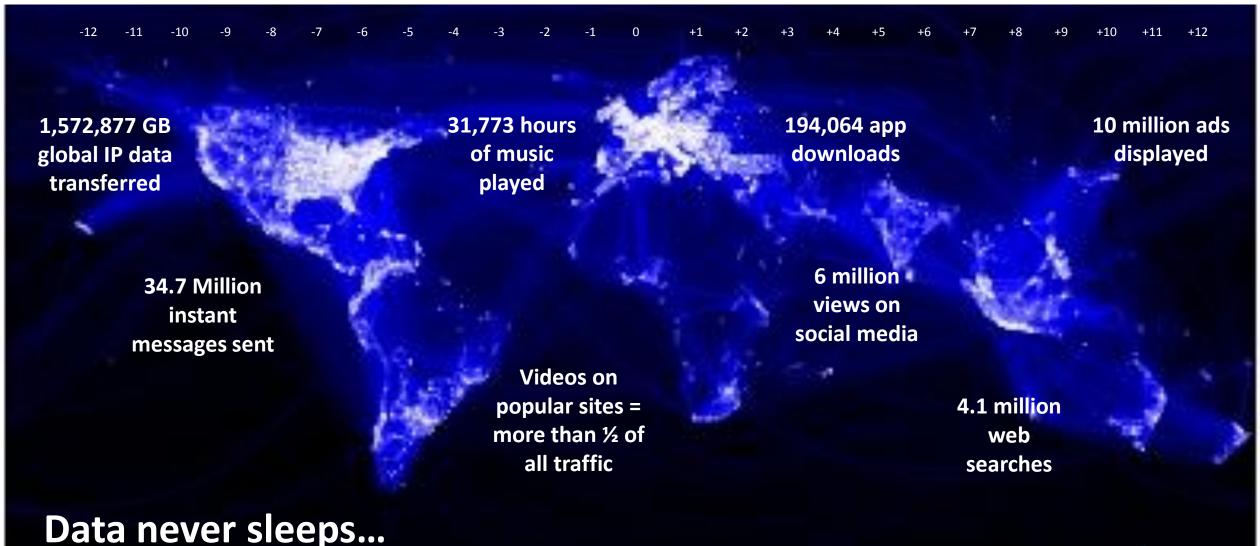
DASpedia Wireless Seminar 2016

San Jose, Ca

Nels Olson

AT&T Antenna Solutions Group

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Wait a Minute – What Just Happened?

-12   -11   -10   -9   -8   -7   -6   -5   -4   -3   -2   -1   0   +1   +2   +3   +4   +5   +6   +7   +8   +9   +10   +11   +12

1,572,877 GB global IP data transferred

31,773 hours of music played

194,064 app downloads

10 million ads displayed

34.7 Million instant messages sent

6 million views on social media

Videos on popular sites = more than ½ of all traffic

4.1 million web searches

Data never sleeps…

Sources: intel.com, inc.com, nickpeall.com

The Challenge

Almost half a billion (497 million) mobile devices and connections were added in 2014. Smartphones accounted for 88 percent of that growth, with 439 million net additions in 2014.

By 2016, more than half of all traffic from mobile-connected devices (almost 14 exabytes) will be offloaded to the fixed network by means of Wi-Fi devices and femtocells each month

By 2019, mobile-connected tablets will generate nearly double the traffic generated by the entire global mobile network in 2014.

By 2019, 4G will be 26 percent of connections, but 68 percent of total traffic

Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update 2014–2019 White Paper

"With at least 80% of traffic coming from indoor locations. Telefonica expects that 95% of data traffic will come from indoor locations in a few years time"

— *Monica Paolini in "Mobile data moves indoors" 9/14/11*

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Antenna Solutions Group

Formed in late 2010

Consisted of RF, BD, PjM, and C+E

Stand alone VP Business group

Recently reorganized

Consists of PjM and C+E

Rolled under National C+E VP

RF and BD rolled under RAN

7,000 venues touched and evolved by AT&T[*]

✈	**75**	Airports, Trains, and Subways
🎓	**85**	Campuses
🏢	**1,300**	Commercial Buildings
⛳	**20**	Golf Courses, Parks, and Race Tracks
🧰	**200**	Healthcare Facilities
🎲	**325**	Casinos
🏢	**4,250**	Enterprise Buildings
🏠	**425**	Retail and Multi-Dwelling Locations
((○))	**100**	Outdoor DAS
🏟	**200**	Stadiums and Arenas

* Since 2010, numbers are approximate

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Mobilizing True North

Services that Enable

Voice

Data

Video

Applications

Internet Access

Location Based Services

Architectures that solve

HetNet Solutions

Anywhere

Hospitality & Convention

Transit

Higher Ed Campuses

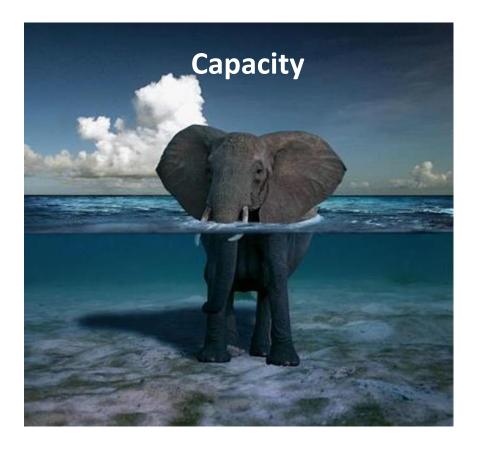Commercial Buildings

Retail/Mall

Multi-Dwelling Unit

Healthcare

Stadiums & Parks

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Mobilizing Coverage and Capacity

Coverage

Capacity

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Level Setting Densification

Macro Sites

Densification of Established Grid

Macro

Micro/Pico

Micro/Pico

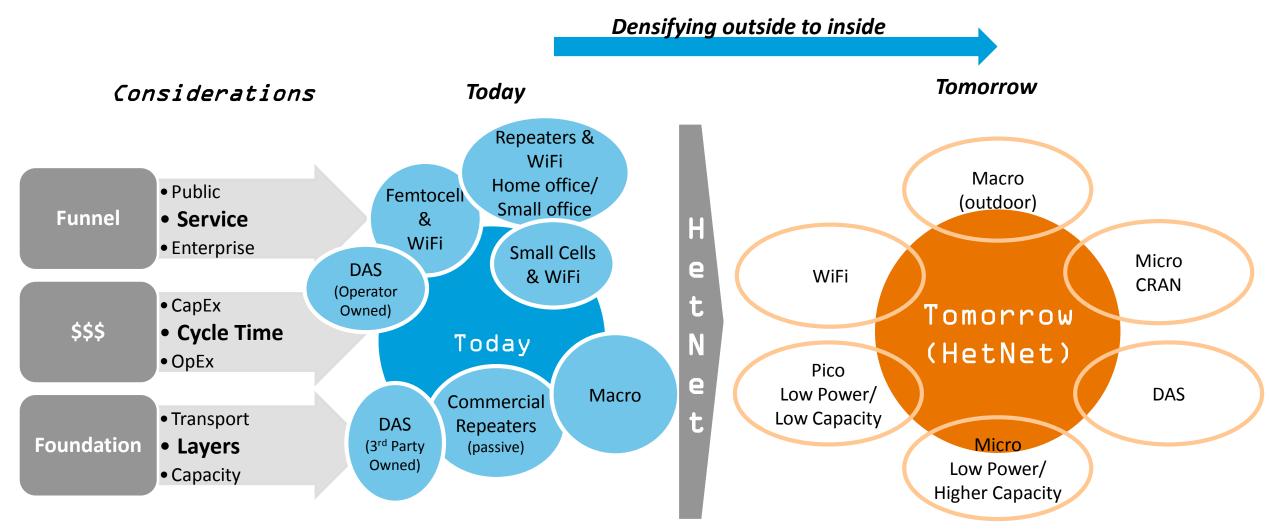|	Macro	Micro/Pico	Micro/Pico (Indoors)
Height	>70' ← Outdoors →	20-70'	Indoors
Radius	0.5-20 mi	<0.5 mi	varies
Power	>40W	20W-1W	1W-50mW

Network density is important for network capacity

- Operators will design their networks with a mix of macro and small cells

- Densification will occur from the outside-in

- A blend of macro-micro-pico below the clutter will emerge

Small Cell term is being used to mean many things – the best representation of the term is **below the clutter**

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Landscape...the Road to HetNet

Densifying outside to inside

Considerations

Today

Tomorrow

Funnel
- Public
- **Service**
- Enterprise

$$$
- CapEx
- **Cycle Time**
- OpEx

Foundation
- Transport
- **Layers**
- Capacity

Today:
- Femtocell & WiFi
- Repeaters & WiFi Home office/ Small office
- Small Cells & WiFi
- DAS (Operator Owned)
- Macro
- DAS (3rd Party Owned)
- Commercial Repeaters (passive)

HetNet

Tomorrow (HetNet):
- Macro (outdoor)
- Micro CRAN
- WiFi
- DAS
- Pico Low Power/ Low Capacity
- Micro Low Power/ Higher Capacity

▶ *A blend of macro, micro, pico, and...*

Ownership model: It needs to be built, but how?

Carrier owned

Carrier builds, owns, and maintains the DAS and BTS equipment. Lease with venue owner for space and power.

Sales funded

Carrier signs a services contract with a customer. Included in contract is wireless coverage at specific locations. Multiple models ranging from Carrier builds, owns, and maintains the DAS and BTS equipment to Customer builds and maintains DAS, Carrier provides BTS equipment.

Customer owned

Customer builds, owns, and maintains the DAS and BTS equipment. Customer leases Carrier equipment and RF signal directly.

The "Big Game"
San Francisco/Santa Clara

AT&T

Big Game Summary

- **Date:** February 7, 2016
- **Venue :** Pro Football Stadium, Santa Clara, CA
- **Stadium Attendance:** 84,000
- **Network Summary:**
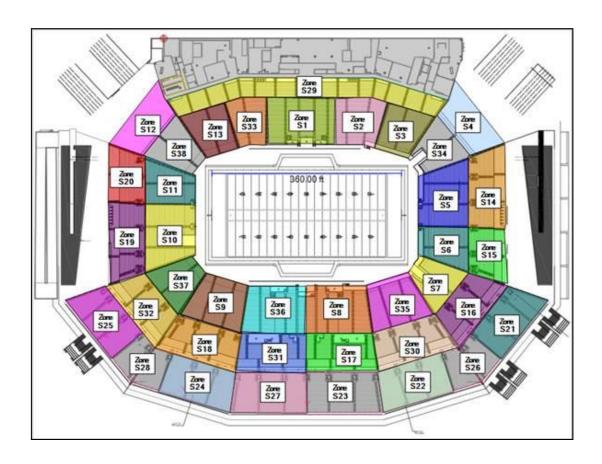   - Inside Stadium
        - iDAS (Bowl + Concourse) : 49 Sector Zones, 98 UMTS & 147 LTE Sector-Carriers
        - Free Wi-Fi will be provided by NFL
    - Outside Stadium
        - oDAS: 7 Sector Zones, 14 UMTS & 21 LTE Sector-Carriers

AT&T Customers at the Stadium used

5.2 TB

of data during the entire game.

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Mobile traffic from event-related activities taking place **Saturday 1/30** through **Sunday 2/7** in the Bay Area, including fan fests, concerts, the game and more, totaled more than

28.4 TB

That's equal to **81M** social media posts with photos.

Data traffic was about 205% greater than what we experienced at pro football's Big Game in Glendale last February

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- **LTE DATA PERFORMANCE**
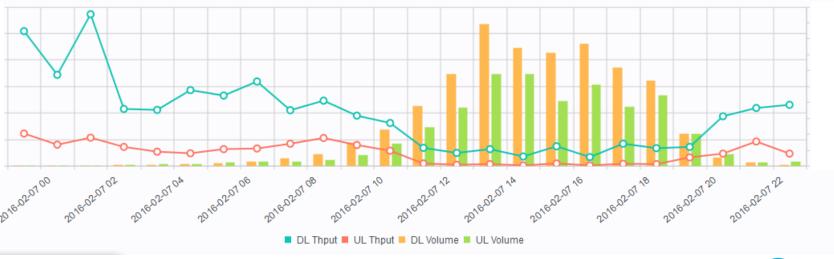1. Uplink noise raise with traffic increase during game.

- **LTE DATA THOUGHPUT**
1. Traffic was optimally balanced between carriers based on available spectrum. 20Mhz PCS band carried majority of the inside stadium traffic.

2. Total spectrum available for Stadium → 35Mhz distributed between 700MHz, 1900MHz and 2100MHz

LTE Data Performance

Legend: Data Accessibility · Data Retainability · DL Volume · UL Volume

LTE Data Throughput

Legend: DL Thput · UL Thput · DL Volume · UL Volume

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Stadium

iDAS –Stadium

Bowl: 36 Sector Zones . 72 UMTS and 108 LTE SC
Concourse : 13 Sector Zones. 26 UMTS & 39 LTE SC

oDAS - Stadium

7 Sector Zones. 14 UMTS and 21 LTE Sector-Carriers

iDAS – Football HQ

7 Sector Zones. 14 UMTS and 21 LTE Sector-Carriers

iDAS – Transport/ Fiber Redundancy

True Fiber/Transport Redundancy

oDAS/Macro – Parking Garage

6 UMTS & 9 LTE Sector-Carriers

Stadium Vicinity

iDAS –Convention Center

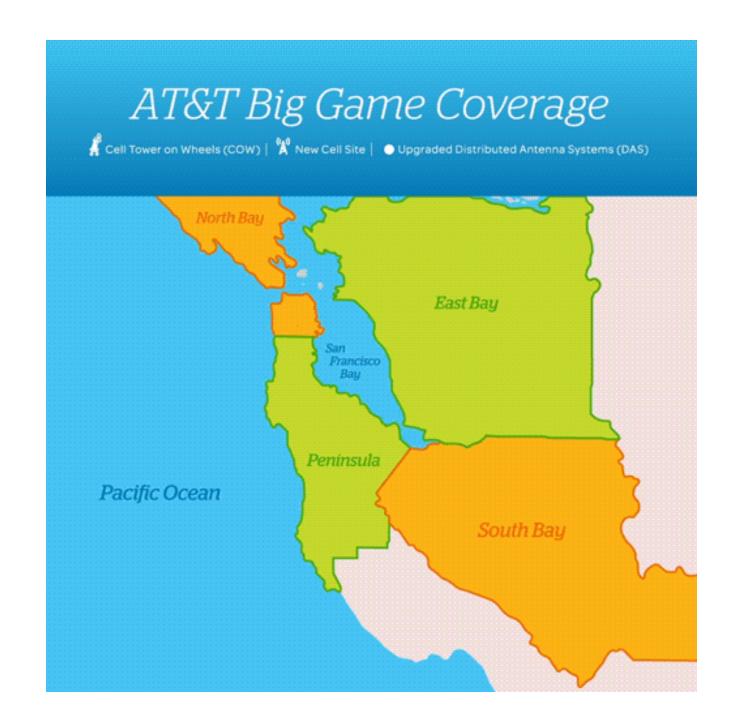4 Sector Zones. 8 UMTS and 8 LTE Sector-Carriers

iDAS – Hotel

2 Sectors. 4 UMTS and 4 LTE Sector-Carriers

iDAS – Hotel

2 Sectors. 4 UMTS and 6 LTE Sector-Carriers

iDAS – Player Hotel

2 Sectors. 4 UMTS and 4 LTE Sector-Carriers

Delivering the "Big Game" for AT&T's customers

Big Game Support Venues

27 DAS projects to support the Big Game

Transportation

San Francisco International Airport

(International Terminal, Terminal 2, and Terminal 3)

Metropolitan Oakland International Airport

(All)

BART

Football event driven

Hockey Arena

(Football Media Night)

San Francisco Convention Center

(Football experience)

Football support

SF Union Square Hotel

(Football HQ)

Santa Clara Convention Center

(Football operations)

College Stadium
(practice facilities)

Santa Clara Hotel
(Team hotel)

Hospitality

Four additional hotels in the Santa Clara area

Three Shopping centers in the Santa Clara area

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AT&T Neutral host DAS systems

AT&T delivered multiple DAS for the Big Game for their other customers

The Carriers

AT&T Owns, operates, and maintains multiple DAS through out the nation.

Q &A

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