DAS and Small Cell Solutions

Deployment Trends
That Impact Your Business
The HetNet Forum, formerly The DAS Forum, is dedicated to the advancement of heterogeneous networks. HetNets provide increased network coverage, capacity and quality through the use of a variety of infrastructure and technology, enabling seamless voice and data communications. The HetNet Forum is a membership section of PCIA – The Wireless Infrastructure Association.
Speakers

Allen Dixon
Corning
MobileAccess

Jamie Dahlgren
AT&T Antenna Solutions Group

Kevin Swank
Black Box Network Services

Tracy Ford
HetNet Forum
Wireless Beyond Phones

Corning Invented first low-loss optical fiber

Places ~ 0.5 Billion

1875 1900 1925 1950 1972 2000 2025
Wireless Beyond Phones

- **People**: 7.0 Billion
- **Places**: ~0.5 Billion
- **Wireless "Things"**: 50 Billion

Corning invented the first low-loss optical fiber.
New devices, applications driving wireless data growth

Rapid Growth of the Number of Things Connected to the Internet:

Web Traffic from Wireless and Mobile Devices Will Surpass the Volume of Traffic from Wired Devices

More than 2/3 of wireless traffic is generated indoors

P2M and P2P Still Make Up the Majority of Internet Connections

Exabytes per Month

Source: Cisco VNI, 2013
The percentages within parenthesis next to the legend denote the relative traffic shares in 2012 and 2017.
Wireless Becoming More Complex

Technology Mix
- 2G/3G/4G plus 802.11 ac/ad
- More active spectrum
- MIMO

Multiband Support
- Public Safety, 700 MHz, 2600MHz, 1600 MHz
- Readiness to support new bands

Coverage & Capacity
- Flexible sectorization requirements
- Ready for SON

Varied RF Sources
- Pico, Small Cells, Femto
- Distributed Base Station (BBU-RRU)
Future Wireless Technologies

- Cellular Technology Consolidation
- 60 GHz Spectrum Adoption
- WiFi Evolution
LTE Rapid Adoption

LTE(4x4), R8+R9, 20MHz
DL: 300 Mbps
UL: 75 Mbps

LTE Advanced R10
DL: 1Gbps
UL: 500 Mbps

Release 10
Bandwidth Aggregation
Relays and Repeaters
MIMO Enhancements
LTE Advanced
60 GHZ Drivers

Devices

- Video
  (1280 x 720 – 1920 x 1080p and beyond uncompressed)

- Kiosk HD Blu-ray download
  (25 Gbytes 1-5 min)

- File transfer
  (2 Gbytes 30 s)

- Wireless I/O
  (USB/PCIe)
60 GHz Drivers
Spectrum Availability

60 GHz Spectrum - Key Drivers
Spectrum Availability

- **U.S. and Canada** (57.00 - 64.00)
- **Japan** (59.00 - 66.00)
- **Australia** (59.10 - 62.90)
- **Europe** (57.00 - 66.00)
- **China** (59.00 - 64.00)
- **South Korea** (57.00 - 64.00)
WLAN Technology Evolution

- **802.11A**
  - 5 GHz carrier
  - 54 Mb/s data rate

- **802.11B**
  - 2.4 GHz carrier
  - 11 Mb/s data rate
WLAN Technology Evolution

- **802.11A**
  - 5 GHz carrier
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- **802.11B**
  - 2.4 GHz carrier
  - 11 Mb/s data rate

- **802.11G**
  - 2.4 GHz carrier
  - 54 Mb/s data rate
WLAN Technology Evolution

- **802.11A**: 5 GHz carrier, 54 Mb/s data rate
- **802.11B**: 2.4 GHz carrier, 11 Mb/s data rate
- **802.11G**: 2.4 GHz carrier, 54 Mb/s data rate
- **802.11N**: 2.4 and 5 GHz carrier, 54 to 600 Mb/s data rate
- **802.11AC**: 5 GHz carrier, 1000 Mb/s data rate
- **802.11AD**: 60 GHz carrier, 7000 Mb/s data rate

- Greater range
- Less interference
- Greater potential data rate/bandwidth
Convergence of Wireless Technologies
Convergence of Wireless Technologies
Different Technologies will Coexist Forming HetNets
Different Technologies will Coexist Forming HetNets

- RHH / Pico cells
- Wi-Fi
- Femto cells

Capacity Requirements

- High
- Medium low
- Low need
- High need

Need for multi-carrier, multi-band support
Different Technologies will Coexist Forming HetNets

Diagram showing capacity requirements with different technologies like RHH/ Pico cells, Wi-Fi, Femto cells, and DAS.
Agenda

Network Business Drivers
In-Building Solution Alternatives
AT&T’s Project Velocity IP
Small Cells into the Future
Network Business Drivers

AT&T: 30,000% increase in mobile data traffic over past six years
Since 2008, expanded Wi-Fi to more types of venues – including hotels, restaurants, retail locations, stadiums, airports, universities, and hot zones.

In 4Q12 mobile devices carried +3x more data traffic than 4Q11.

In 4Q12, 705.5M connections were made to the AT&T Wi-Fi Network – More than 5000 connections per minute.

+40% connections made in 4Q12 from mobile smartphone and tablet devices versus 2011.
Network Business Drivers

AT&T is one of the leading smartphone providers in the U.S.

AT&T Smartphone Penetration:

<table>
<thead>
<tr>
<th>Quarter</th>
<th>1Q'10</th>
<th>2Q'10</th>
<th>3Q'10</th>
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<td></td>
<td>35%</td>
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<td>53%</td>
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<td>59%</td>
<td>62%</td>
<td>64%</td>
<td>67%</td>
<td>72%</td>
<td>73%</td>
</tr>
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AT&T’s Antenna Solutions Group

- AT&T’s Antenna Solutions Group (ASG) is responsible for extending the capabilities of AT&T’s wireless network within large public venues providing our customers the best mobile broadband experience.

- Once the venue is under contract, ASG will turn over responsibility to AT&T’s Towers group to market the system to the other wireless carriers. www.atttowers.com
What’s in the Toolbox?

- Neutral-Host Distributed Antenna Systems (DAS)
- Wi-Fi
- Small Cells
Comparing In-Building Solutions

Repeater*
Repeaters (also called BDA or bi-directional amplifier) are used in small (<100K sq. ft) venues to expand coverage. A repeater uses a rooftop antenna draw capacity from a nearby macro cell site as the RF source and rebroadcasts the signal throughout the facility. Donor cell site capacity is shared with external traffic and is not dedicated to the venue. DAS antennas and splitters provide coverage to various locations inside the building from the input of the BDA.

Base Transceiver Station (BTS)
The Macro BTS is the RF source primarily used in the macro network. For in-building applications, BTS are expensive and require dedicated backhaul, but offer a coverage & capacity solution that can support a large number of users over a wide area.

Distributed Antenna System (DAS)
The DAS distributes the RF signal across antennas that are installed throughout the facility. A Small Cell, BDA or BTS can be used as the RF source for the DAS. Primarily used to modify, improve or extend coverage of a site. Primarily used in large buildings, stadiums, public spaces, airports, enterprise & outdoor environments with strict zoning, etc.

Small Cells
Low-powered radio access points (less than 1 Watt) that improve indoor and outdoor coverage to increase capacity and offload traffic. Deployments to begin in 2013.

Femtocells
Femtocells are small personal BTS providing service over a limited area (5K sq. ft) to a limited number of users (4~20). Primarily used in small office / home office or residential areas.

* Repeaters are not available in some markets or venues

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Premier Mobile Network: Densification

Supporting Growing Customer Demand

Densification of Wireless Grid

Enhances AT&T’s ability to offer best-in-class voice and data services

Supports launching Voice over LTE

Multiple technology deployments PLANNED*:

- 10,000+ new macro sites
- 1,000+ distributed antenna systems
- 40,000+ small cells

*Over plan period for Project VIP (2013-2015)

Lead to Better Customer Experience, Usage and Revenue
Premier Mobile Network: Small Cell Technologies

Small Cells: Delivering Flexible Coverage Where It's Most Needed

**Improve in-building coverage**

Used in densely populated areas to help augment the wireless carrier’s capacity and coverage needs.

**Multi-technology UMTS/HSPA+/LTE/Wi-Fi**

- Initially 3G UMTS and 4G HSPA+
  - 4Q12: First field application
  - 1Q13: Start general deployment
- 2014: Future evolution to 4G LTE and Wi-Fi

50+% of densification program to use Small Cell Technology by 2015
The Future is bright with Small Cells

Features

- To meet coverage hot spot, coverage hole filling and capacity requirements
- Increased capacity to meet enterprise capacity demands
- Broaden market penetration to business segments
- Flexible deployment - IT Tech installation possible in future
- Lower cost than alternatives. (Macro, Micro, DAS, etc.)
- Simple IP connectivity, intended to leverage existing IP backhaul, where possible
- Multi-mode technology: 3G/LTE/Wi-Fi Standards
- Low profile, compact, scalable unobtrusive solution
Designed for easy deployment

**Metrocell can be deployed with minimal disruption**

- Compact measuring 9.5” X 9.5” X 2” and weighing 4.4 lbs.
- Supports multiple antenna options
- Wall and ceiling mountable - can be deployed almost anywhere
- Uses existing Internet access for backhaul can be either shared or dedicated
- Self-configures when multiple Metrocells are deployed which makes installation significantly less complex and costly than traditional distributed antenna systems
- Low profile, compact, scalable unobtrusive solution
Each Metrocell can:

- Connect up to 32 devices with each device supporting simultaneous voice and high-speed data sessions
- Securely connect to the AT&T network via Ethernet and the Internet
- Seamlessly handoff calls to other Metrocells as well as support seamless two-way interworking with the greater AT&T network
- Cover 7K-15K sq ft depending upon building construction
- Be used for indoor and outdoor coverage
- Open to all AT&T users in range of the device
Small Cells – Marching Forward!

- **Multi-Technology Small Cells (All with WiFi)**
  - Indoor-Office
  - Outdoor-Neighborhood
  - DAS
  - Indoor – Home
  - WiFi

- **LTE Macro**
  - 3G (HSPA+) Metrocells
  - 3G (HSPA+) & LTE Metrocells
  - WiFi Integration
  - SON Integration
  - 40,000+ SC APs

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Small Cells

for your home, office and neighborhood

AT&T Small Cell Line-Up

Small cells are a resourceful network solution that AT&T is deploying to provide you with flexible coverage.

<table>
<thead>
<tr>
<th>Types of Small Cells</th>
<th>Serves up to</th>
<th>Simultaneous Calls</th>
<th>Location</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femtocell</td>
<td>4</td>
<td>Indoor</td>
<td>3G</td>
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</tr>
<tr>
<td>Metrocell</td>
<td>32</td>
<td>Indoor &amp; Outdoor</td>
<td>4G</td>
<td></td>
</tr>
<tr>
<td>Multi-Standard Metrocell</td>
<td>64</td>
<td>Indoor &amp; Outdoor</td>
<td>4GLTE, 3G, Wi-Fi</td>
<td></td>
</tr>
</tbody>
</table>
Wireless data usage is pervasive and continues to grow, driving demand for in-building wireless solutions.

Building owners are looking to wireless broadband services as the “4th utility” (i.e., power, phone service, Internet).

In-building wireless solutions such as DAS & Small Cells extend wireless voice and data connectivity into buildings.

Very relevant for existing and new construction.
New Building Construction Considerations

In order to “future-proof” the building consider incorporating wireless during the new building construction phase, much less disruptive than a retrofit

Pull extra fiber, coax & GigE cable installed in risers between floors and in conduit across the building

Ensure add’l space & AC power is available in IDF closets

Ensure add’l space, AC power & temperature controlled room is available near the telco demarc

Utilize fiber backhaul, if it is available
Questions?

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