



# Understanding Evolving DAS Standards for Design, Deployment and Optimization

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# Agenda

*Network Drivers*

*Wireless Evolution*



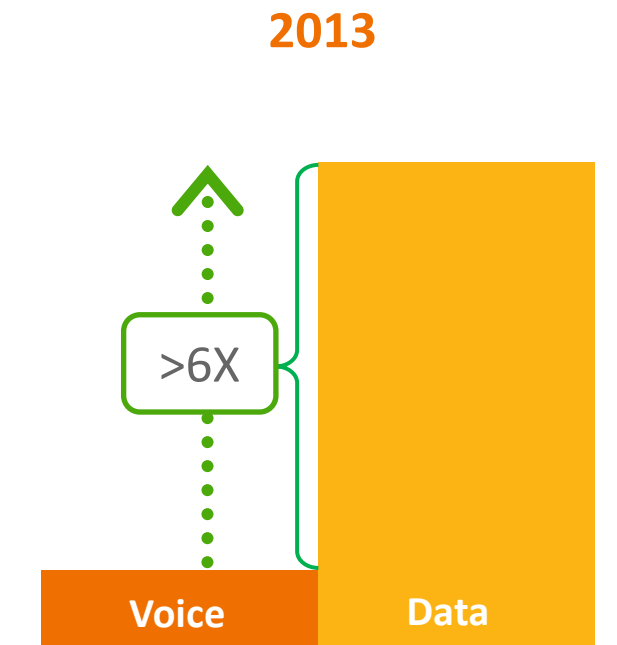
# MOBILE INTERNET EXPLOSION

*AT&T wireless data traffic up  
50,000% over past 7 years*

*100M+ U.S. wireless  
subscribers*

# Driving the Need for More Network Capacity

## AT&T Wireless Traffic Per Subscriber



The volume of wireless data traffic on AT&T's network is now over six times higher than the amount of voice traffic

**Continued pressures** on capacity – driven by video applications, smartphone and tablet growth



# 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\***:

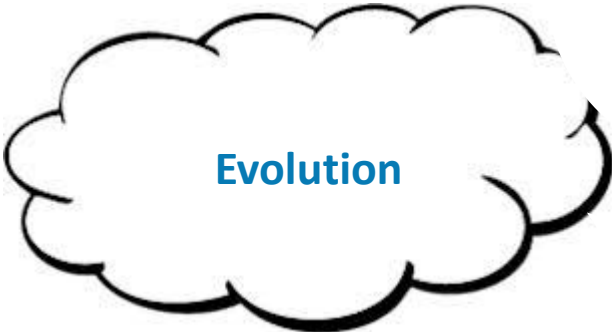
- **Thousands of** new macro sites
- **Hundreds of** distributed antenna systems
- **Thousands of** small cells

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

*Lead to Better Customer Experience, Usage and Revenue*



# Wireless Evolution



# Wireless Evolution

## Customer

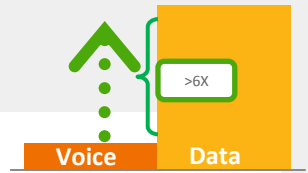
- Behavior
- Expectation
- Experience

## Evolution





# How have “we changed” – behavior & expectation?



## Usage

- Who
- What
- How
- Where
- When

## Human

- Toddlers → Entertainment
- Elementary-12K → Digital Learning
- College → Online Learning
- Workspace → Productivity
- Social Media → On the go
- Elderly → Going online

## Machine

- Internet of things
- Cars
- Gadgets
- Meters
- Point of sale
- People finder

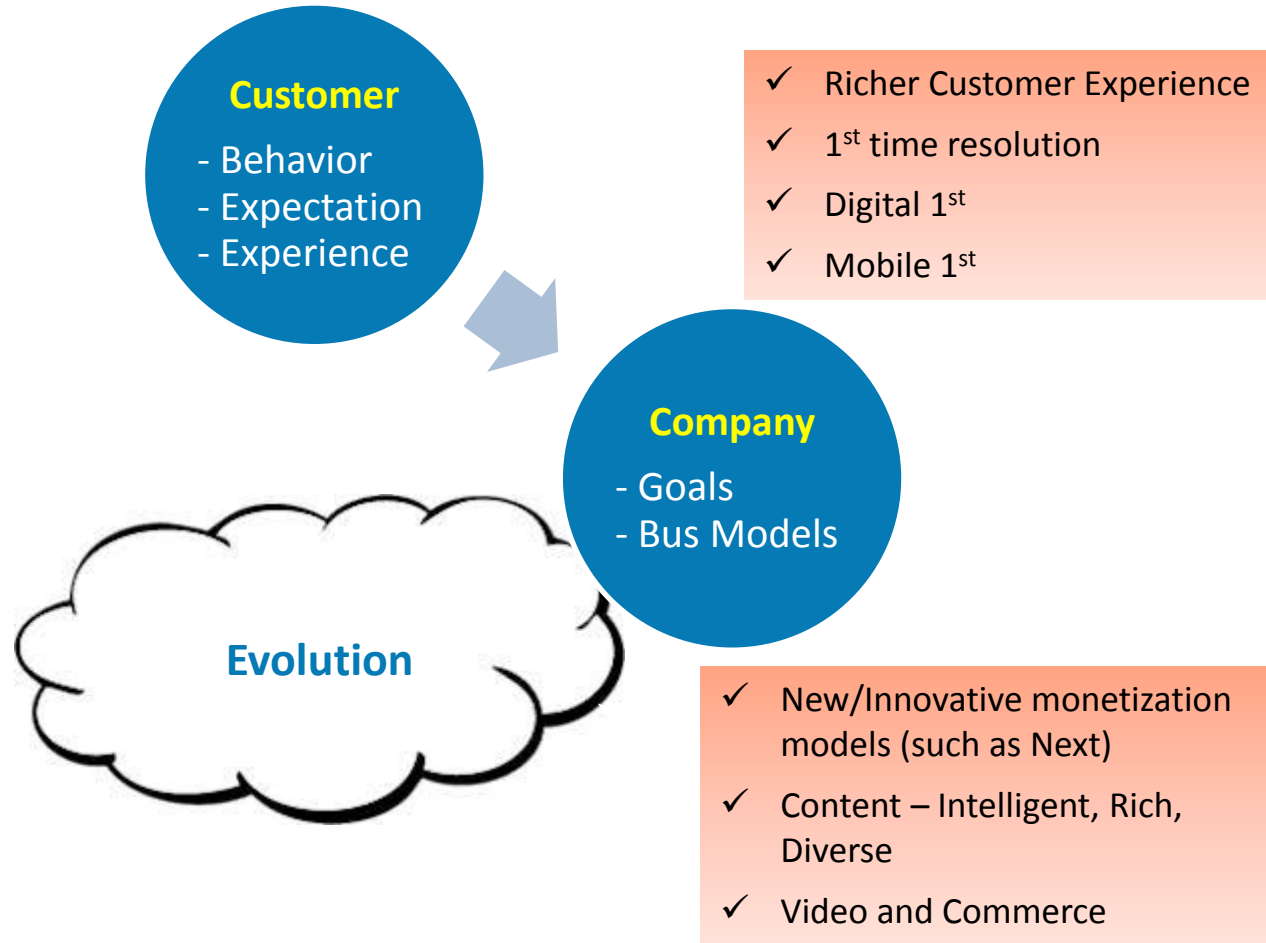
Across age groups → constituents have changed  
 → demographics have changed



Transformation    Luxury → Necessity → Utility → Commodity  
Evolving            Anywhere / Anytime / Any Device



# Wireless Evolution

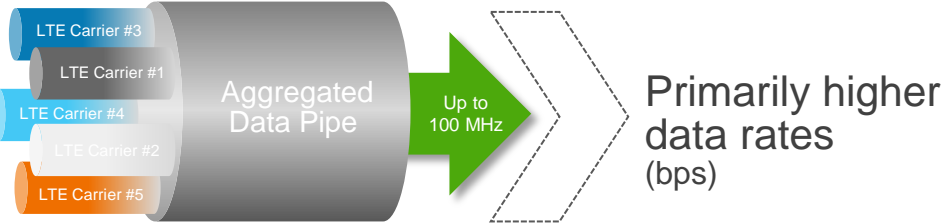
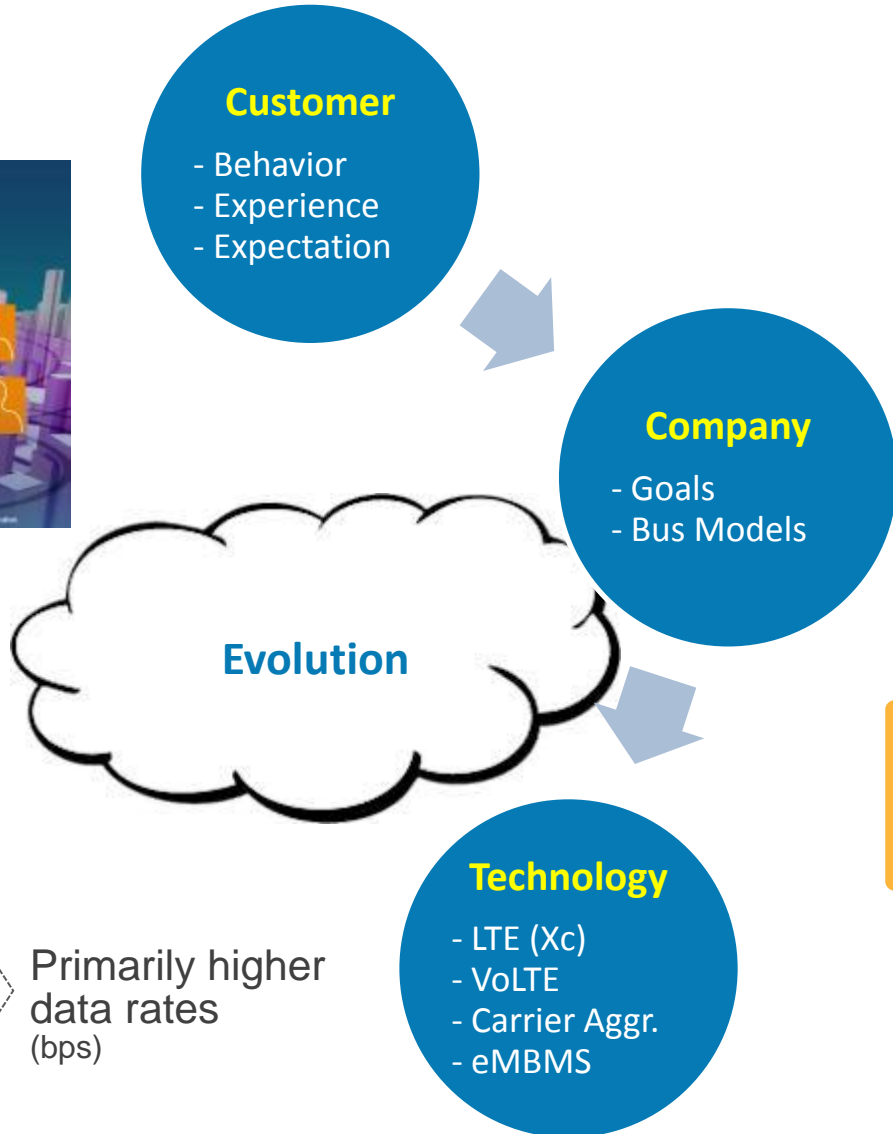


# Wireless Evolution

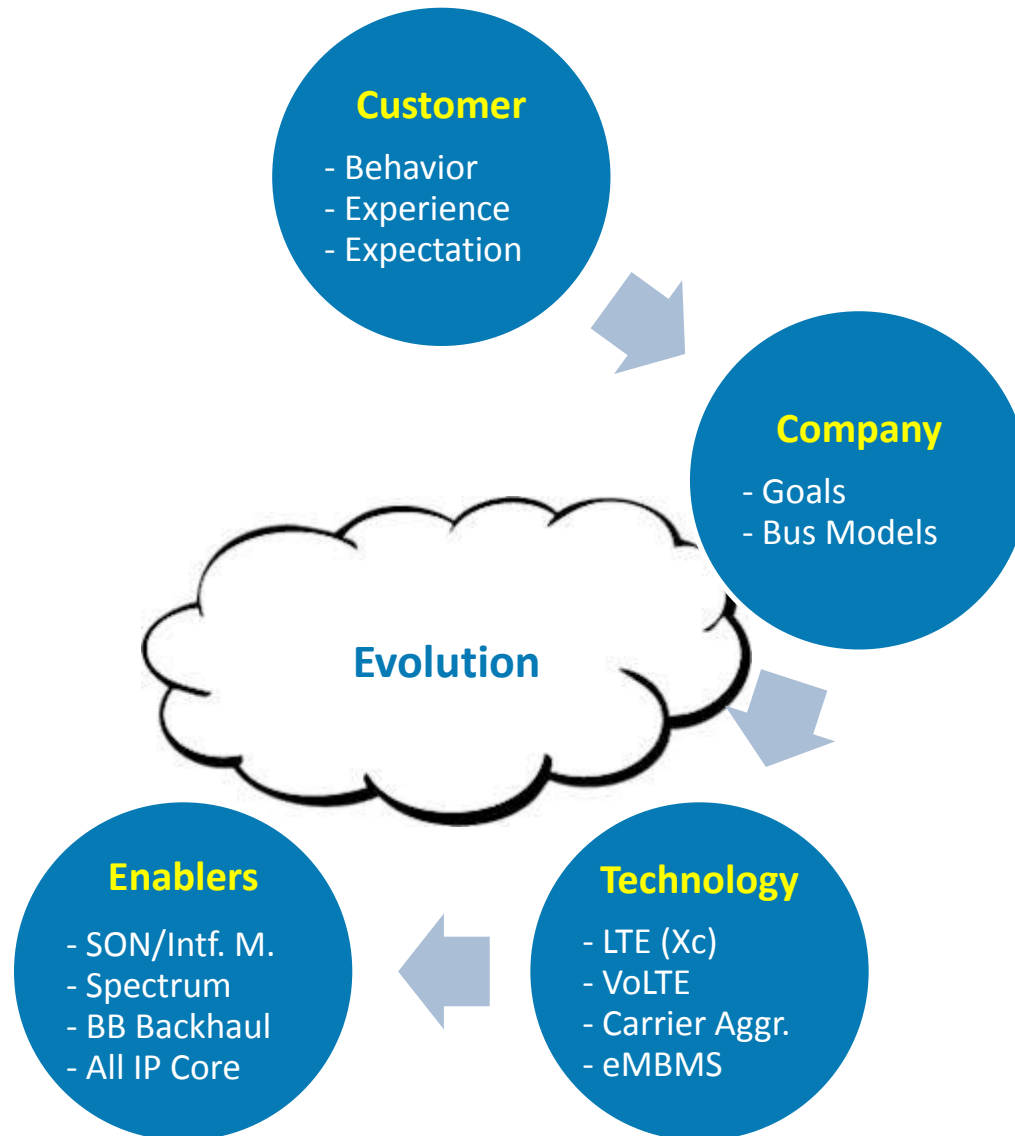
**LTE Broadcast**  
flexible and better use of spectrum

**5**  
Users per site average consuming same content

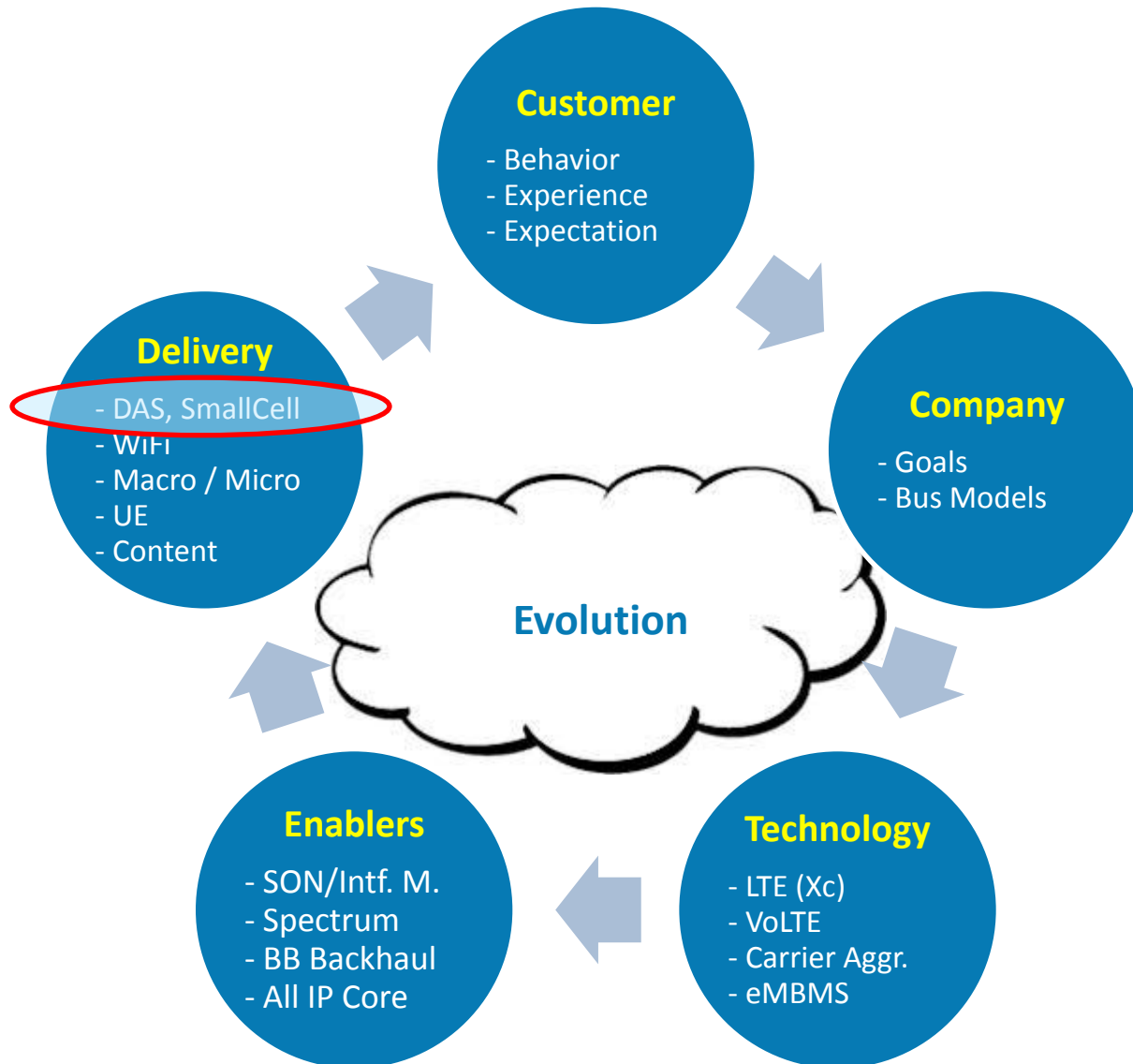
**7x**  
Throughput gain



# Wireless Evolution



# Wireless Evolution



## In-Building Solutions; Growth Impact; Evolution in Solution set

### SmallCell

- Deployment Consideration
- Case Study

### DAS

- Platform, Deployment and Optimization
- Case Study



# Consider an In-Building Solution

In-Building → Mainstream

Filling in gaps....



Meet Capacity... More BW, S/C...



?

Impact



# In-Building growth & impacts

- End customer behavior and expectations
- Venue owner's desire to improve tenant experience
  - More Coverage in More Places

## ↑ Capital Cost

- Infrastructure
- Design Complexities

## ↑ Deployment Cost and Complexities

- Space and Installation
- Integration and Commissioning
- Optimization

## ↑ Operating Cost

- Rent and Utilities

## ↑ Maintenance Cost



## Possible Solution (s)

- HetNet / Cost effective RBSs (SmallCells)
- CIPRI Connectivity
- Intelligent Integration, Commissioning, Optmz

## ↓ Capital Cost

- Infrastructure Reduction
- Design Complexities [?]

## ↓ Deployment Cost and Complexities

- Space and Installation
- Integration and Commissioning
- Optimization [?]

## ↓ Operating Cost

- Rent and Utilities

## ↓ Maintenance Cost

TCO





# Densification & SmallCells – The Heterogeneous Network

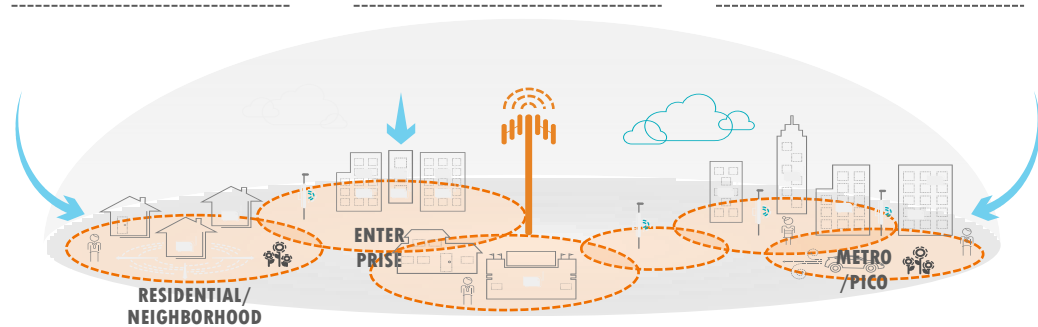
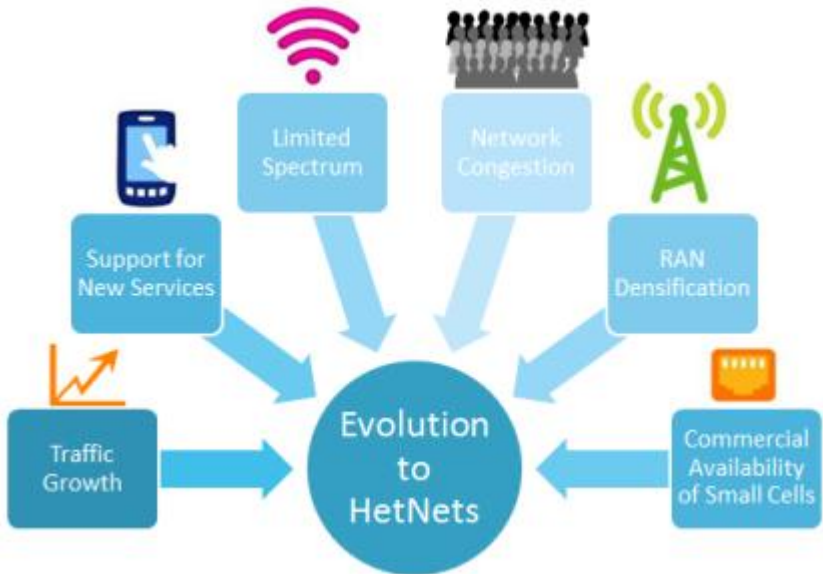
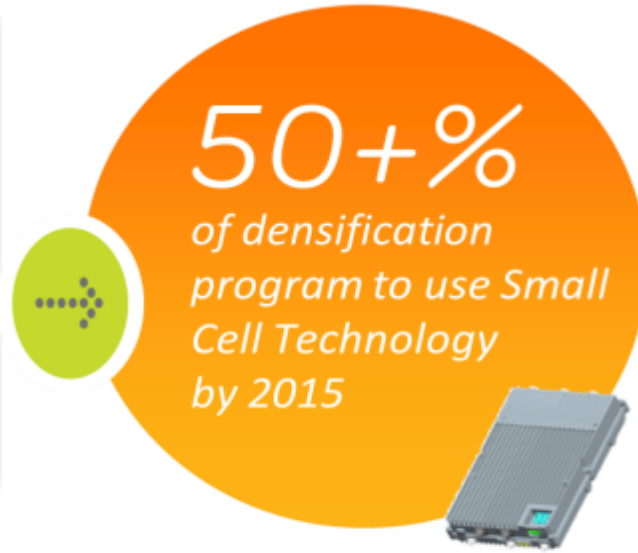
**Improve spectrum efficiencies**

**Cost efficient radio access networks**

**Improve in-building coverage**

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

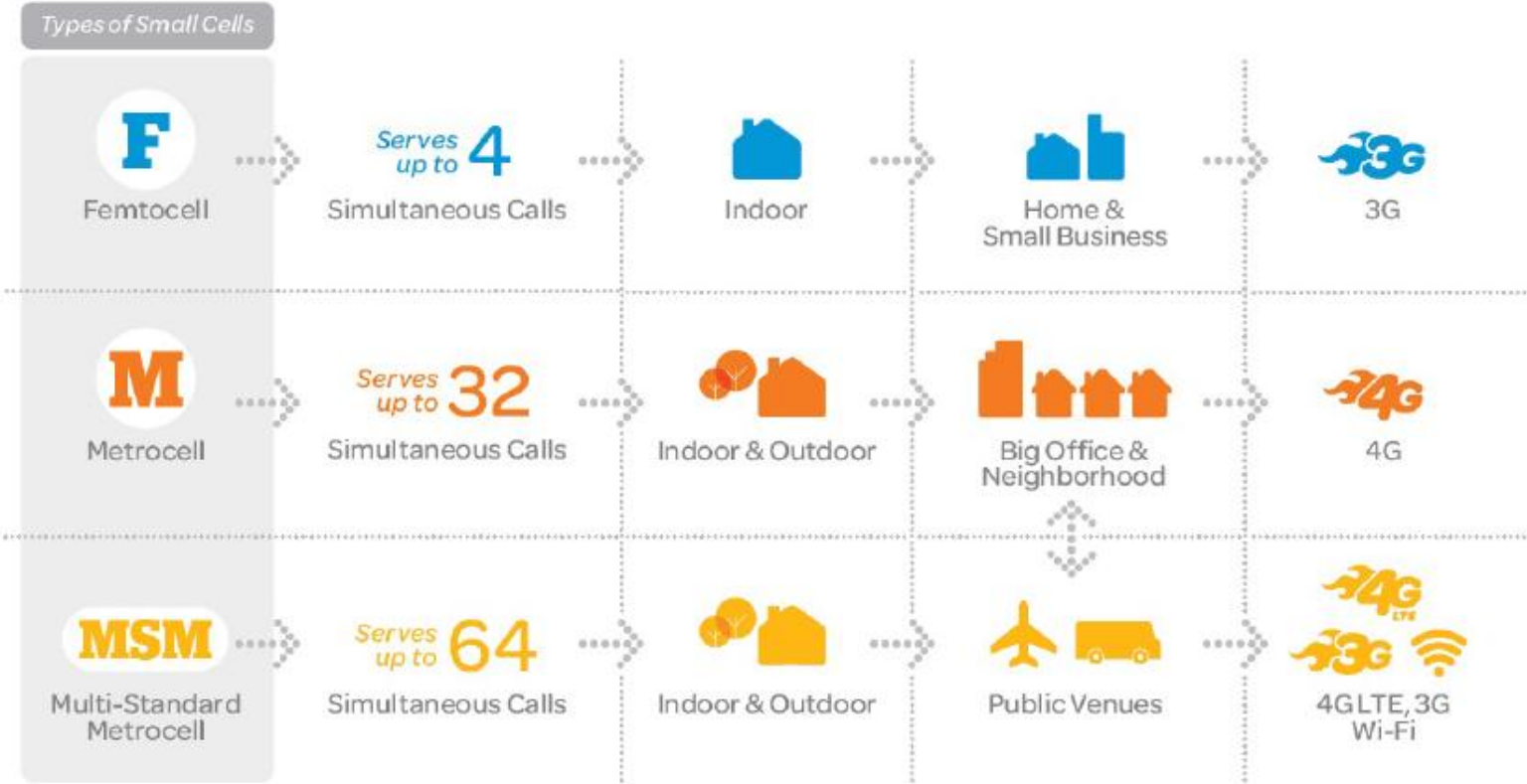
- Initially 3G UMTS and 4G HSPA+
  - 4Q12: First field application
  - 1Q13: Start general deployment
- 2014: Future evolution to 4G LTE and Wi-Fi



# SmallCells 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.



# SmallCell Drivers

## In-Building Coverage / Capacity

- Over 80% of connections are made indoors, where macro coverage may not be adequate

## Improved User Experience

- Device usage and communication is growing at an exponential rate

## Rapid Deployment

- SmallCells have the potential to meet urgent demand and can improve customer satisfaction and retention
- Backhaul is key challenge for rapid deployment

## Economic Viability

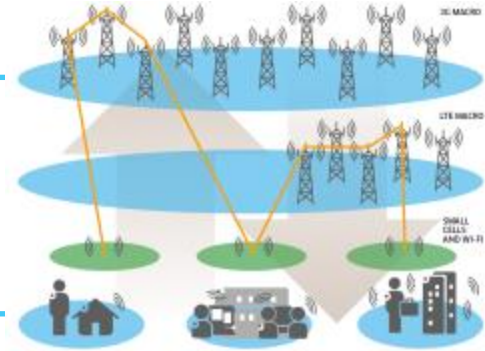
- Small cells vs. other indoor solutions (primarily DAS) – building size, structure, and capacity requirements can push the envelope regarding expense and effort



# SmallCell Deployment Considerations

## Co-Existence w/Macro Network

- Co-Chn vs. Dedicated Chn
- Minimize Interference (both direction); Maximize Transition
- Offload Capacity
- Access, Load and Layer Management ; and SON



## RF and Transport Capacity

- Air Interface - RF Interferences (Multiples SC); Technology Impacts (UMTS/LTE)
- Number of Users per Small Cell; Types of antennas and antenna Placements
- Per Desired BW, Determine Best Backhaul Solution per SmallCell Location (FTTB, Cable/DSL, MIS, MW, etc.)

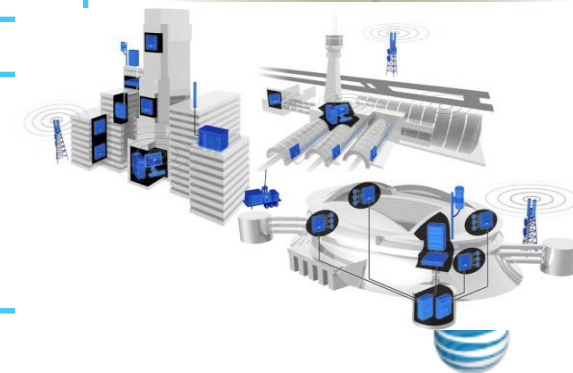


## Indoor Environment / Morphologies

- Design strategies varies w/different morphologies - Urban Area High Rise (1 or multiple floors); Campus; Enterprise Building (<5 floors), etc.
- Design must consider Variety of building materials; Size/Shape and Layout of buildings; Points of Ingress/Egress

## Power

- Power Over Ethernet (POE) - Same Ethernet connection used for BH powers SmallCell
- Limited to 100m (328 feet) distance
- Power via AC outlet or DC power supply – Cost and Maintenance
- Battery backup – may be for mission-critical venues/areas?



# SmallCell Deployments



**Office Building, Waukesha, WI:**  
**Indoor Coverage Solution:**  
**12 Access Points** deployed in an enterprise environment

**Customer & Network Experience:**

- **15% Increase in traffic**
- **Combined (metro/macro) drop rates equivalent to the macro network and trending down**
- **Processed more than 50,000 data sessions per day**

★ SmallCells are operational in AT&T network in more than 30 states, spread across corporate high-rise, outdoor, and indoor locations.

- ✓ AT&T has successfully ★ deployed more than 350 SmallCells in Orlando, FL & Anaheim, CA.
- ✓ In both Orlando and Anaheim, areas with SmallCells have experienced >10x increase in mobile voice/data traffic.



**Multiple Enterprise Customers, New York City, NY:**  
**Indoor Coverage & Capacity Solution:**  
**Ex. 20 Small Cells: 4 per floor x 5 floors**

**Customer Satisfaction:**

*"The Metrocell is working very well, we've seen significant improvements with data connection and speed which was our biggest issue before installation. Voice also seems to be working well."*

*"The individuals within the office have seen a stronger signal and are able to make and receive calls in areas that they couldn't before."*

*"The new system seems to be working – my primary benchmark is whether or not I experience dropped calls .... I am not. In the past I received a voice mail notice but the phone never rang to give me an opportunity to answer it now all calls are coming through."*



# DAS – Deployment, Optimization and Platforms



# DAS Commissioning Process (DCP) Standardization

## DAS Commissioning

- Driven standardization of DAS Commissioning
- ATT 5-Step DCP and specialized technique for RF Validation has made significant value to the DAS Ecosystem

## Framework for DCP

### Success

- Collaborative Effort between AT&T and DAS OEMs
- Certification Program
- Set Entry Criteria (Certification, Experience, Documentation, Test Equipment)
- Step by Step Procedures with well defined **core objectives**
- Standardized framework for reporting results and determining success of meeting objectives.

## Successes of 5-Step DCP

- Substantially Reduced Installation Challenges during Optimization Process
- 5 Step Process Adopted and Successfully Implemented by 3<sup>rd</sup> Party Neutral Host Companies
- 5 Step Process Adopted and Successfully Implemented by other Wireless Service Providers (ATT Competitors)



# AT&T 5-Step DAS Commissioning Process

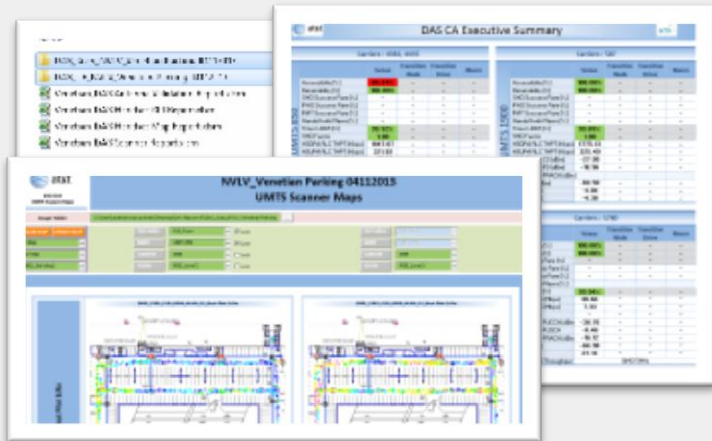
- Step 1: Validate infrastructure is properly installed and **functional**.
- Step 2: Ensure **UL interference** or excessive **UL noise** is not being measured thru external or internal sources – Important for integrity of measurements taken in steps 3,4 & 5)
- Step 3: Validate **RF Connectivity and Quantify UL/DL Loss** – Essential for having a quantified point of reference when integrating RAN with DAS
- Step 4: Quantify UL Noise, Normalize system gain/losses, **maximize UL sensitivity**  
– Key aspect of the architecture that impacts performance of the DAS more than any other part of the architecture is uplink sensitivity.
- Step 5: **Adjust UL/DL signal conditioning levels**, Post RAN & DAS Integration – Maximize performance of the DAS.





# Simplification

**Before**



Data  
Collection



Post  
Processing



Report  
Generation

**After**



&



# Validation and Fault Detection

## Stage 1

SCANNER



Floor	Antenna ID	SC	Max of RSCP (dBm)				Max of Ec/Io (dB)			
			Target	Green	Yellow	Red	Target	Green	Yellow	Red
			<-3.0	<-3.0	<-3.0	<-3.0	<-3.0	<-3.0	<-3.0	<-3.0
			Carrier				Carrier			
			837	862	4359	4384	837	842	4359	4384
Floor 1	2-3-5A	292	-58.8	-58.7	-57.7	-57.7	-2.9	-2.9	-2.8	-2.8
	2-3-5A	292	-68.8	-56.5	-59.2	-63.0	-3.8	-3.9	-3.5	-3.5
	2-3-4A	292	-60.1	-57.8	-62.4	-69.4	-3.3	-3.5	-3.9	-2.1
Floor 2	2-3-5A	292	-53.0	-53.8	-59.0	-61.1	-2.0	-2.0	2.0	-2.0
	2-4-5A	292	-56.0	-44.8	-59.3	-61.1	-1.1	-1.9	1.0	-2.0
	2-4-5A	292	-56.8	-51.3	-59.4	-67.0	-1.0	-1.4	1.9	-0.2
	2-4-5A	292	-58.7	-54.2	-63.2	-64.4	-3.3	-3.3	3.3	-2.8
	2-4-4A	292	-57.0	-55.1	-62.0	-61.0	-3.3	-3.8	2.0	-2.0
Floor 3	3-3-5A	292	-55.2	-54.3	-59.5	-66.1	-2.0	-2.1	-2.6	-2.3
	3-3-5A	292	-56.9	-52.8	-62.8	-67.9	-2.0	-3.2	2.0	-2.4
	3-3-5A	292	-55.7	-54.5	-60.2	-67.7	-2.9	-3.8	2.0	-2.0

## Stage 2



LTE

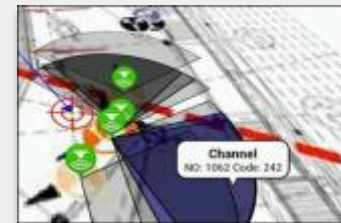
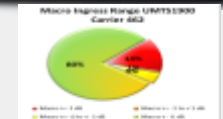


UMTS, LTE,  
VoLTE & Small  
Cells



2 Hours

## Stage 3

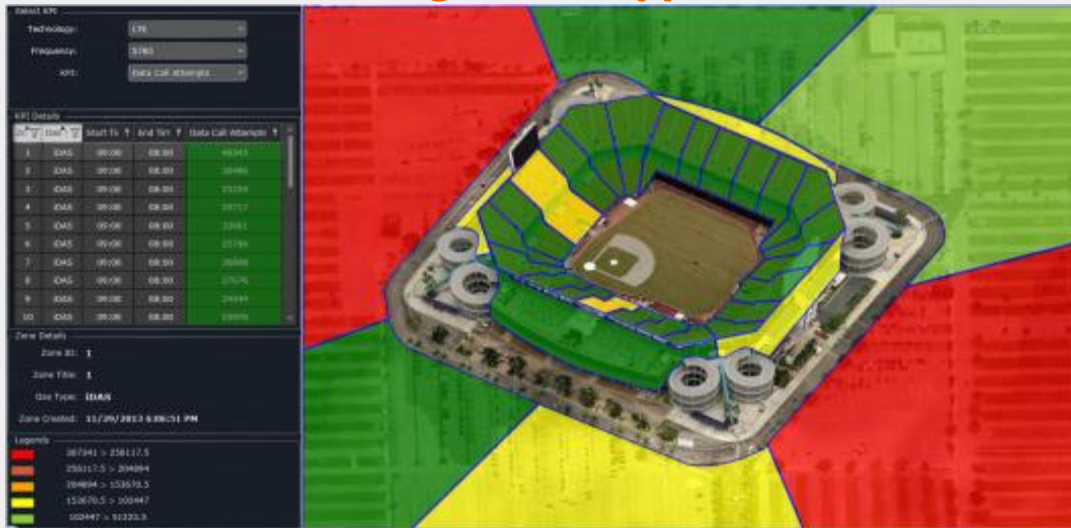


Real-Time

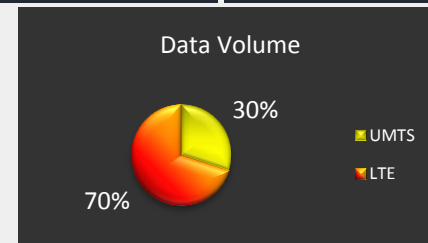
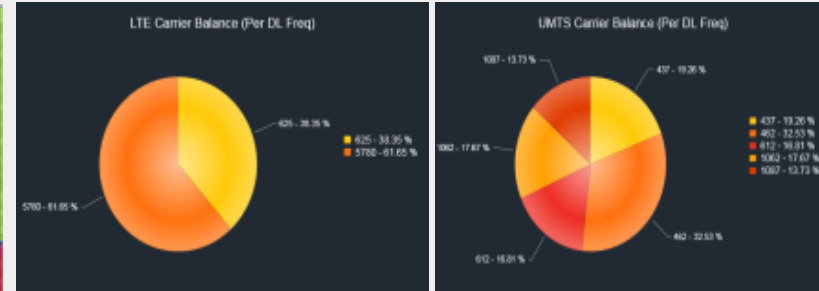


# Real-Time Event Monitoring – Hi Cap parameters transforming mobility into capacity

## KPI Visualization using Zone Mapper



## Traffic Balance View



### UMTS & LTE Summary Report (Venue Level)

Info		UMTS										LTE									
DAS Type	Start	End	Zone/Carrier	CS Acc	CS Ret	CS Acc	CS Ret	PS Acc	PS Ret	PS Acc	PS Ret	DL Thrt (Mbps)	DL Vol (TB)	UL Thrt (Mbps)	UL Vol (TB)	DL Thrt (Mbps)	DL Vol (TB)	UL Thrt (Mbps)	UL Vol (TB)		
iDAS	09:00:00	20:00:00	28/6	99.99	99.9	42.7	99.99	99.72	885	16975.5	80	NA	35	2872	99.1	1553	99.54	4.5	135	1.1	52
eDAS	09:00:00	20:00:00	18/6	99.88	99.9	60	99.93	99.79	744	27108	121	NA	25	1872	99.74	1128	99.79	7.1	207	2.6	37

## Auto emails every 15 min



## Top Offenders

(Data Accessibility)					
Cell ID	Zone ID	Type	DL Freq	Rate %	Total Failures
MOL02954_7A_1	13	eDAS	5780	97.91	6945
MOL0502					

(Data Retainability)					
Cell ID	Zone ID	Type	DL Freq	Rate %	Total Failures
MOL0502_7T_1_DB	6	iDAS	5780	99.21	500
MOL0501_PS_1					

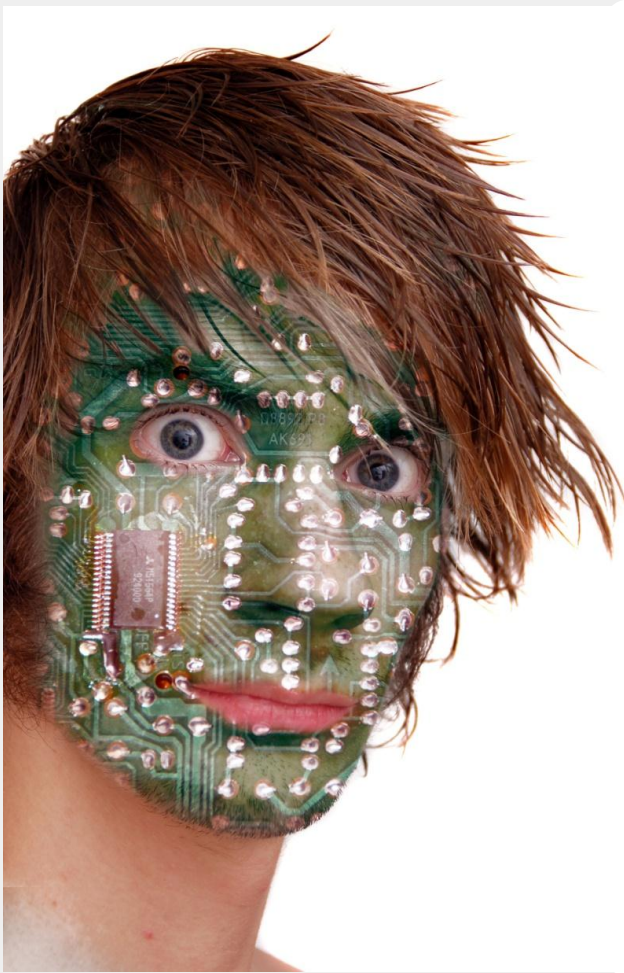
(PS Retainability)					
Cell ID	Zone ID	Type	DL Freq	Rate %	Total Failures
MOL05211	9	iDAS	5780	99.26	387
MOL05247					

(PS Accessibility)					
Cell ID	Zone ID	Type	DL Freq	Rate %	Total Failures
MOL035157	6	Mp...	402	99.37	64
MOL05042	11	iDAS	4115	98.61	45



## ION-U

### Embedded Intelligence

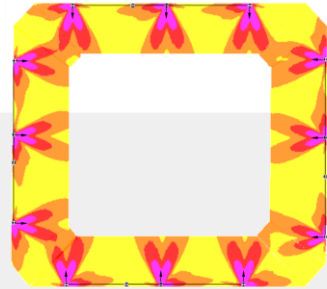
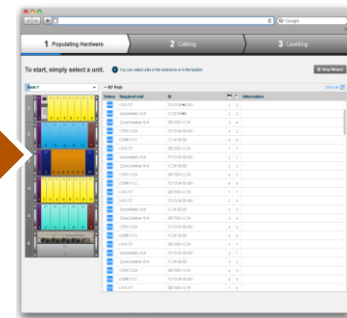


❑ System Configuration Tool

❑ Installation Wizards

❑ Auto Setup/System Commissioning

❑ System Optimization Tool



# Corning MobileAccess



- Integrated Capabilities

- Single Platforms that can handle Cellular, WiFi and Applications

- Ease of Installation

- Software Wizards – Automating the Process; Integrating Planning stage into Commissioning
- Backplanes and Harnesses to Reduce Wiring; Stubbed Solutions to Reduce Field Splicing

- Cost Reduction

- Smaller footprints
- Direct Connect between the BTS and DAS @ Low, Medium and High Power Solutions

- Future Proofing for Additional Bands, LTE and MIMO

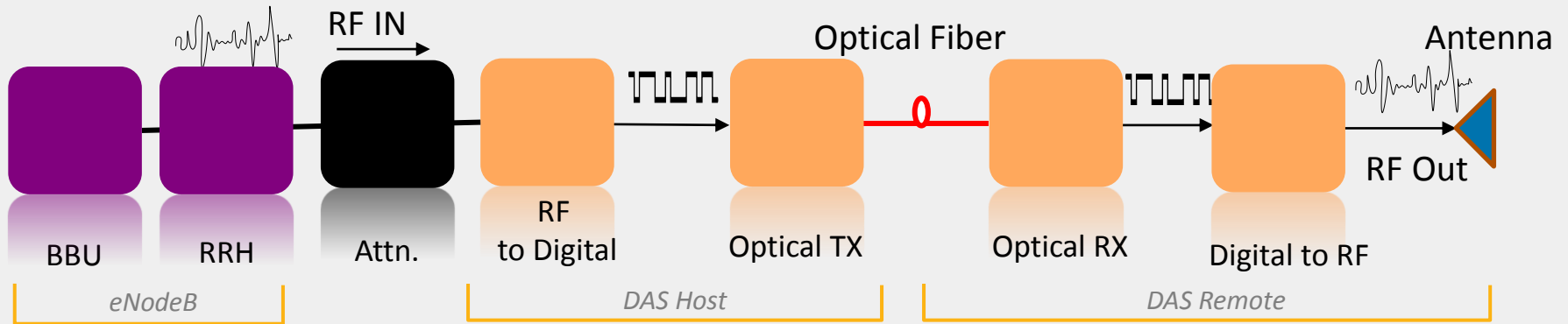
- Modular Solutions that is easy and field upgradable; Software Definable Radios
- Capacity Steering

- Adding Applications to the DAS

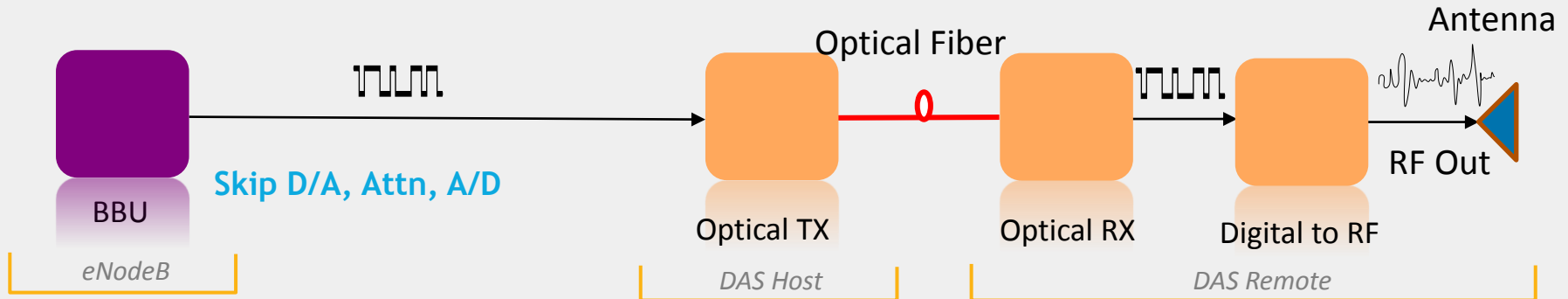
- Location Based Services; POS; Healthcare and Hospitality Applications



## TE Digital RF Transport DAS with Traditional RF input



## TE / ALU Digital DAS



# CIPRI/Digital Interface Brings Efficiencies

- ✓ **Direct CPRI connectivity to DAS**
  - ✓ Eliminates unnecessary RF conversion & amplification
  - ✓ Eliminates attenuation, POI interface and RF cabling
- ✓ **Capital Cost**
  - ✓ Reduces number of elements
- ✓ **Deployment Cost**
  - ✓ Eliminates rack space required for DAS infrastructure
- ✓ **Operating Cost**
  - ✓ Saves energy
  - ✓ Saves HVAC required when attenuating RF inputs for DAS
- ✓ **Quality Improvement**
  - ✓ Improved EVM (error vector magnitude)
  - ✓ Improved ACLR (Adjacent Channel Leakage Ratio)



# Case Study - Arena

- ✓ 7 Sectors
- ✓ Current Configuration (each/sector)
  - ✓ 2 - 850 WCDMA
  - ✓ 2 - 1900 WCDMA
  - ✓ 1 - 700 LTE (5MHz)
  - ✓ 1 - 2100 LTE (10MHz)
- ✓ CDIU Deployment (Phase 1)
  - ✓ AWS from RF DARTS → CDIU
  - ✓ Compare Pre and Post
  - ✓ Eliminate 7 RRH, 7 DAS trays and POI cabling
- ✓ Phase 2
  - ✓ 700 from RF DARTS → CDIU

Green Experience



Before

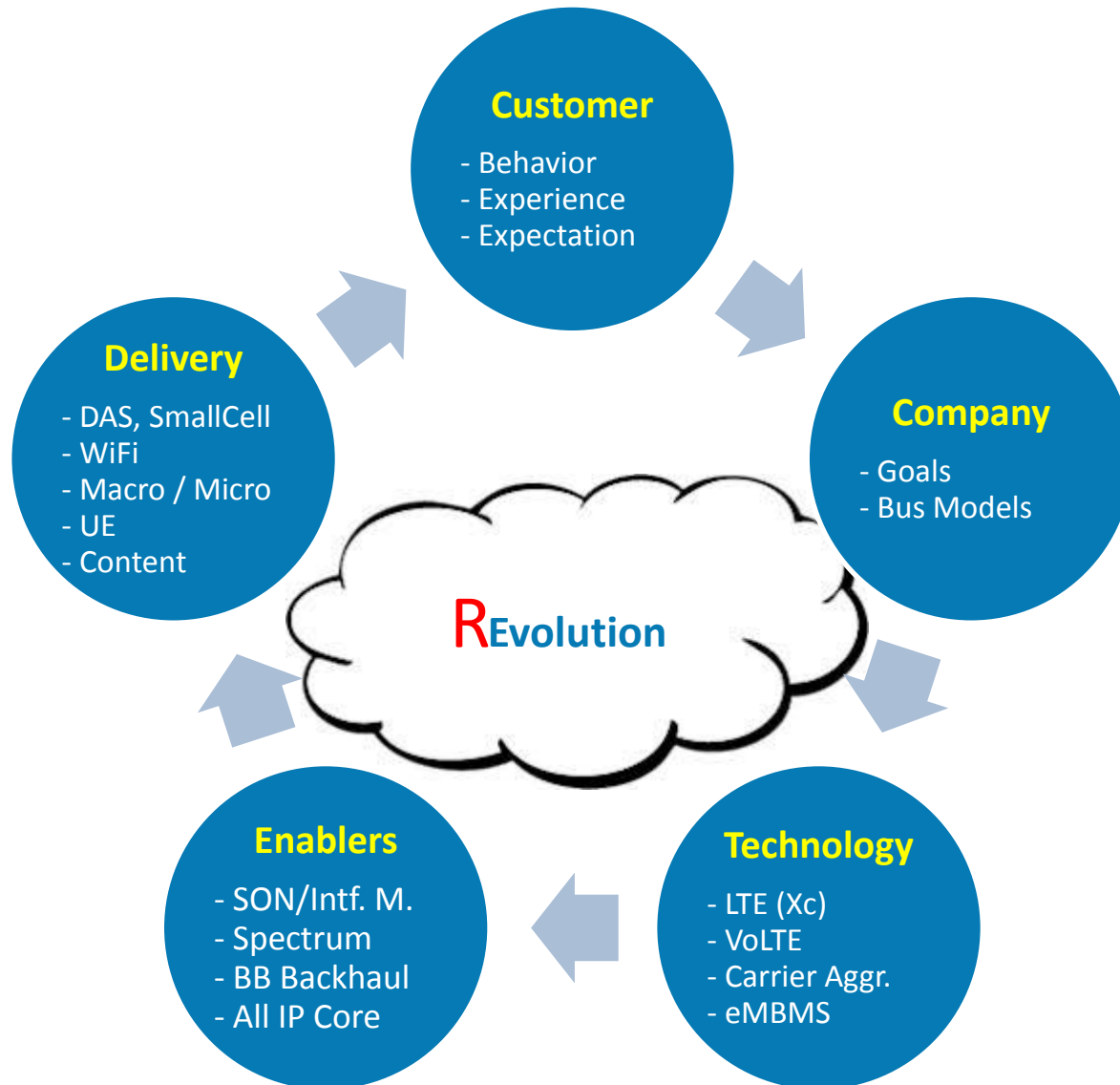


After





# In Conclusion...



# Q&A



Thank you.

