Designing & Deploying Wireless LAN Systems

Interference-Free™ 4th Generation Wi-Fi

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Extricom

- Vitals
  - Principal offices in New York, London, Tel-Aviv, Tokyo
  - Founded 2002
  - Strategic Investors include Motorola & Belden
  - Patented: 18 filed, 5 granted
  - CTO is one of original members of IEEE 802.11 group
  - Distribution - Worldwide through Distributors, Resellers, and OEMs
- Our Proposition
  - Superior performance and dramatic simplicity
  - Multi-use infrastructure – voice, data, location, video, guest services

Extricom

The Realities of 802.11

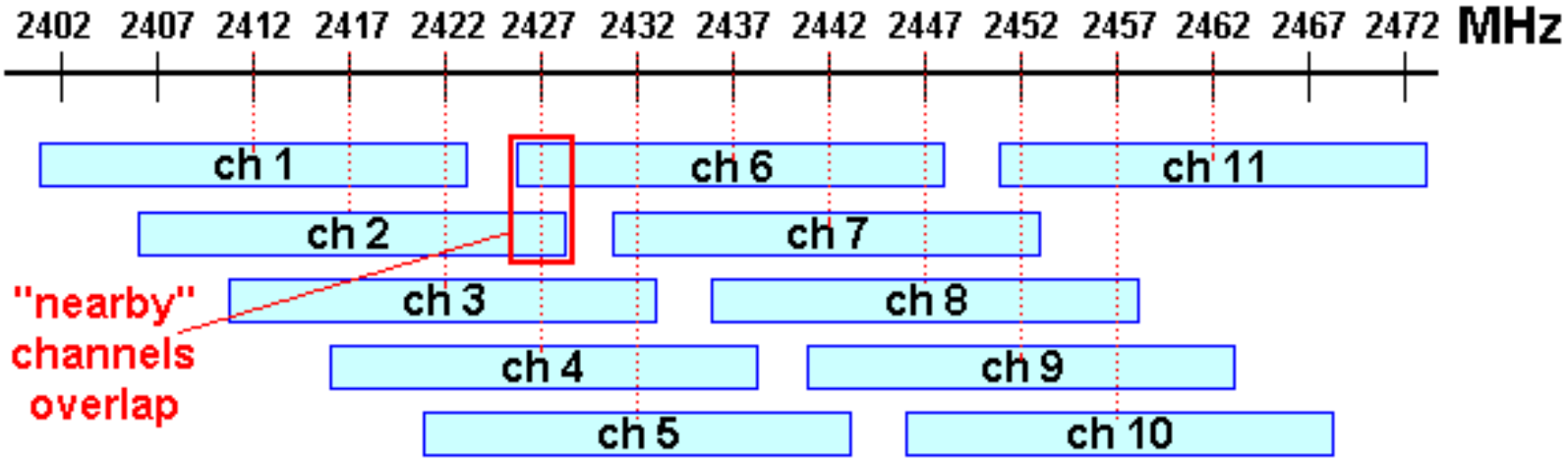
The Realities of 802.11

- Frequency constrained
  - Only 3 non-overlapping channels available for 802.11b/g (2.4 GHz)
- Protocol designed for portability, not mobility
  - Handoff decision is up to the client, instead of the infrastructure
- Mixed mode (b/g) backward compatibility degrades capacity
- Voice and data contention degrades capacity and service quality
- WiFi networks are a challenge to install and maintain

These traits are inconsequential in small deployments.
But have major implications for mid-to-large enterprise systems.

Frequency constrained

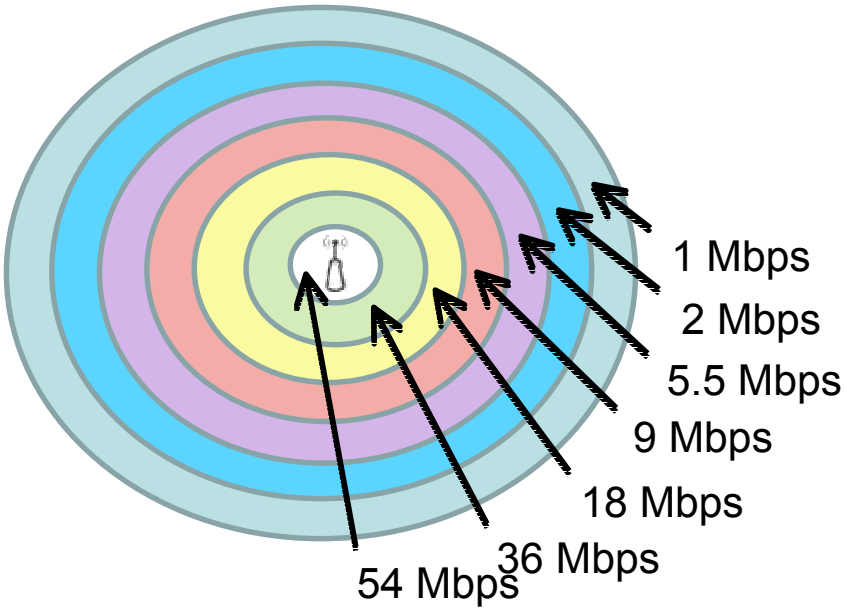
Only 3 non-overlapping channels available for 802.11b/g (2.4 GHz)



Regulatory Domain	Allowed Channels
US (FCC) / Canada (IC)	1 to 11 (2.412-2.462 GHz)
Europe, excluding France & Spain (ETSI)	1 to 13 (2.412-2.472 GHz)
France	10 to 13 (2.457-2.472 GHz)
Spain	10 to 11 (2.457-2.462 GHz)
Japan (MKK)	14 (2.484 GHz)

Protocol designed for portability, not mobility

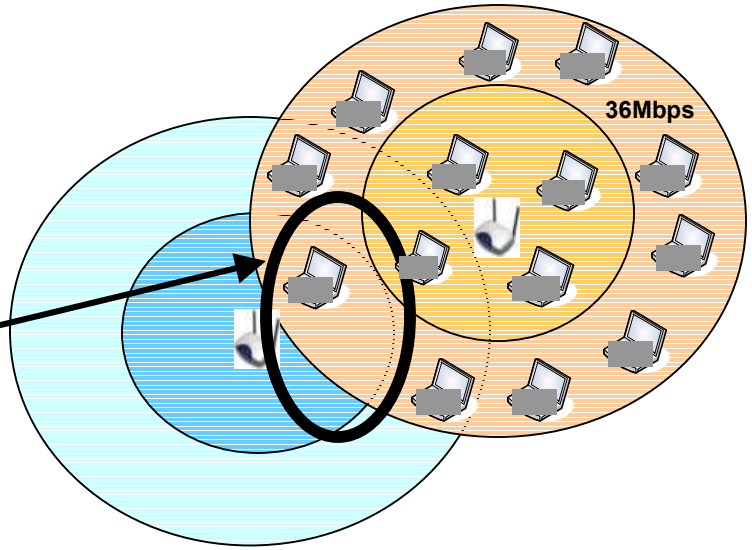
Handoff decision is up to the client, NOT the infrastructure



To achieve the maximum data rate, you have to be very close to the AP (around 30 feet)

Clients rate-adapt when moved further away from the AP

"Edge-Users" lower the throughput of the entire system



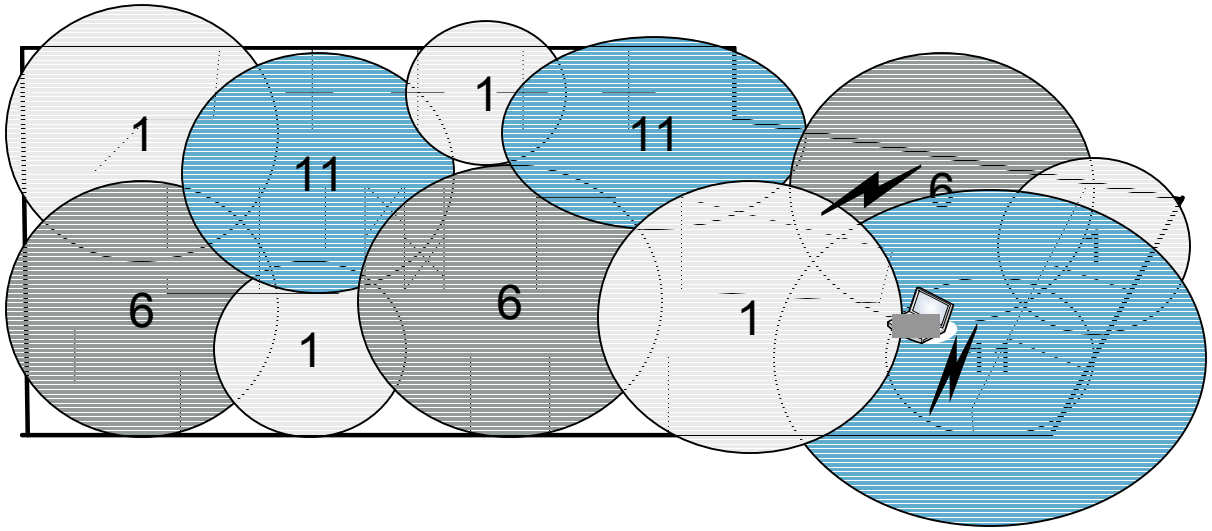
Client holds on to current AP, at lower data rate, even if another AP is available to serve it at higher data rate.
Result: Client Bunching

Protocol designed for portability, not mobility

Handoff decision is up to the client, NOT the infrastructure

What is the effect in a traditional controller based system?

Dropped sessions, Latency, Jitter



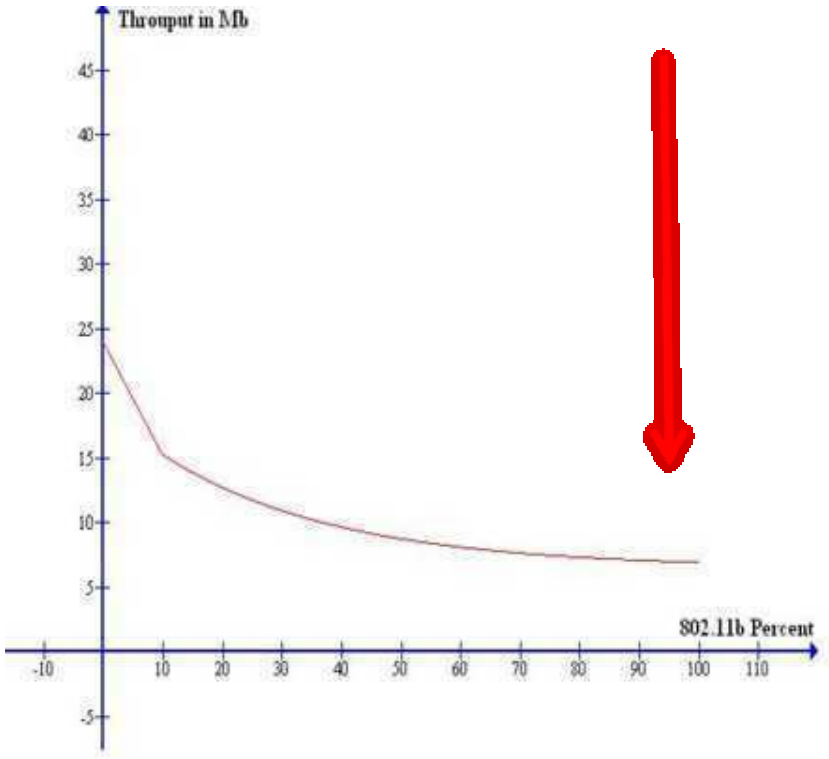
Client Introduced to System
- AP Association

Client Roaming
- Data Rate Adaptation

Forced de-Association and
- re-Association to a new AP

Mixed mode (b/g) backward compatibility degrades capacity

- 802.11g backwards compatible with 802.11b
- A single 802.11b user lowers the throughput of the entire system
- 802.11g in “mixed mode” is not much better than 802.11b
- 802.11n is likely to behave the same, when backward compatible to .11a and .11g



Introducing 10% 802.11b users to a pure 802.11g system reduces throughput by 44%

Based on:
IEEE 802.11g Network Behavior in a Mixed Environment,
by Jim Zyren, Tim Godfrey, and Menzo Wentink. Intersil Corporation, 2003

Mixed mode (b/g) backward compatibility degrades capacity

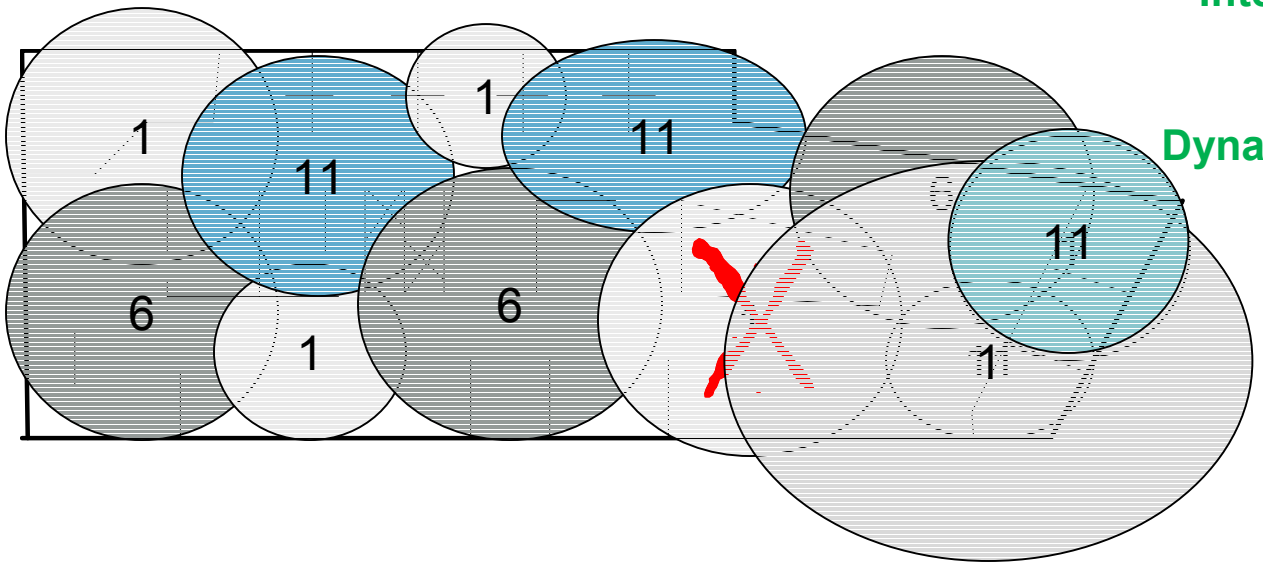
#802.11b Clients	0	1	2	3	4	5	6	7	8	9	10
	Number of 802.11g Clients										
10	*7.9*	8.3	8.7	9.1	9.5	9.8	10.1	10.4	10.7	11.0	11.2
9	7.9	*8.4*	8.8	9.3	9.6	10.0	10.3	10.7	11.0	11.2	11.5
8	7.9	8.4	*8.9*	9.4	9.8	10.2	10.6	10.9	11.2	11.5	11.8
7	7.9	8.5	9.1	*9.6*	10.1	10.5	10.9	11.2	11.6	11.9	12.1
6	7.9	8.6	9.3	9.8	*10.3*	10.8	11.2	11.6	12.0	12.3	12.6
5	7.9	8.7	9.5	10.1	10.7	*11.2*	11.7	12.1	12.4	12.8	13.1
4	7.9	8.9	9.8	10.6	11.2	11.8	*12.3*	12.7	13.1	13.4	13.7
3	7.9	9.3	10.3	11.2	12.0	12.6	13.1	*13.5*	13.9	14.3	14.6
2	7.9	9.8	11.2	12.3	13.1	13.7	14.3	14.7	*15.1*	15.4	15.7
1	7.9	11.2	13.1	14.3	15.1	15.7	16.1	16.5	16.8	*17.0*	17.2
0	0.0	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	*30.5*

Table 3.1-1 IEEE 802.11g Network Throughput Depends on Number and Type of Client Associated with AP

IEEE 802.11g Network Behavior in a Mixed Environment, by Jim Zyren, Tim Godfrey, and Menzo Wentink. Intersil Corporation, 2003

Mixed mode (b/g) backward compatibility degrades capacity

What is the effect in a traditional controller based system **if an AP malfunctions or is removed?**



Interference Detection and Avoidance & Dynamic Channel Assignment

Dynamic Transmit Power Control

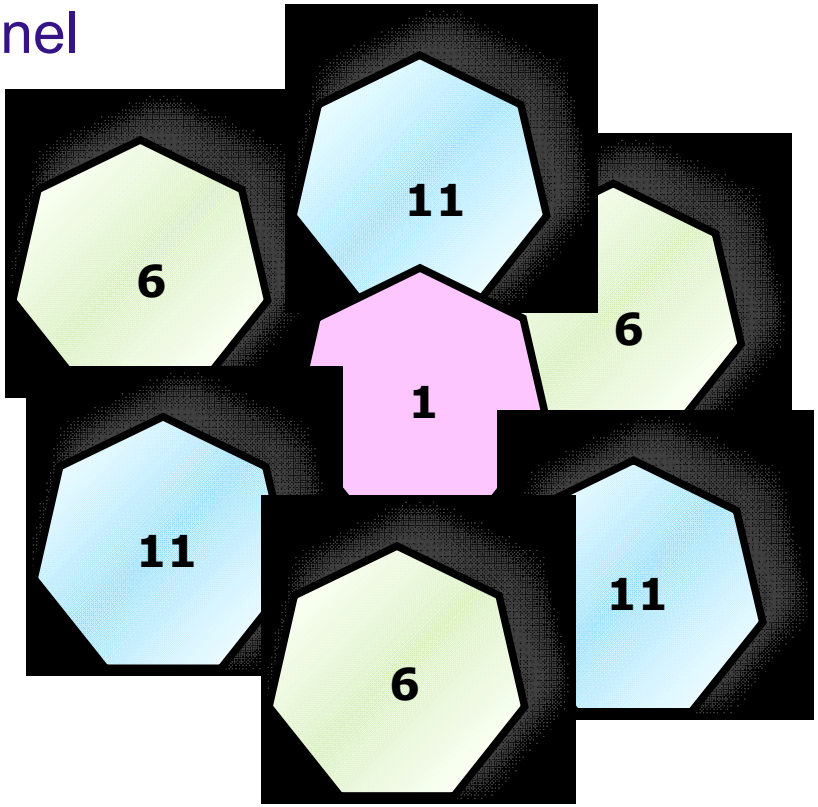
Coverage Hole Detection and Corrected – But what about Throughput

Traditional Wi-Fi Cell Topology

The Traditional Cell-Planning WLAN Approach

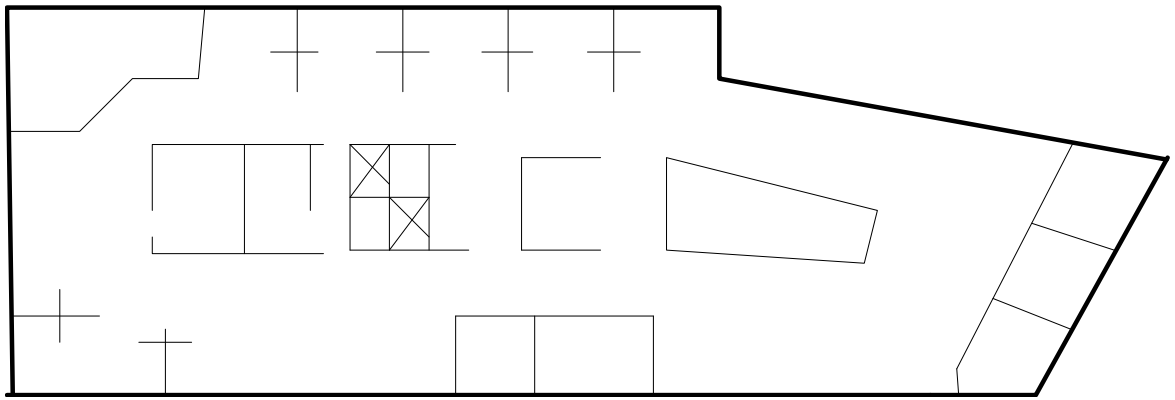
- Each Access Point (AP) is assigned a channel
- APs distributed to minimize interference between any two APs operating on the same channel

This architecture is impaired by the 802.11 Standard.



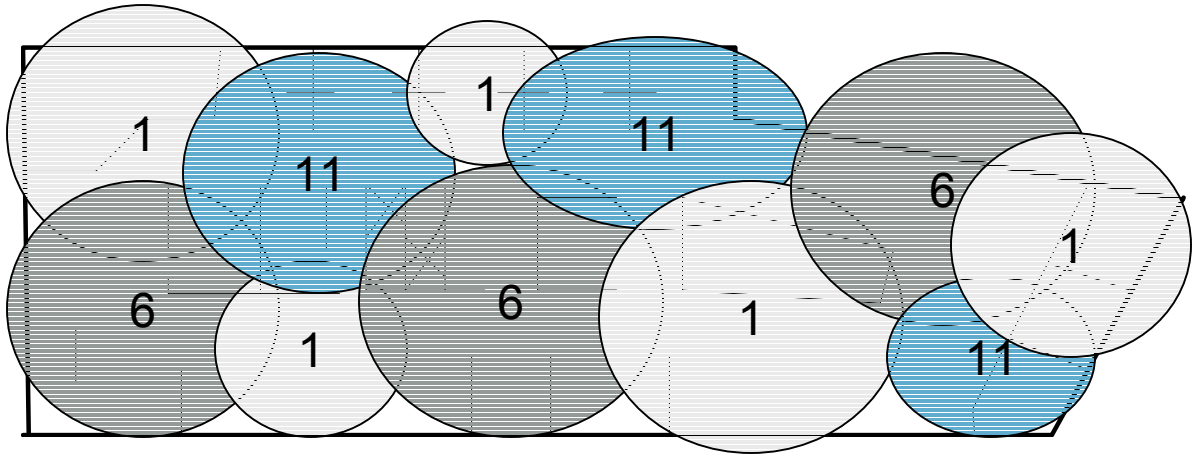
Traditional Cell Based Installation

- Start with an office and/or warehouse
- Core Question: How do I provide *complete coverage*, providing the *greatest bandwidth*, with *no co-channel interference*?



Design – A Multi-Variable Problem

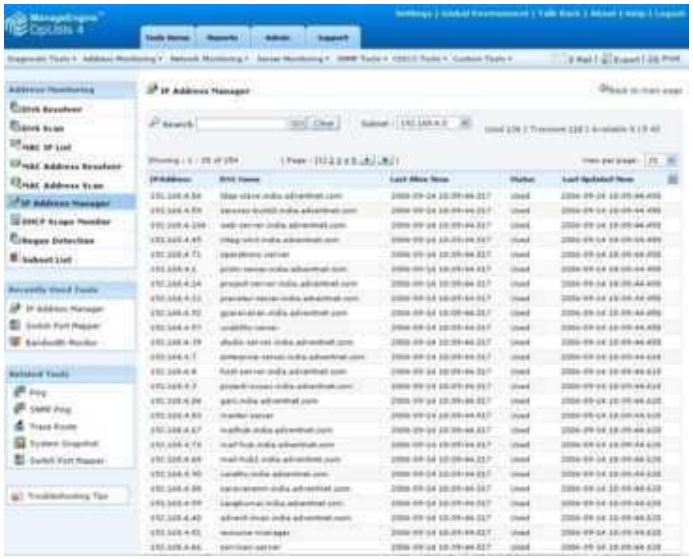
- Number and Location of APs – a function of desired data rate
- Channelization – 3 channels at 2.4GHz
- Co-Channel Interference – a function of channel reuse
- AP-to-AP Overlap Zones – impacts handoff and client distribution
- Collision Domain Sharing – impacts bandwidth / throughput
- Transmit Power
- Antenna Type

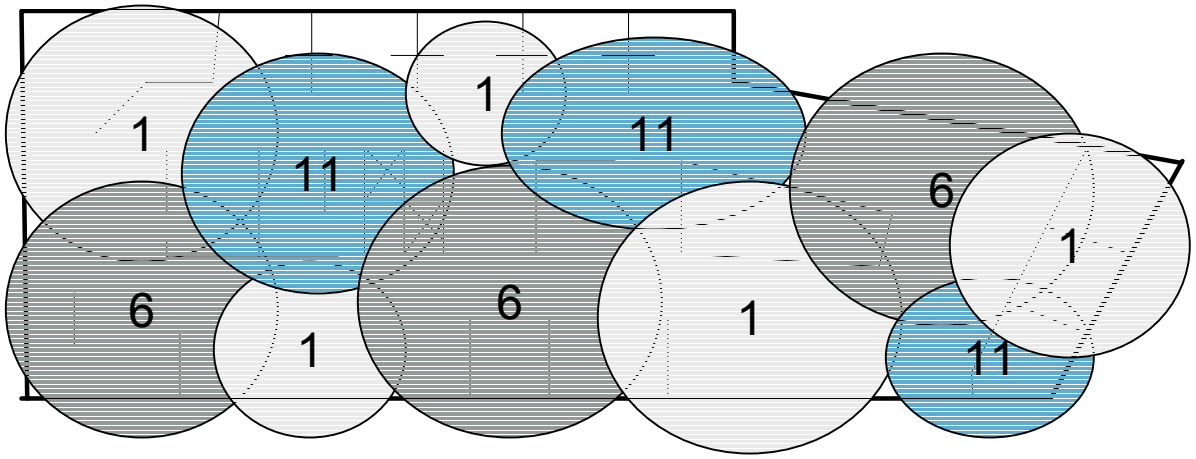


Deploy

- Configure each AP and switch
- Create an IP map to assign

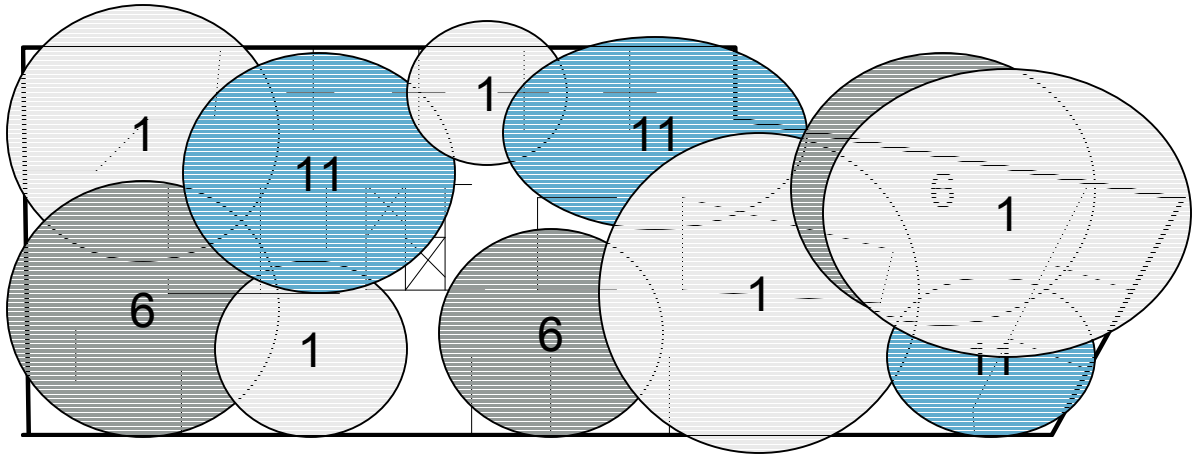
  IP address to each AP





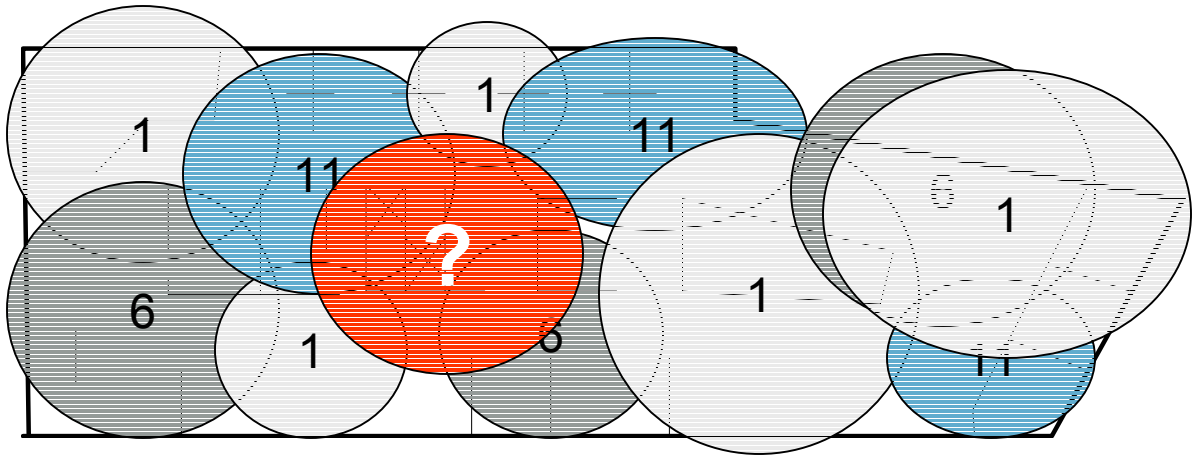
Validate

- For each AP, measure actual downlink data rate
- Identify overlap, assess handoff points
- Measure throughput per AP, and at the switch (aggregate) – is collision domain sharing occurring?



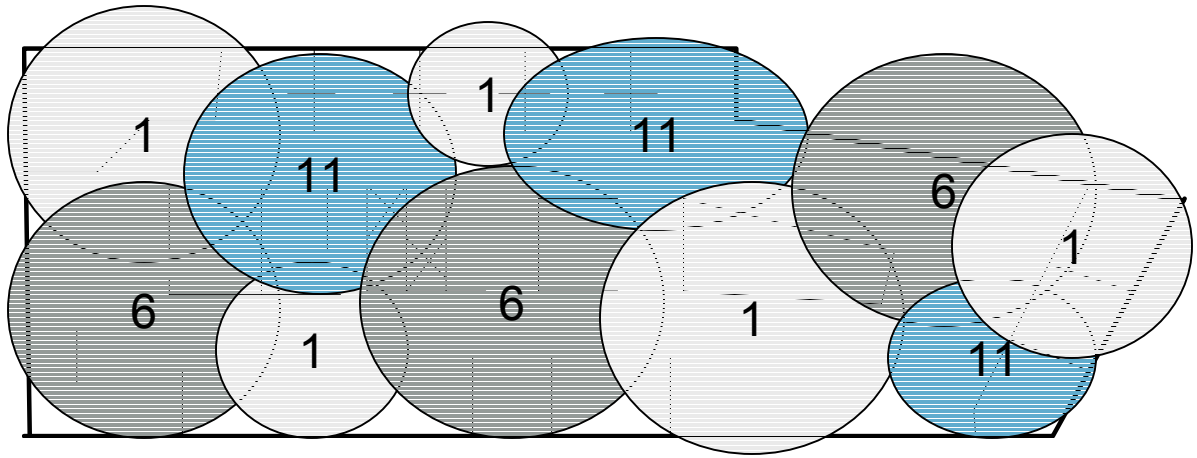
Adjust

- Dead Spot – start over with channelization; may need to change data rate target
- Co-channel interference – re-channelize, adjust power



Design	❑ Number and Location of APs ❑ Channelization ❑ Co-Channel Interference ❑ Predict Overlap Zones ❑ Predict Collision Domain Sharing ❑ Transmit Power ❑ Antenna Type
Deploy	❑ Configure each AP and Switch ❑ Create IP map to assign IP address to each AP
Validate	❑ For each AP, measure downlink data rate ❑ Find overlap zones – measure handoff effectiveness ❑ Identify collision domain sharing – aggregate throughput
Adjust	❑ Re-channelize, re-model

802.11 Implemented in a Cell Topology



COMPLEX

- **Need RF expertise**
- **Ongoing "tweaking"**
- Device configuration burden

GIVE-AND-TAKE PERFORMANCE

- **Always Co-channel interference**
- **No guarantees on throughput**
- Coverage "black holes"
- Portability, not mobility
- **Unreliable wireless connections**
- Security conflicts with mobility

INFLEXIBLE

Everyone competes for the same wireless resource

“Channel Blanket” Architecture and Capabilities

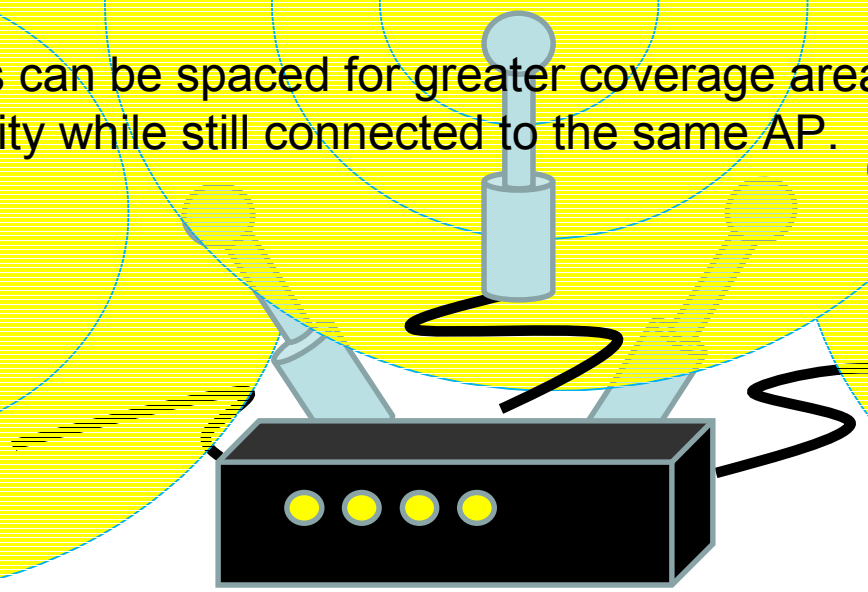
What if this “simple”, “Interference Free”, Single Access Point Design was made Scalable?

First: Let’s separate the “wireless” from the LAN

And if we add more antennas… What do we gain?

Benefit:
The Radios can be spaced for greater coverage area, allowing users more mobility while still connected to the same AP.

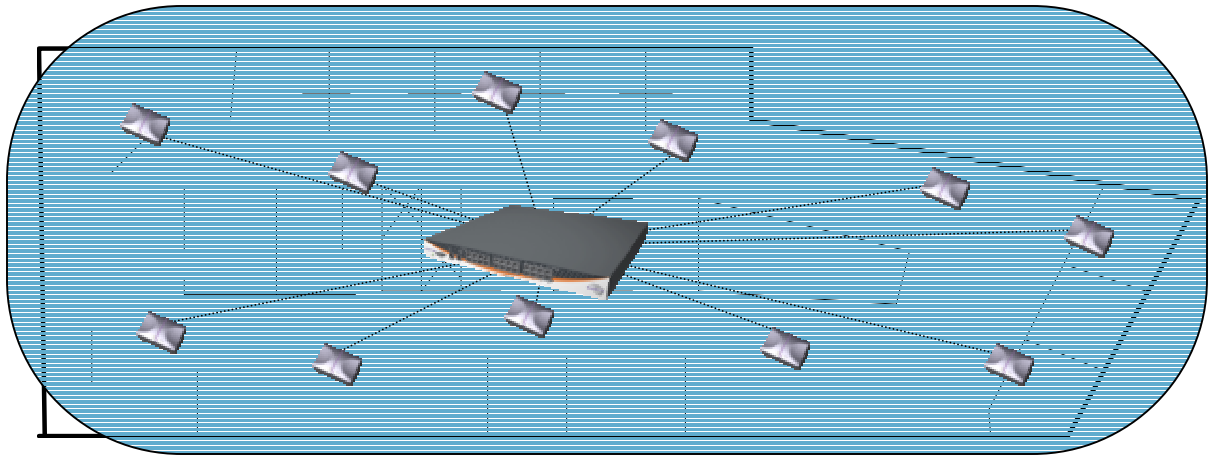
Greater Coverage
Greater Capacity
Greater Mobility



How many AP’s are installed?

1

Simple - Self Adapting Architecture



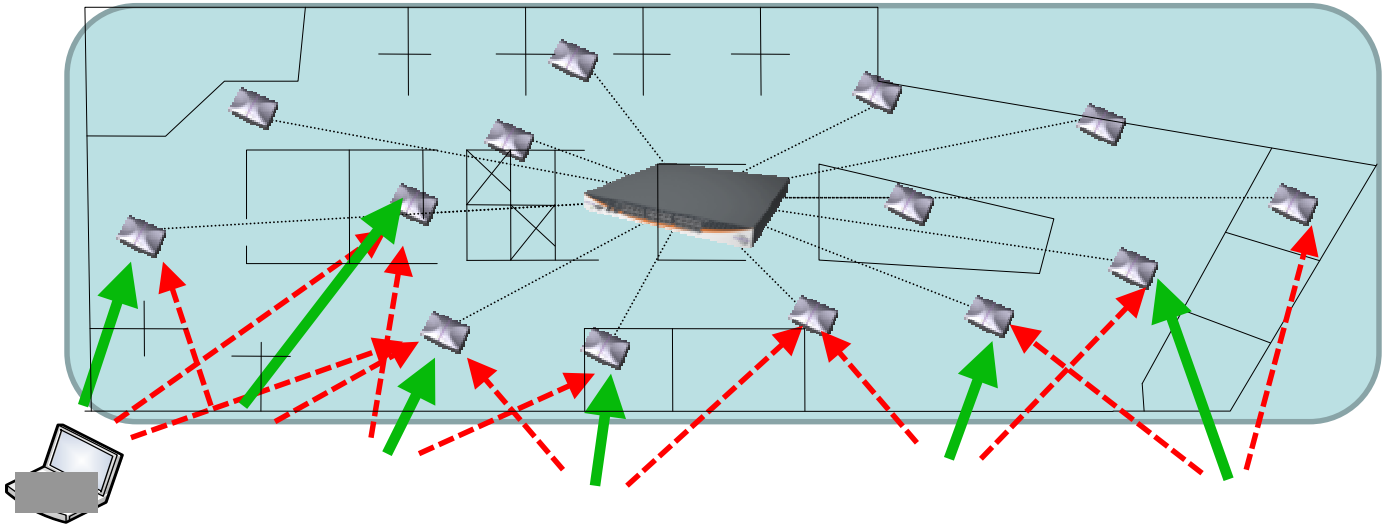
- The channel blanket is formed from the aggregate coverage of all the APs
- APs operate on the same channel(s) to create the channel blanket
- The Switch completely controls the APs, preventing co-channel interference
- The AP is only a radio/antenna; no software, no configuration; no IP address, no processing
- **The Client associates with the switch, not the AP; the APs are simply conduits between the client and the switch**

The system offers guaranteed bandwidth – based on the self adapting architecture

Extricom Efficiency - Interference-Free™

All APs on same channel, at Full Power, with no Co-Channel Interference

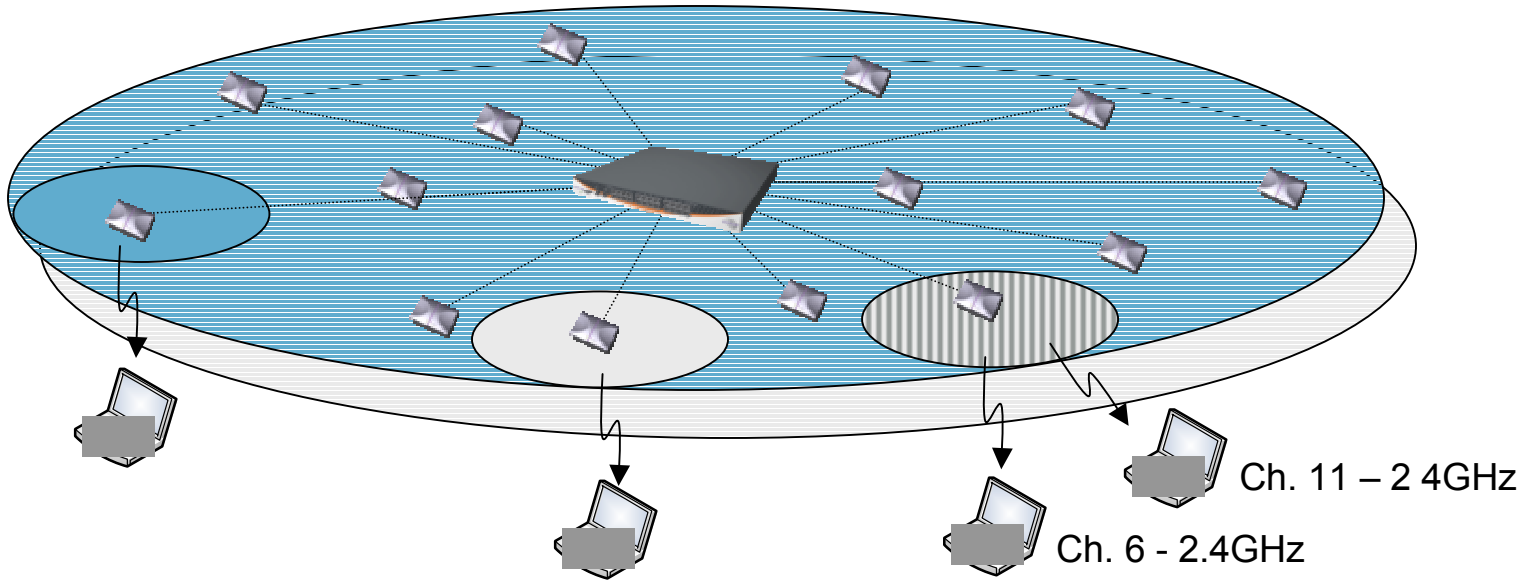
Guaranteed Data Rate, Zero Latency, True Mobility, and Quality of service Regardless of the AP Density



Extricom offers Guaranteed QOS using Frequency based VLANs

Feature - Multi-Layered System – Same Band Configuration

- Multi-Radio APs enable overlapping channel blankets on different channels, even **same band**, from the **same set of APs**
- Guarantee QoS and security by segmenting different traffic / device / user types over physical channel bandwidth



Simple to install – Average AP placement based on Data Rate required in SLA

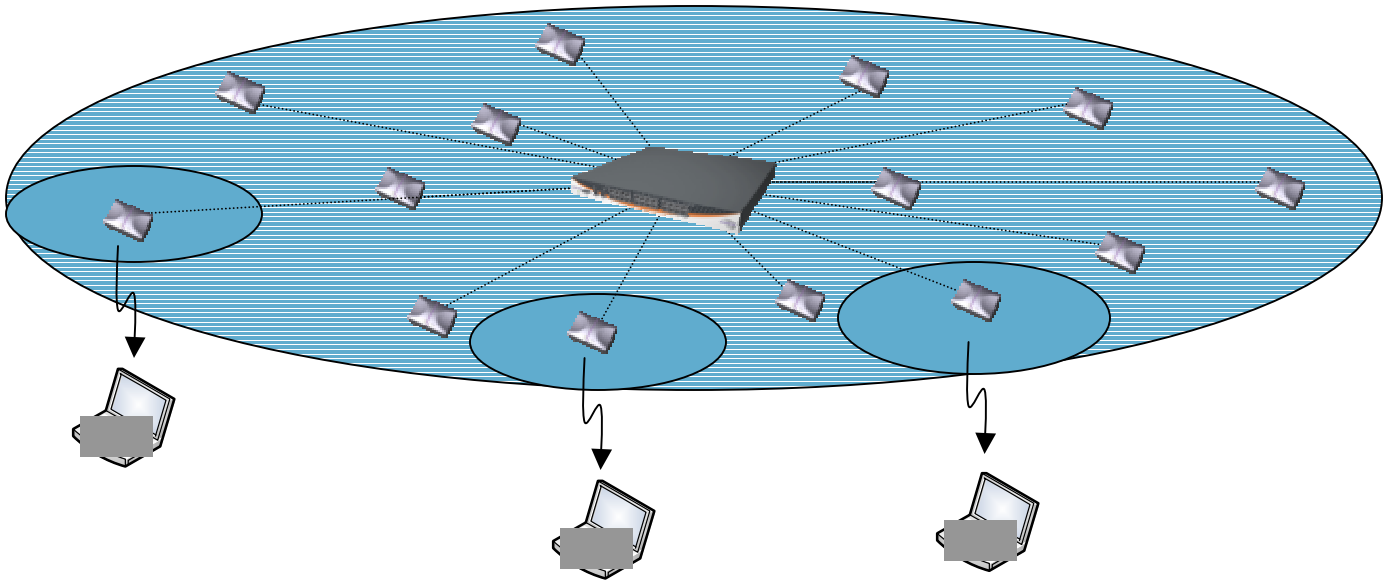
Band / Mode	Data Rate	Throughput(2)	Range(1)
2.4GHz, .11b	11 Mbps	6.5 Mbps	209’
2.4GHz, .11g	54 Mbps	30 Mbps	55’
5GHz, .11a	54 Mbps	30 Mbps	36’

Data Rate, Throughput, and Range Relationship

(1) Assumes propagation exponent 3.3, 6dB link margin
(2) Very high overhead (due to IFS, PLCP, and MAC)

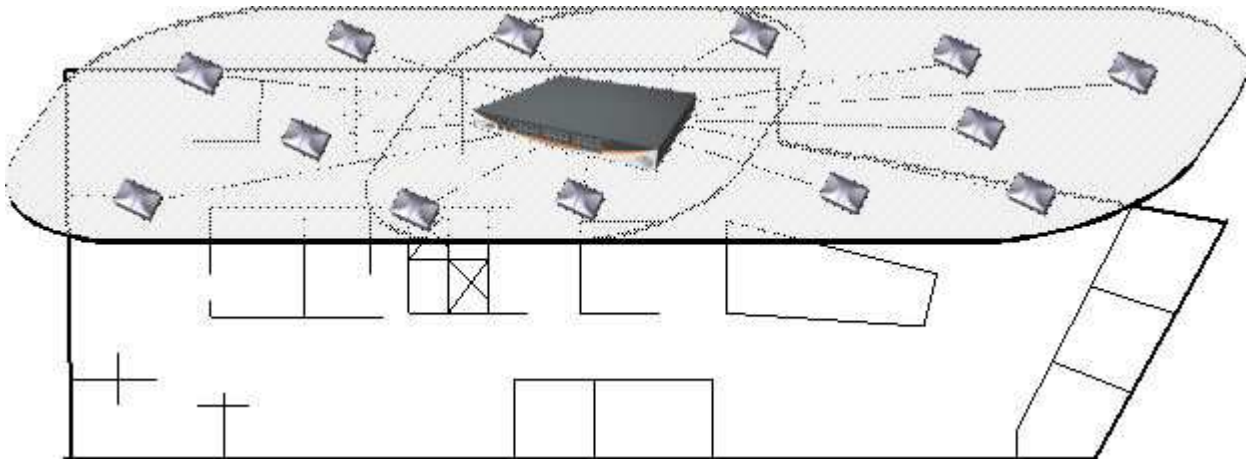
TrueReuse CREATES MORE EFFECTIVE BANDWITH

Designed to increase the effective bandwidth by 3+ times



- Channel blanket dynamically “subdivided” into multiple collision domains, to create simultaneous multiple links without co-channel interference
- Switch uses real-time knowledge of link differentials between all clients and all APs to determine the re-use opportunity

The Extricom Channel Blanket Approach

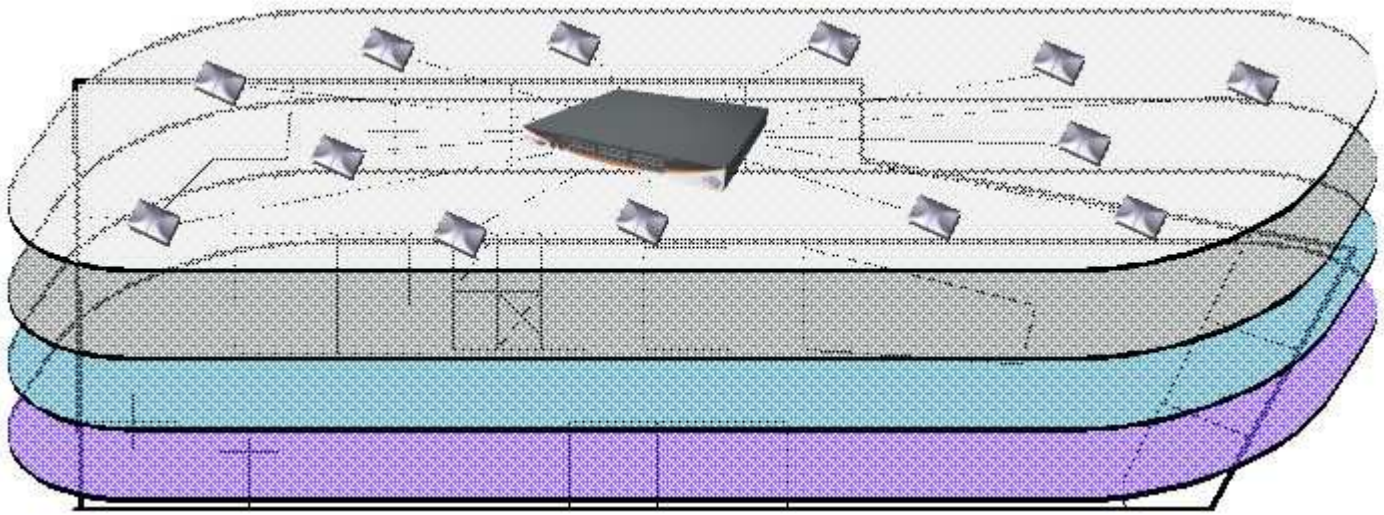


The Channel Blanket

Centralize 802.11 Logic, Distribute the Radio Only

- Experience of a Single Cell, plus:
- Wide-Area Coverage
- Guaranteed Bandwidth
- Link Stability

The Extricom Channel Blanket Approach



The Channel Blanket

Centralize 802.11 Logic, Distribute the Radio Only

- Experience of a Single Cell, plus:
- Wide-Area Coverage
- Guaranteed Bandwidth
- Link Stability

+

Multi-Layer WLAN

Distributed two or four radios per AP. Radios operate in b, g or a mode

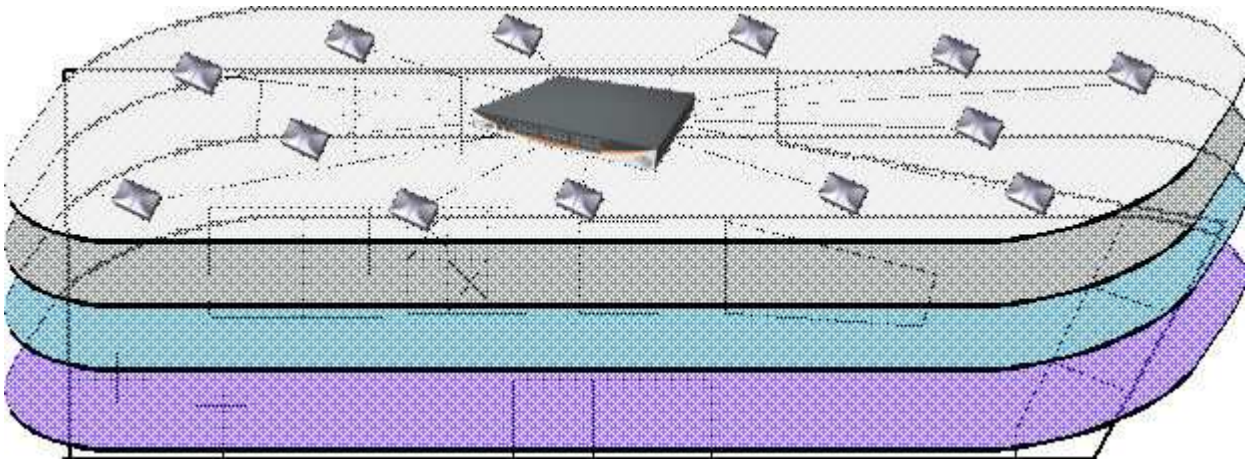
- Capacity
- Simplified QoS
- Dedicated Security Monitoring

+

TrueReuse™ Dynamic frequency reuse

- Coverage with Capacity
- 3X BW per Channel
- Up to 10X Aggregate Bandwidth

The Extricom Interference-Free™ Architecture



SIMPLE

- No RF cell planning
- Plug-and-play install
- Zero-configuration AP

CAPABLE

- No co-channel interference
- Guaranteed throughput
- Zero-handoff mobility
- Complete coverage
- TrueReuse™ - up to 10X Bandwidth
- Wire-like connection
- Secure while mobile, even WPA

FLEXIBLE

- Multi-Layer WLAN
- Guarantee QoS by separating:
  - voice, data, video
  - 802.11b and .11g
  - private / public zones

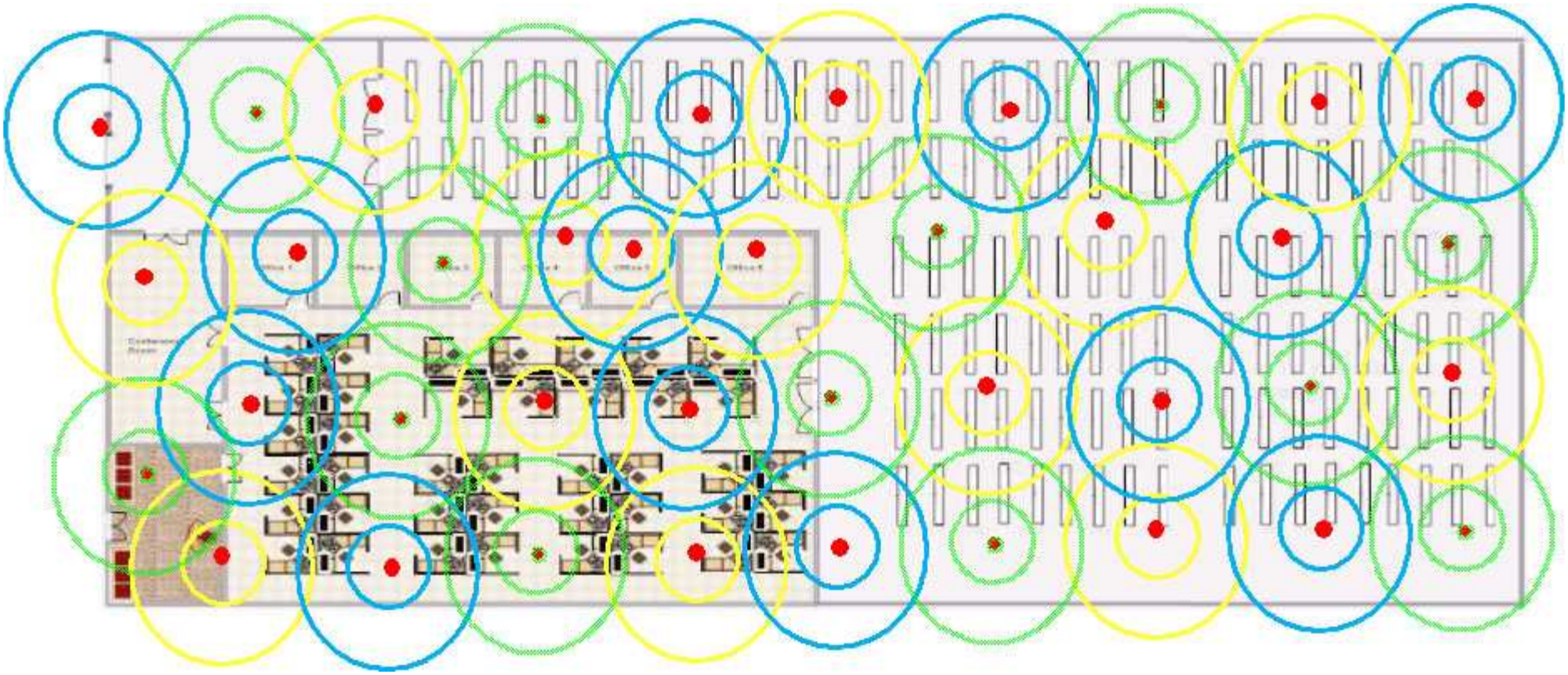
Design Simple to Design	❑ Number and Location of Aps Based on the desired data rate ❑ ~~Channelization~~ ❑ ~~Co-Channel Interference~~ ❑ ~~Predict Overlap Zones~~ ❑ ~~Predict Collision Domain Sharing~~ ❑ ~~Transmit Power~~ ❑ ~~Antenna Type~~
Deploy Simple to Deploy	❑ ~~Configure each AP and Switch~~ Configure Switch only ❑ ~~Create IP map to assign IP address to each AP~~ One IP for switch
Validate Simple to Validate	❑ ~~For each AP, measure downlink data rate~~ ❑ ~~Find overlap zones – measure handoff effectiveness~~ ❑ ~~Identify collision domain sharing – aggregate throughput~~ ❑ Measure desired data rate for channel – ***one pass***
Adjust Simple to Adjust	❑ ~~Re-channelize, re-model~~ ❑ Add and/or move one AP – no config, no re-planning

Large Warehouse

Design

Cell Based

- Fat APs
- Co-Channel Interference
- No QoS
- ‘Best Effort’ Throughput
- Roaming only through Proprietary Client

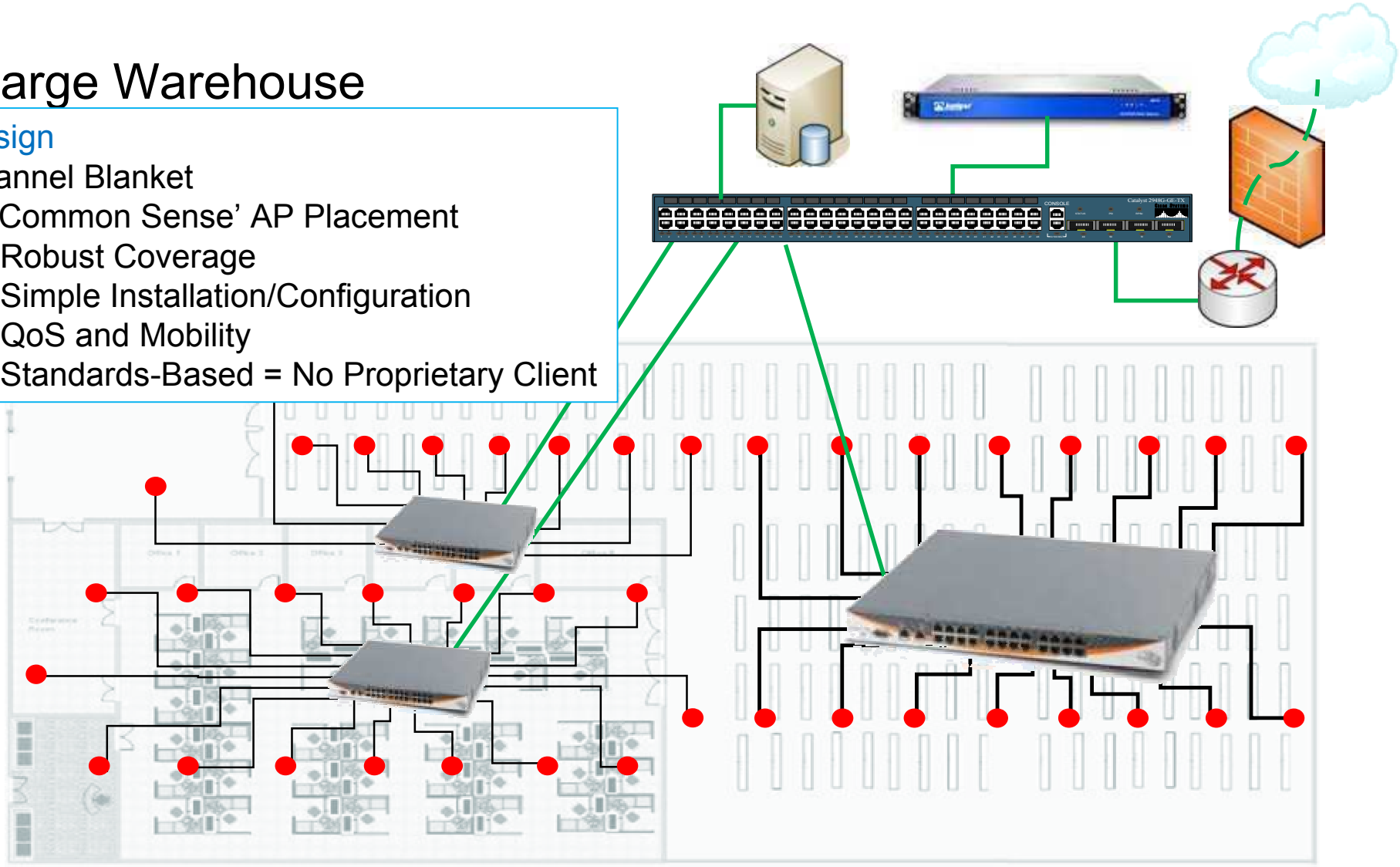


Large Warehouse

Design

Channel Blanket

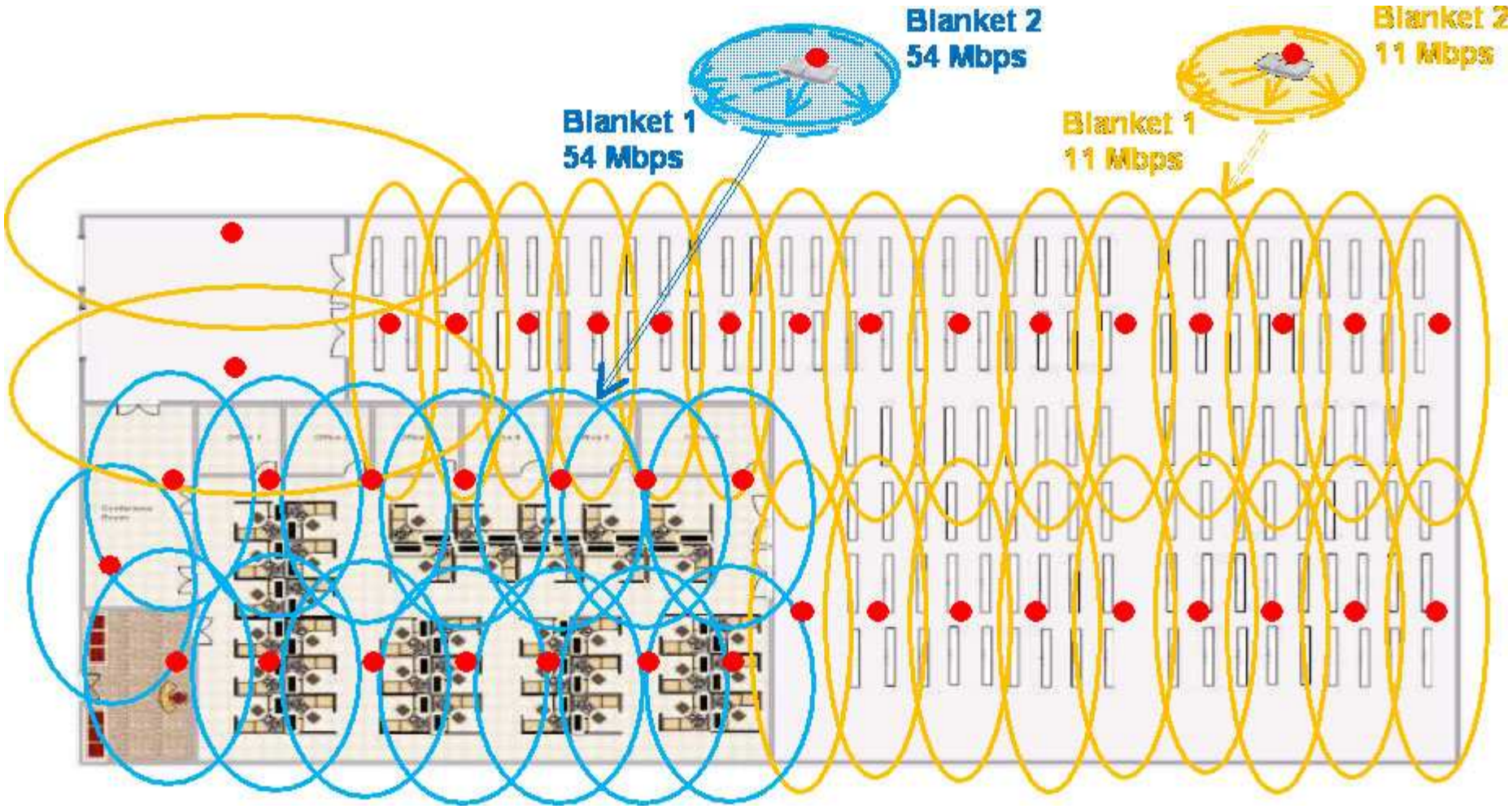
- ‘Common Sense’ AP Placement
  - Robust Coverage
  - Simple Installation/Configuration
  - QoS and Mobility
  - Standards-Based = No Proprietary Client



Extricom

Design
Channel Blanket
- 'Common Sense' AP Placement
- QoS and Mobility (G and B)

Large Warehouse



Extricom

Some of the customers we are working with

Plumpton College
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NIKE

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BT

FOUR SEASONS
Hotels and Resorts

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NYSIA
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MANDARIN ORIENTAL
THE HOTEL GROUP

FUJITSU

ENH EVANSTON NORTHWESTERN HEALTHCARE

GOODRICH

Dorseyville Middle School
Fox Chapel Area School District

WATFORD
BOROUGH COUNCIL

Summary - Extricom WLAN

- The market is entering a new era
  - Mobility, Multi-Application, Convergence drive a new level of hoped-for value, but reveal a new set of challenges never-before confronted
- A New Experience for Enterprise WLAN
  - Shift from “best efforts wireless” to Guaranteed Performance
  - Superior performance for all services
  - A “must-have” architecture for voice over Wi-Fi (VoWLAN)
  - **Radically reduced deployment and ownership costs**
- See a live demo of TrueReuse at:
  - http://www.demo.com/demonstrators/demo2006/62982.php