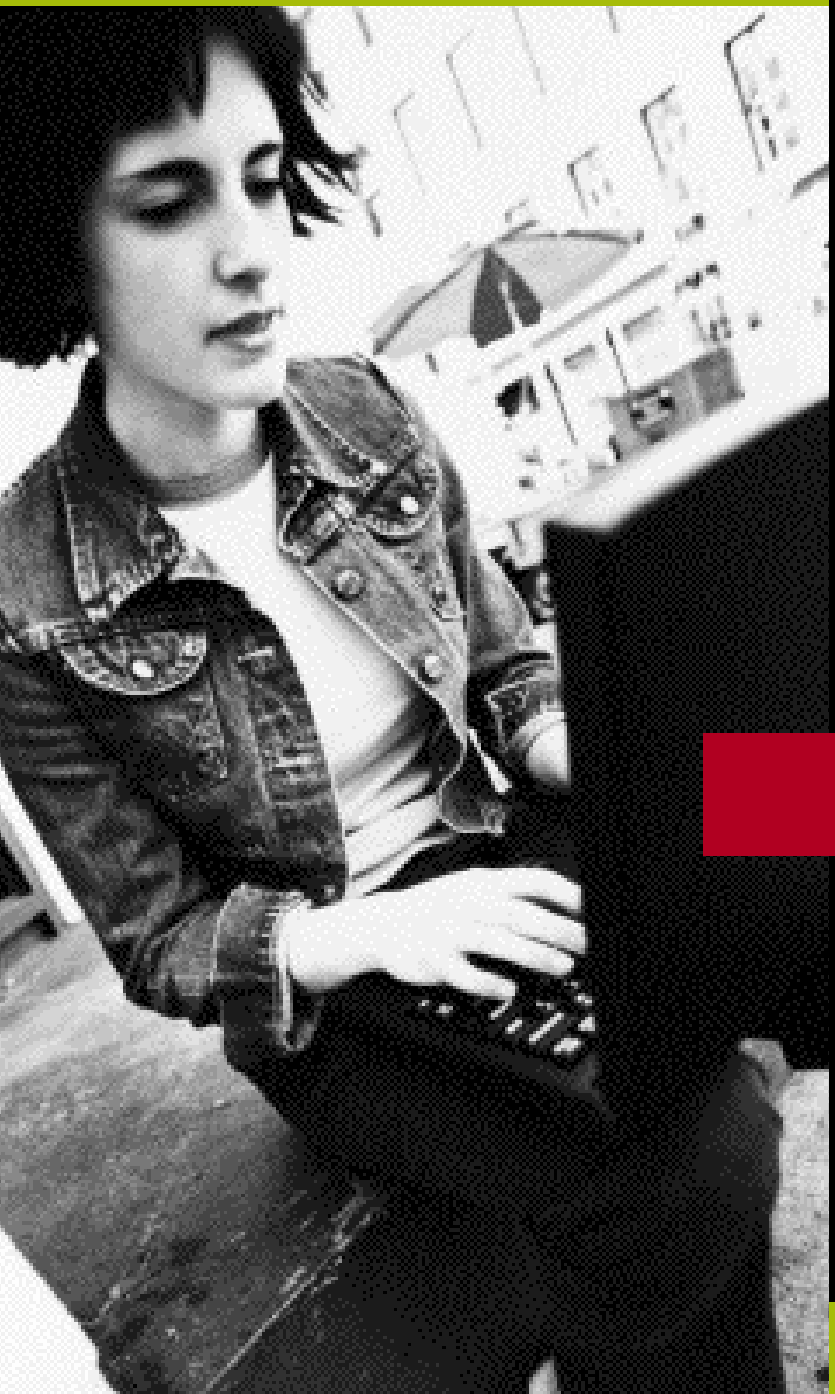


innovaphone
PURE IP-TELEPHONY

TRAPEZE
smart mobile

Our Introductory View on VoWLANs

Smart Mobile™ from Trapeze Networks breaks through the limitations of today's WLANs, enabling customers to deploy massively scalable WLANs that support the most demanding data and voice applications while providing unlimited reach indoors and outdoors.

Strategic WLAN Investment Criteria

PERFORMANCE: How can I future-proof my WLAN to support the coming 802.11n high-throughput standard?

VOICE: How do I deliver voice over WLAN for more than just a few users to get the full benefits of VoWLAN?

REACH: How can I extend my WLAN and deliver enterprise services beyond my wired area?

MANAGEABILITY & SECURITY: How can I ensure highest security with lowest operating expense?

COST: How do I get the benefits of unified switch but without the high capital and operating expense?

Trapeze Networks Overview

- Founded March 2002
- Fully capitalized – $102.5 million in venture capital raised to date
- Trapeze technology successfully deployed at the largest global enterprises
- 2,000+ direct & OEM end-customers worldwide
- 180 employees
- Growing patent portfolio – 30+ filed to date
- Shipping since July 2003

2,000+ organizations worldwide deploy Trapeze WLAN technology

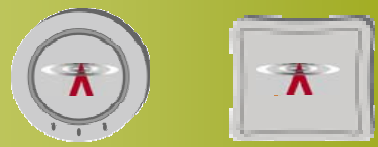
Elements of the Smart Mobile System

RingMaster™

Mobility System Software

Mobility Exchange

Mobility Points



Security – Integration – Scalability

Planning – Deployment – Management

Smart Mobile Product Family

The Trapeze Mobility System™

- Mobility Exchange™
- Mobility Point™
- Mobility System Software™
- RingMaster™

Smart Mobile – Enterprise WLAN Leader

WLAN Security leader

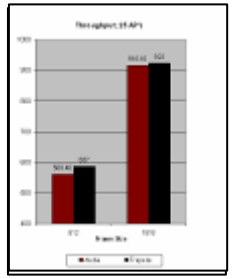
- Comprehensive study of top 11 WLAN vendors
- Trapeze ranked #1 – December 2006*

ABIresearch®

*20 page report available

WLAN Performance leader

- Trapeze outperforms Aruba and Meru
- Same criteria as Network World test (11/06)
- VeriWave certified test results

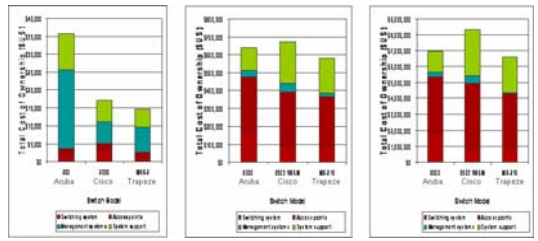


TESTED BY veriwave

*certified results available

WLAN TCO leader

- Commissioned research by Yankee Group*
- Trapeze delivers lowest TCO over Aruba and Cisco



yankee group

*In-depth TCO study available

WLAN Architecture leader

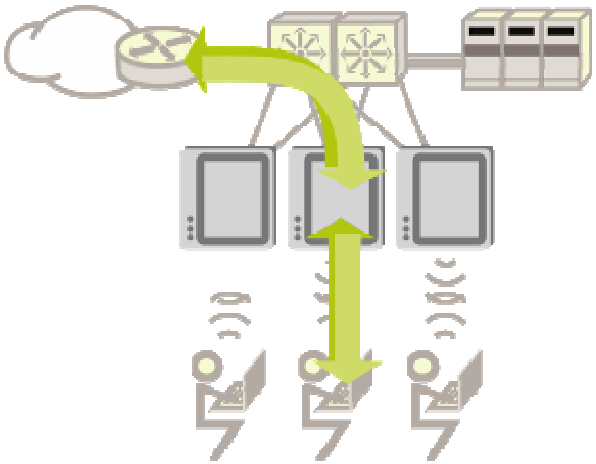
- Next generation WLAN architecture
- Application-driven intelligent switching
- 802.11n ready, voice optimized

TRAPEZE smart mobile.

Approaches to WLAN Architectures

Fat AP Architecture

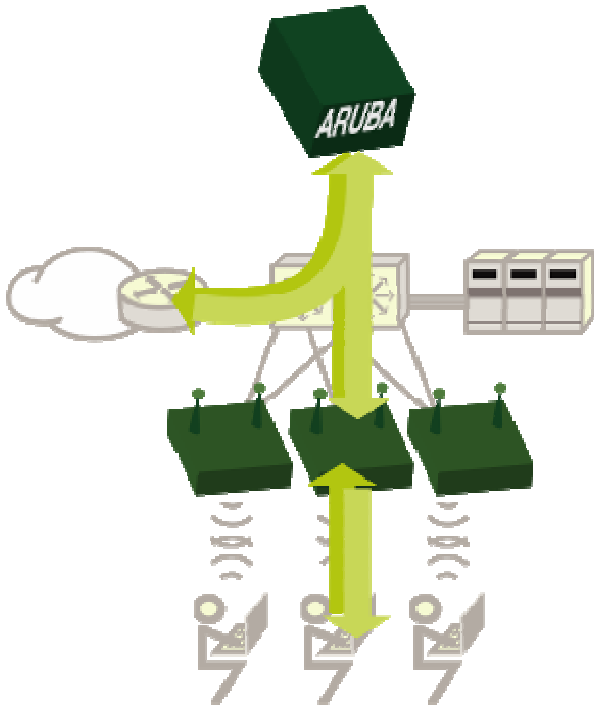
High Op Ex, Unmanageable



- ☒ Control
- ☒ Management
- ☑ Traffic

Centralized Architecture

One Size Fits All

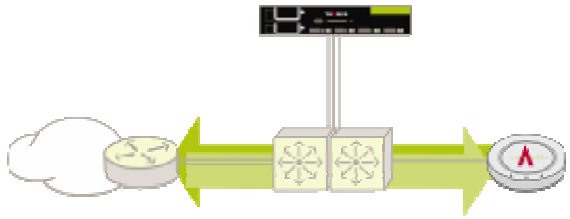


- ☑ Control
- ☑ Management
- ☒ Traffic

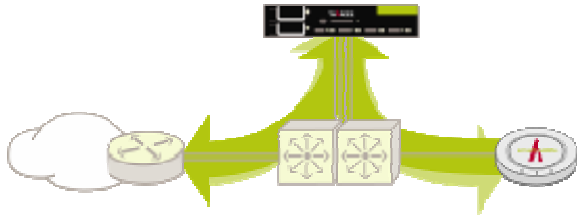
Smart Mobile

Intelligent Switching

Distributed Forwarding for Latency-sensitive Applications



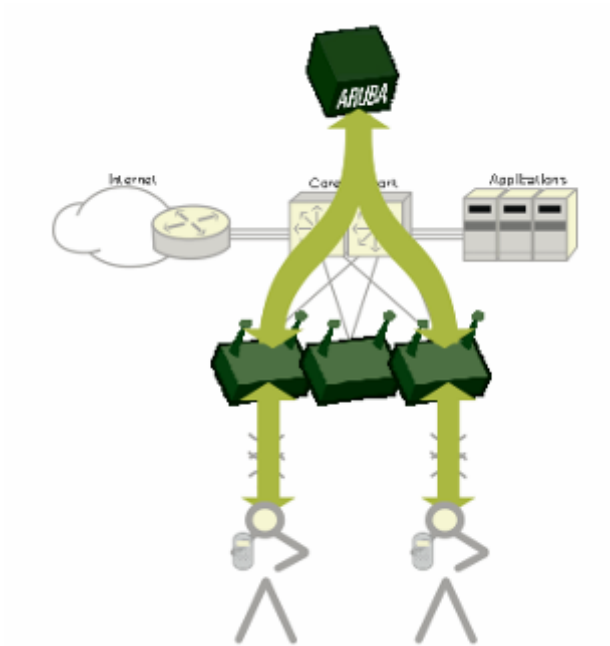
Centralized Forwarding for Other Applications (e.g. security-sensitive)



- ☑ Control
- ☑ Management
- ☑ Traffic

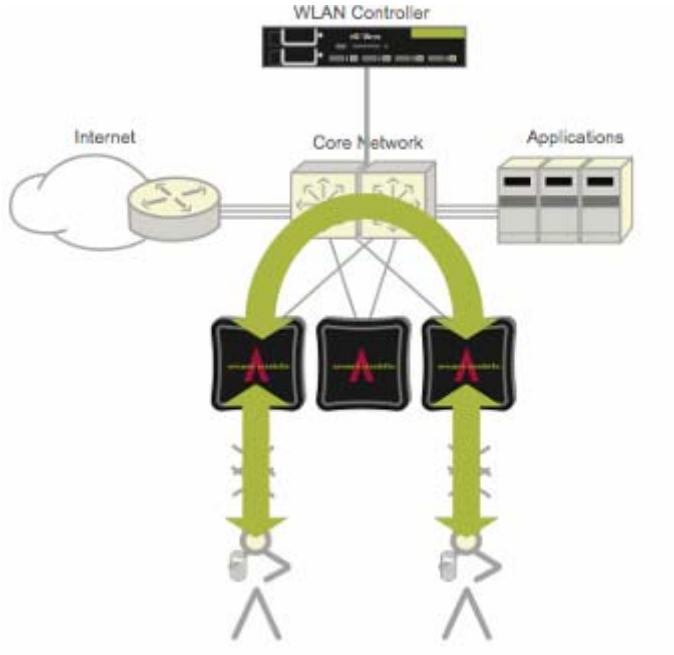
VoWLAN – Problem and Solution

Centralized-Only Switching



- All traffic goes through controller
- Increased latency
- Not optimized for voice
- Inflexible architecture limits scalability

Smart Mobile Intelligent Switching

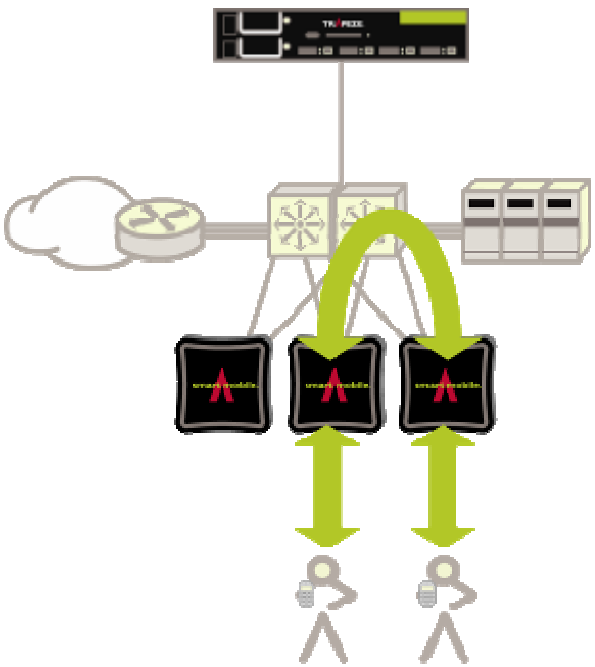


- Voice traffic takes shortest path
- Very low latency
- Optimized for voice—SIP-like architecture
- Flexible architecture scales

Smart Mobile Application-Driven Switching

Voice over Wireless

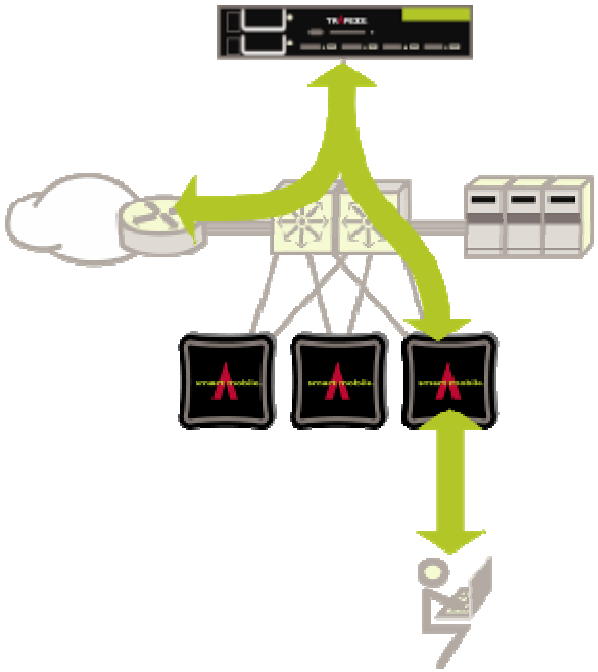
Latency Sensitive Applications



Distributed

Guest Access

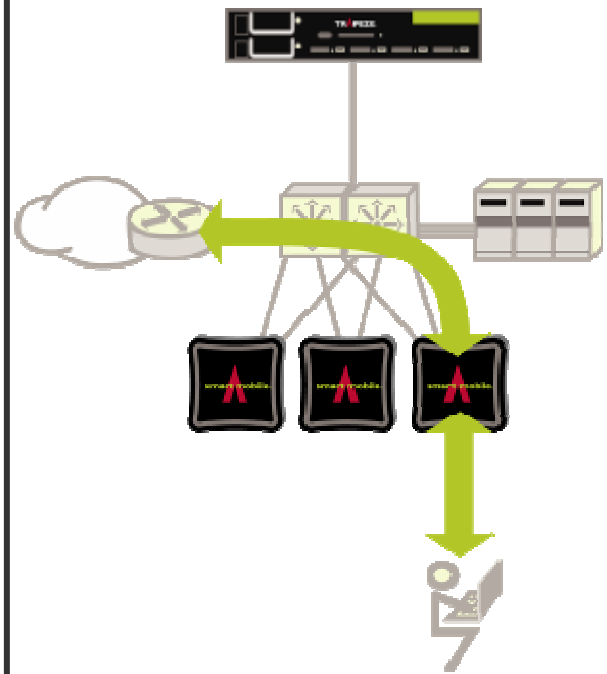
Security Sensitive Mobility Applications



Centralized

.11n Ready Today

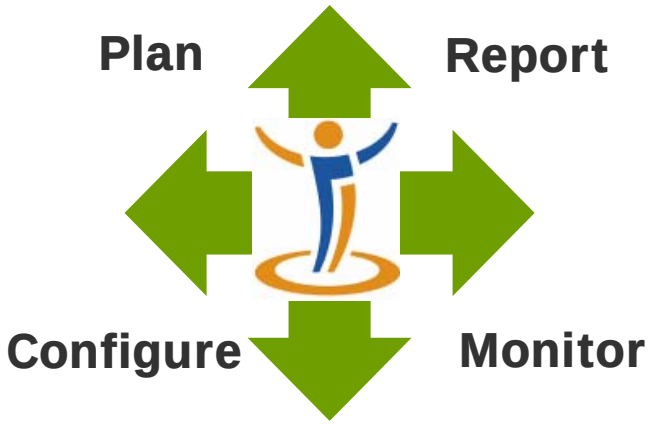
Tomorrow's Applications

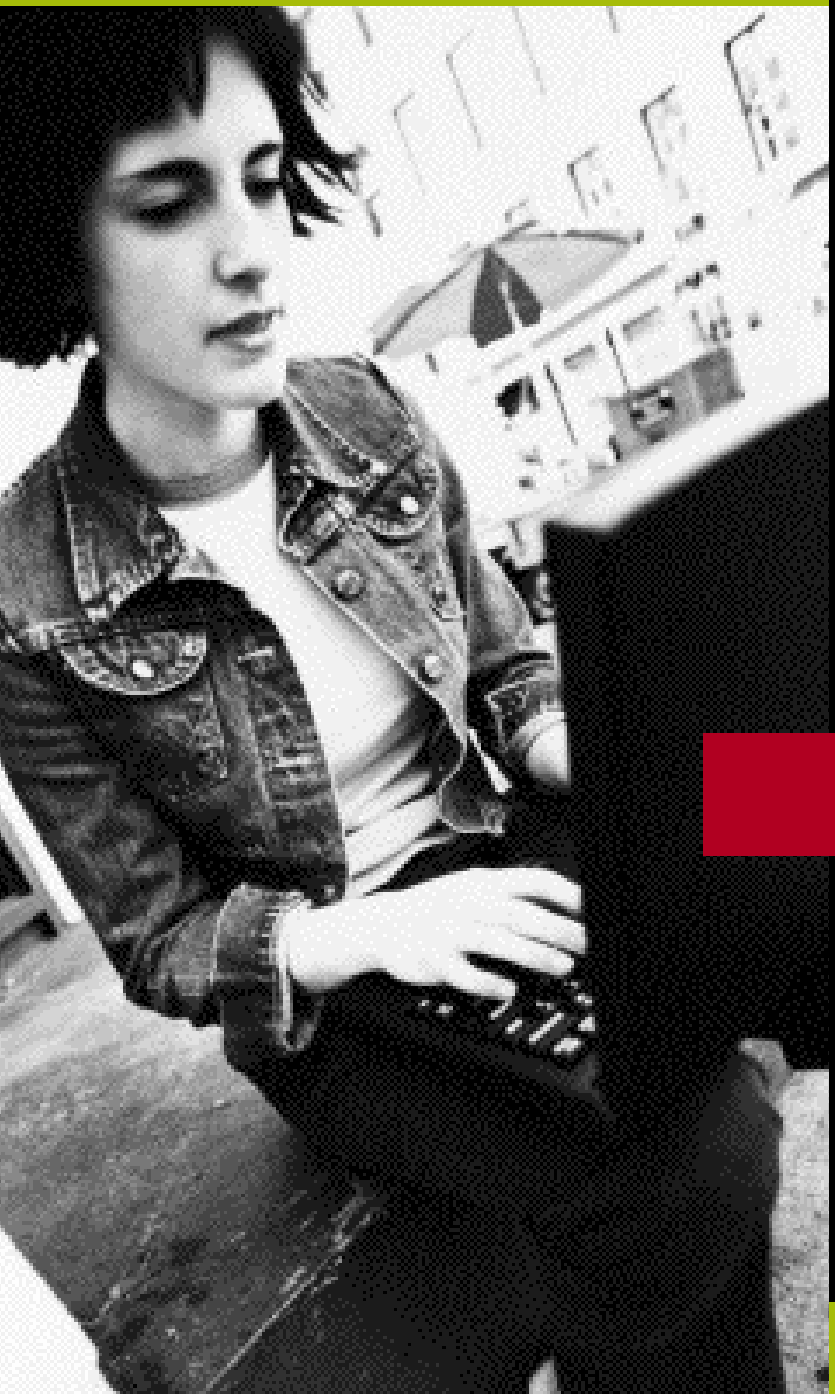


Distributed

Leading WLAN Management Solution

- Full lifecycle management
  - Integration, automation and ease-of-use reduce on going OPEX
- Comprehensive planning
  - Tools ease installation and eliminate surprises
- Scalable configuration
  - Rapid deployment of hundreds of APs in one click with simple wizards and off line consistency checking
- Scalable monitoring
  - Thousands of wireless clients
  - Mobile client management, tacking and logging
- Extensive reporting
  - Drives the planning cycle





TRAPEZE smart mobile

Best Practices on Supporting Voice

Things One Needs to Know

The Voice Opportunity

- Goal of a Voice over Wireless IP (VoWIP) Implementation
  - Reduce costs by…
    - **Reducing to a single infrastructure:** for both for voice & data
    - **Enabling least cost routing for voice calls:** when in the office use the Wi-Fi
    - **Allowing 'toll bypass':** route inter-office calls over the data WAN
    - **Improve productivity:** enable data and voice from a single mobile terminal and by ensuring continuous reachability
    - **Leveraging other Services:** e.g. presence, location
- According to the Infonetics Research 'Mobile and Wi-Fi Phones and Subscribers Report' from January 2007
  - WiFi phone sales topped $535 million [in 2006] up 327% from 2005
  - For the 4-year period between 2007 and 2010, shipments for WiFi handsets are forecast to increase nearly 1300%

  "The fastest growing segment in the market by far is the dual-mode WiFi/cellular VoIP phone, with worldwide units shipping at a phenomenal rate: Infonetics forecasts a 5-year compound annual growth rate of 198% between 2006 and 2010"
- Wi-Fi as a catalyst for VoIP
  - As soon as an enterprise-wide Wi-Fi network is available, people want to use it for voice

The Voice Challenge

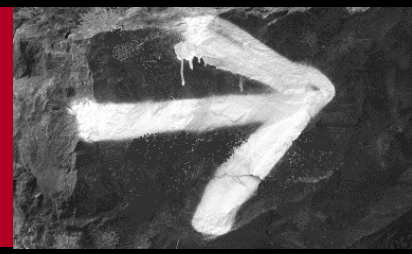
- Supporting voice on a WLAN network presents special problems
- Effective support for voice requires:
  - Appropriate Quality of Service (QoS), i.e.
    - Low latency
    - Consistent latency (i.e. minimal ‘jitter’)
    - Minimal packet loss
  - Contiguous coverage
  - Truly seamless roaming
  - Security provisions for the voice environment
  - Effective power save capabilities to improve handset battery life
- Without appropriate QoS a voice call can sound like this…

Voice sample
no QoS

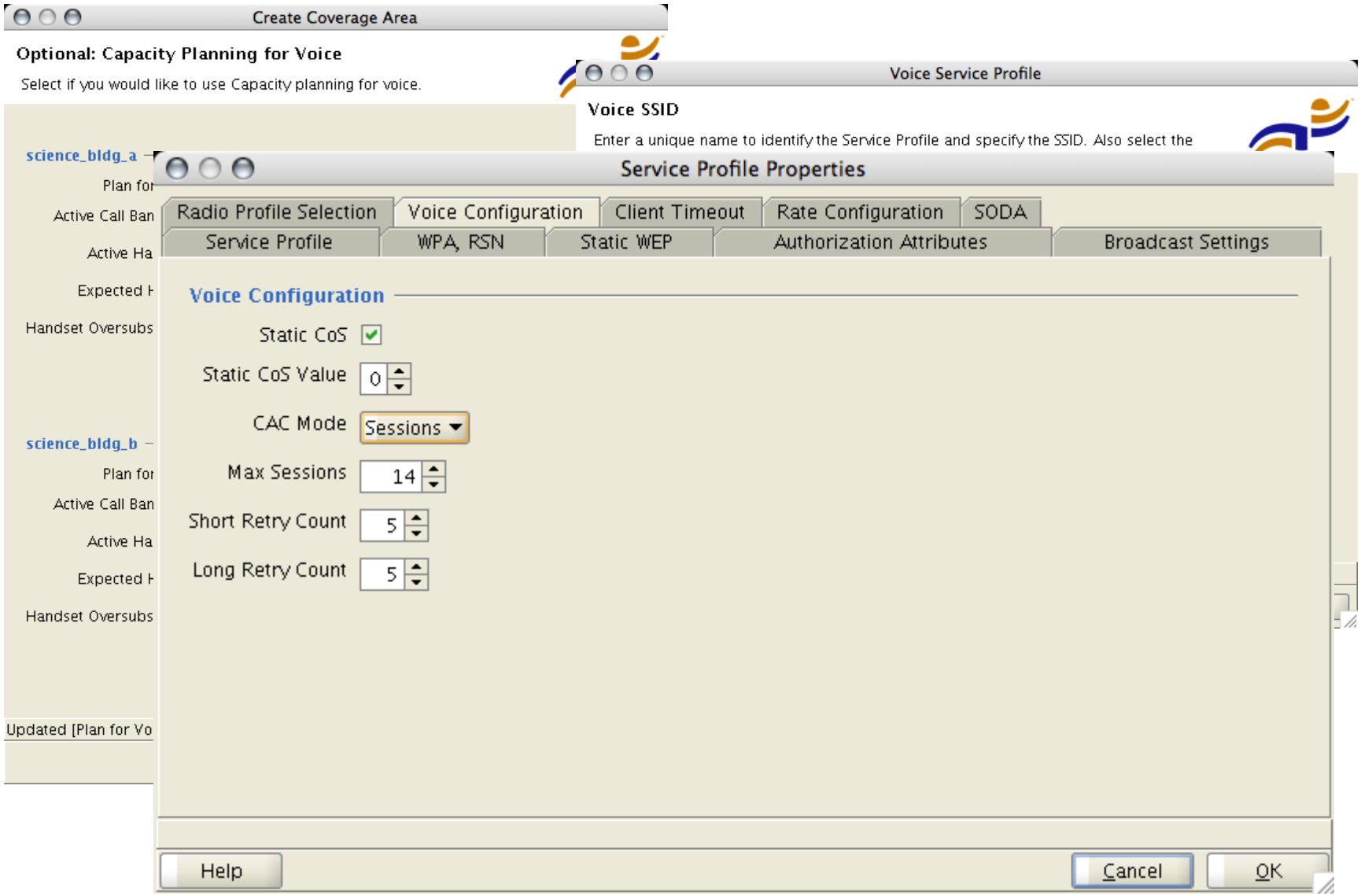
Future Voice 802.11 Capabilities

- 802.11k: Radio Resource Measurement
  - RF measurement data for improved performance and roaming
  - To include ‘neighbor reports’ listing adjacent APs to improve roaming performance
  - Close to completion
- 802.11r: Fast Roaming
  - Faster roaming between APs for better support of voice
  - In progress
- 802.11u: Interworking with External Networks
  - Smooth transitions between WLAN, cellular, WiMax, etc…
  - This group is working together with the 802.21 (Media Independent Handover Services)
  - In progress
- 802.11v: Wireless Network Management
  - Extension of the work of 802.11k to allow management of client devices, e.g. set client transmit power, provide pro-active load balancing
  - In progress

Planning for Voice



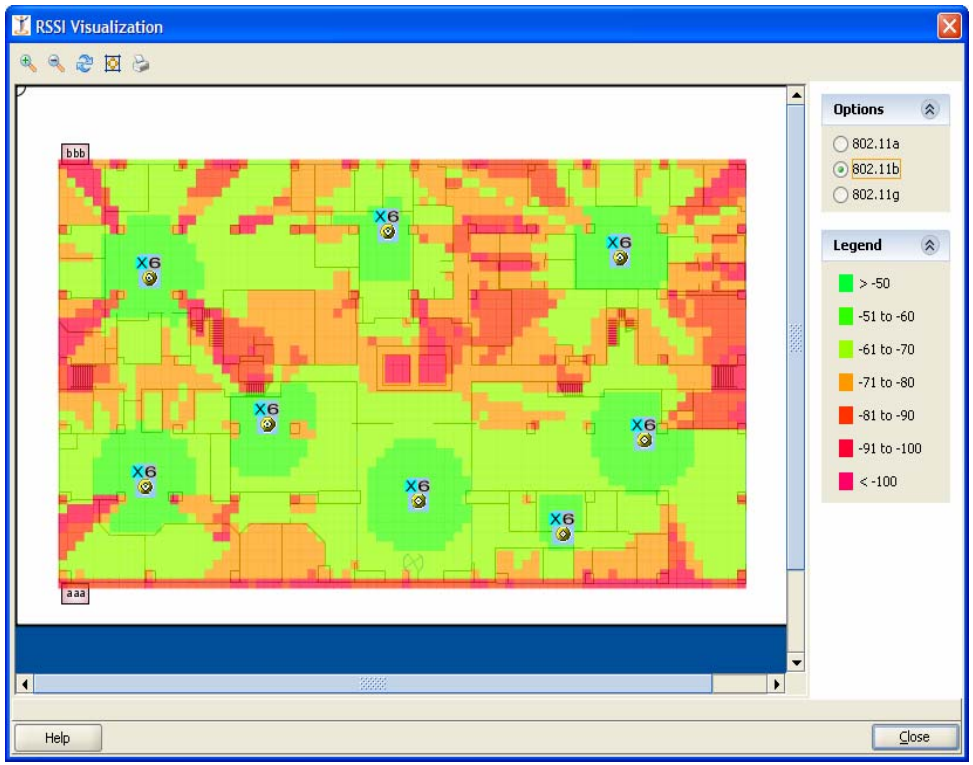
Voice Wizards for Mortals



Coverage Planning for Voice

- Contiguous coverage
  - RF coverage must be contiguous throughout the area where voice is required
  - AP coverage areas should overlap by at least 20%
  - RSSI throughout the coverage area should be better than -60dBm

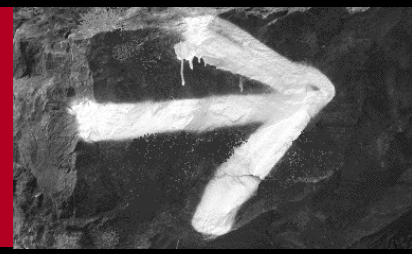
    Note: Leaky coax antennas are not a good solution for voice
- RingMaster RF Planning
  - Use RingMaster to plan for coverage and capacity for voice
  - RingMaster RSSI visualization areas with <-60dBm
    - Move or Add APs to fill in any holes



Voice Best Practices Summary

1. Plan the RF for Voice (RingMaster)
   - Ensure adequate coverage at -50dBm to -60dBm
   - Separate voice and data (by SSID and preferably by RF band)
   - Ensure adequate capacity for the expected voice load
   - Consider using CAC to manage the number of active calls per AP
2. Optimize the Topology for Voice
   - Separate voice and data (by VLAN)
   - Minimize router hops between the handsets and the PBX
   - Decide where to assign priorities (on the PBX/Server or in the MX)
   - Ensure end-to-end QoS
   - Plan security for the voice VLAN
3. Optimize the Radios for Voice (Radio Profile)
   - Use 802.11b radios only (depends on the clients)
   - Do not use auto-tune
   - Do not enable rogue countermeasures on voice radios
   - Enable WMM (depends on the clients)

Trapeze Networks Partner Model



Channel Model

- Distributor
  - Global
  - Regional

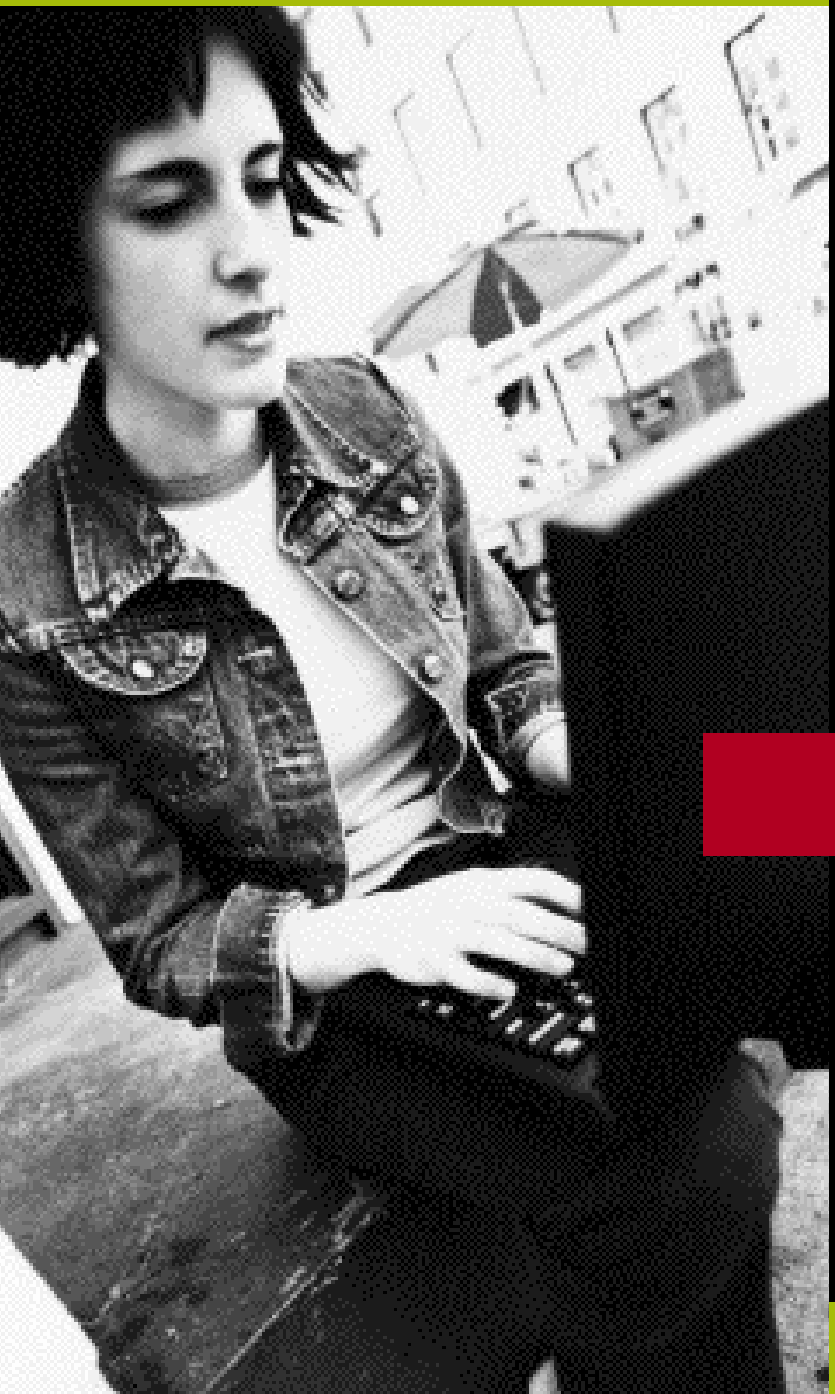
Global **Regional**

- Reseller/Partner
  - Gold
  - Silver
  - Bronze

- Associate Reseller/ Unauthorized Partner

TRAPEZE smart mobile. PARTNER PROGRAM

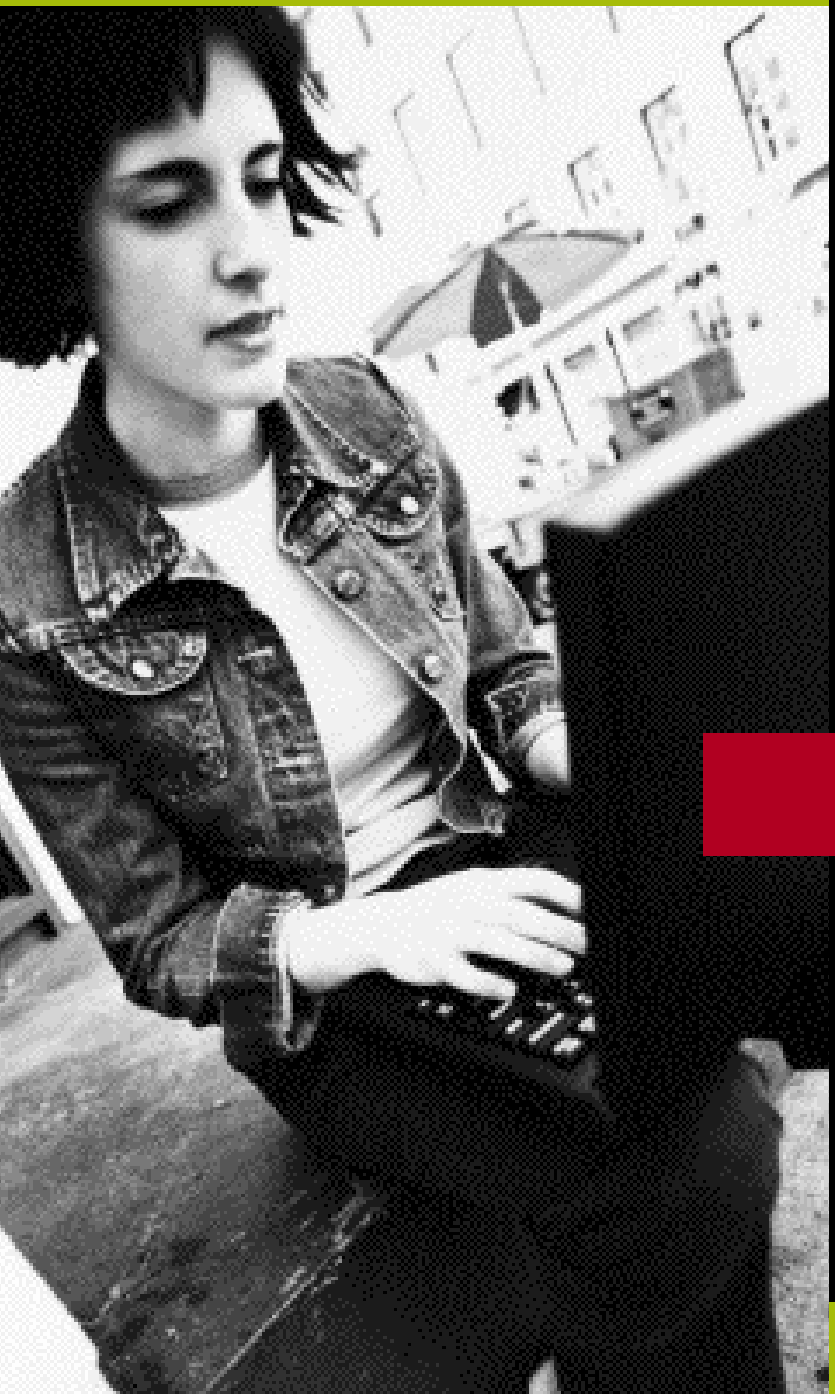
We are looking for new partners specialized in voice. Please contact us!



TRAPEZE smart mobile

Thank You - Vielen Dank!

Bart Tillmans
Field Marketing EMEA



TRAPEZE smart mobile

Backup Slides

Voice Protocols

- Voice solutions require two types of protocol

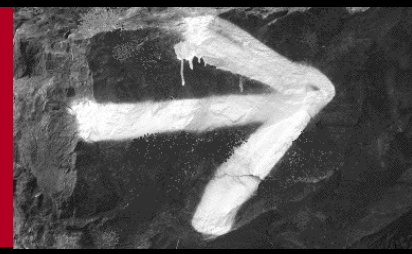
1. Signaling

- Protocols used during call setup, management and teardown
- These protocols generally require low bandwidth, may use a connection-oriented model (TCP) and are typically not delay sensitive
- Examples of signaling protocols:
  - RTCP
  - H.323
  - MGCP (Megaco)
  - SCCP (Cisco 'skinny')
  - SIP
  - H.225
  - UniStim (Nortel)
  - Spectralink Voice Priority (SVP)

2. Bearer

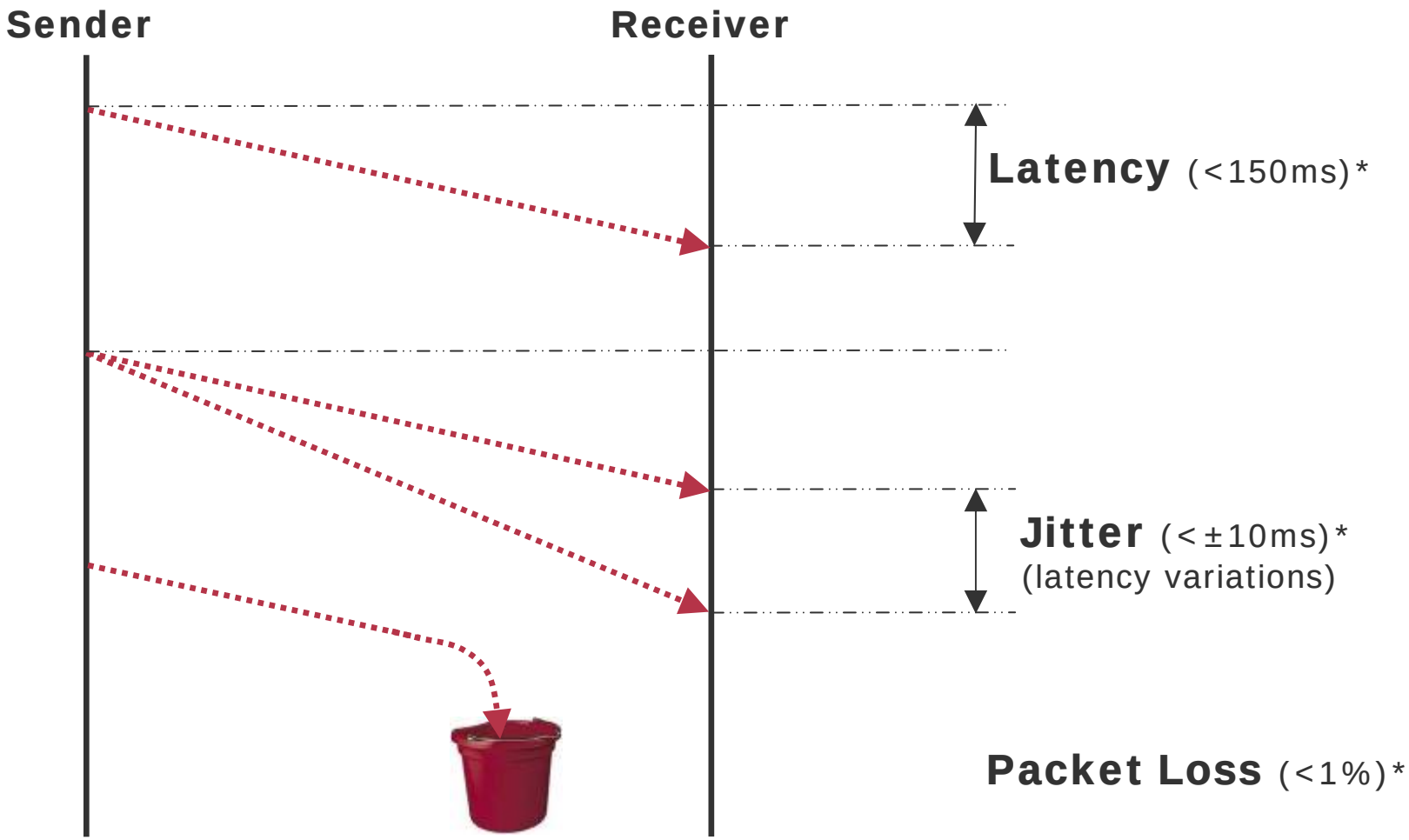
- The protocol actually used to carry the stream of voice samples
- A separate stream is usually required in each direction
- These protocols are delay sensitive, are connectionless (UDP) and require special treatment to ensure prioritization over other types of traffic
- Examples of bearer protocols:
  - RTP
  - Spectralink Radio Priority (SRP)

Voice Characteristics



Voice “Killers”

- Factors affecting Voice Quality



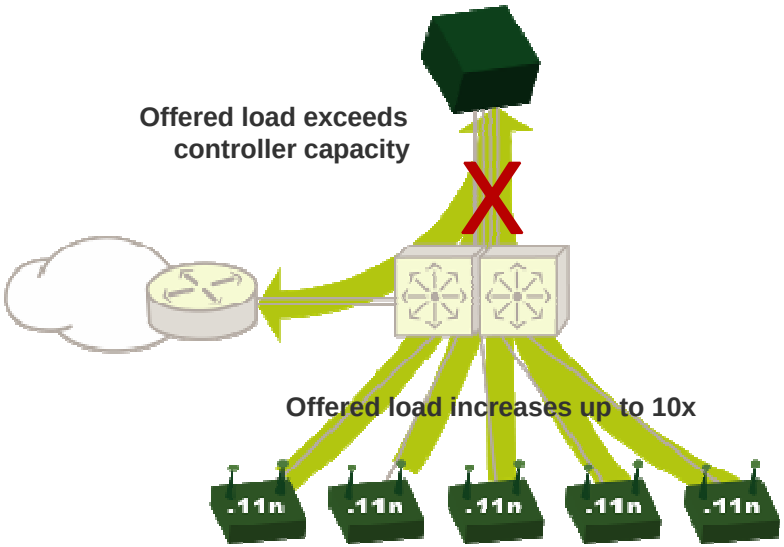
*ITU-T recommendations

Voice Client Capabilities

- RF capabilities
  - Most handsets are 2.4GHz only (requires less power than 5GHz)
    - Many legacy handsets are 802.11b only
    - Many 802.11g handsets have the OFDM data-rates disabled
  - Some dual-mode handsets (WLAN & Cellular) are becoming available
- Powersave Modes
  - Handset battery life is a major problem
    - The original 802.11 standard had a simple powersave capability
    - New Automatic PowerSave Delivery (APSD) capabilities are defined in the 802.11e specification
- QoS
  - Not many handsets yet support WMM/802.11e
- Security
  - Legacy handsets may only support MAC authentication and WEP
  - Newer handsets may support WPA/WPA-2 (most with PSK only)
  - Clients running softphones should be capable of performing a full 802.1X authentication

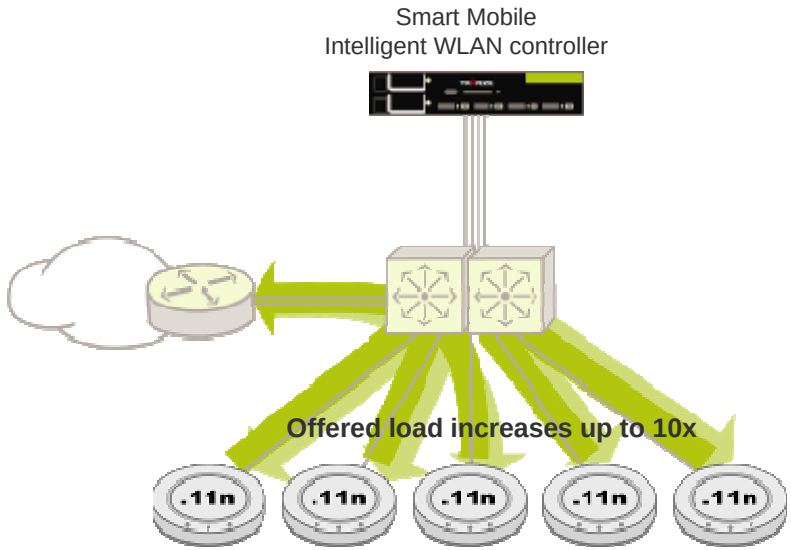
802.11n – Problem and Solution

Breakdown in Centralized-Only Switching



- 802.11n creates up to 10x increase in throughput
- Throughput exceeds controller capacity
- Cannot scale without expensive hardware upgrades

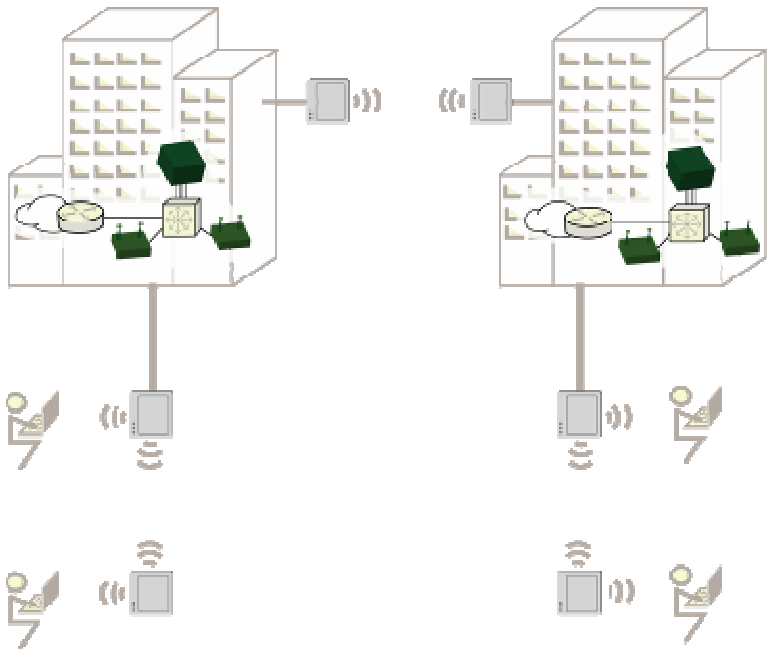
Smart Mobile Intelligent Switching



- Forwarding occurs at the AP, not through controller
- No impact on controller
- Scales in place without expensive forklift upgrade

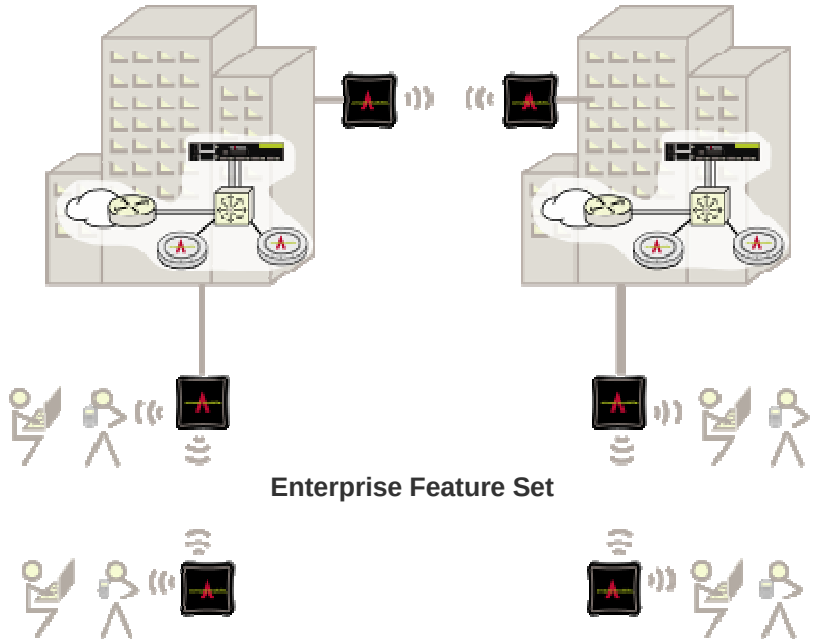
Outdoor WLAN – Problem and Solution

Disparate WLANs for Outdoor and Indoor



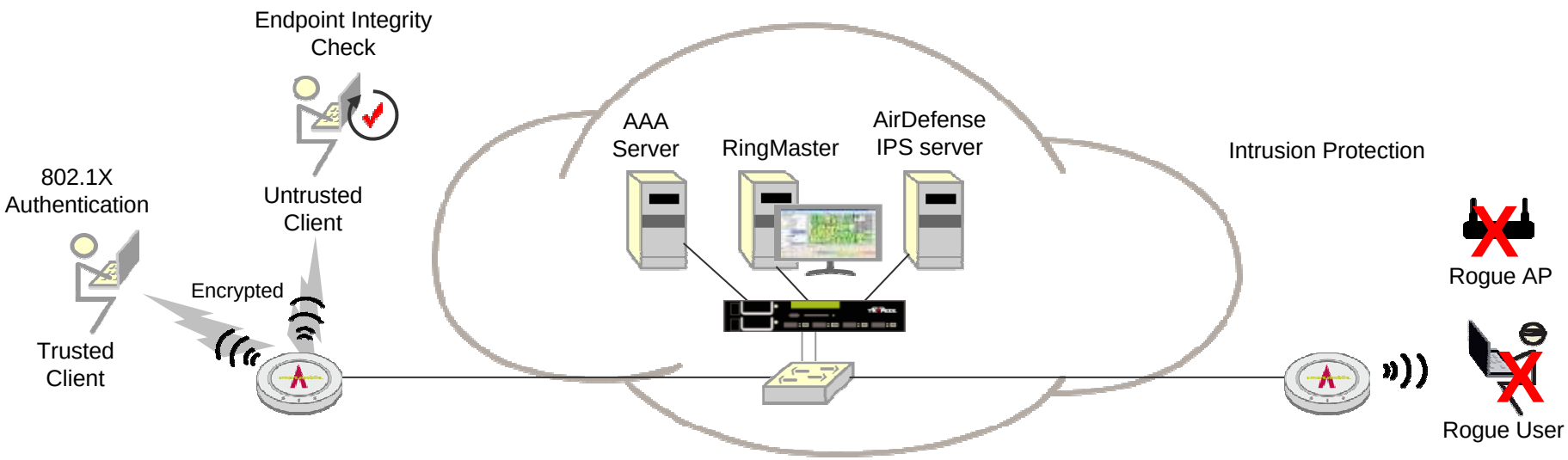
- Inefficient bandwidth usage (centralized policy enforcement)
- No single management platform
- No single operations model

Smart Mobile Integrated Indoor/Outdoor WLAN



- Self-optimizing with distributed policy enforcement
- Single management platform
- Single operations model—seamless indoor/outdoor integration

Multi-tiered Security



Endpoint Integrity

- Trusted Network Connect (Trusted Computing Group)
- Microsoft Network Access Protection (NAP)
- Symantec On-Demand Endpoint Protection

Authentication & Encryption

- 802.1X authentication
- WPA, WPA2 security certification
- AES CCMP encryption

Application-based Mobile Firewall Enforcement

- Per user, per station, per group policy enforcement
- Application-aware QoS scheduling, location and security filtering
- Policy enforced closest to the end station

Intrusion Protection

- Core WIDS/WIPS bundled with every switch
- Full integration with AirDefense (market-leader)
- NIAP Common Criteria Certification
- Defense against 230+ attack types

Smart Mobile Summary

Smart Mobile Elements Solutions for a Superior WLAN	Smart Mobile Delivers Unique Functionality without Compromise
Performance Scales in Place	**Supports 802.11n without the Forklift** Only 802.11n Ready Enterprise Wireless
Voice Application Driven Switching	**1,000s of VoWLAN Handsets** Lowest Latency Architecture
Reach Single Platform Service Delivery	**Indoor/Outdoor with or without Wires** Only Self-optimizing Enterprise Solution
Security Centrally Defined, Distributed Enforcement	**Strongest Access/Intrusion Protection** Most Comprehensive Secure Mobility
Management Planning, Deploying, Monitoring and Optimizing	**Total Control from a Single Console** One Operations Model, One Platform, Indoor/Outdoor

Full VoWLAN Training Topics

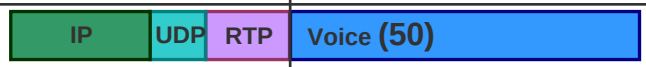
- Voice Overview
  - The Voice Opportunity
  - The Voice Challenge
  - Voice Protocols
  - Common Voice Solutions
  - SIP Architecture
  - Spectralink Architecture
- Voice Characteristics
  - Voice Sampling & Coding
  - Impairments to Voice
  - Security & Roaming
  - QoS Marking Standards
  - 802.11e Quality of Service
  - Voice Client Capabilities
  - 802.11g Protection
  - Future Voice Capabilities
- Planning for Voice
  - Planning Steps
  - Coverage Planning for Voice
  - RF Planning for Voice
  - Topology Optimization for Voice
  - QoS Planning for Voice
  - Security Planning for Voice
  - Radio Optimizations for Voice
  - Voice Best Practices Summary
- Voice Practicals
  - Configure a SIP Service
  - Configure a SVP Service
  - Configure Distributed Forwarding

Common Voice Solutions

- Complete PABX Solutions
  - Avaya
    - OEM Spectralink Handsets and ‘IP Office’ PBX, SVP for call control and SRP bearer
  - Nortel
    - Range of Handsets and ‘Business Communications Manager’ PBX, may use UniStim or SIP for signaling and RTP bearer or SVP for Spectralink OEM handsets
- Voice Client Providers
  - Spectralink
    - Proprietary handsets with ‘Netlink’ server, SVP for call control and SRP bearer
  - Skype
    - Peer-to-peer softphone, proprietary protocol for signaling and bearer
  - Vocera
    - Voice badges with Windows-based communications server, uses a proprietary protocol for signaling and bearer
- Convergence Solutions
  - DiVitas
    - Appliance for seamless WLAN⇔cellular roaming of Windows Mobile 05 phones, uses SIP for signaling and RTP bearer

Voice Sampling & Coding

- Voice coding
  - Many Codecs are available, e.g. G.711, G.729, G.723.1, GSM, Skype
  - Voice sample size, packet size, packet frequency and therefore throughput and quality is different for every Codec
  - The Mean Opinion Score (MOS) is a measure of the perceived voice quality

CODEC	Headers (40Bytes)	Payload (Bytes)	Sample Period (ms)	Data-rate (Kbps)*	MOS (1-5)
G.711			20	80	4.1
G.729			20	24	3.92
G.723.1			30	17	3.9
GSM FR			20	29.2	3.5
GSM EFR			20	28.4	3.9
iLBC 20ms (Skype)			20	31.2	3.0
iLBC 30ms (Skype)			30	24	2.38

***In telephony, a 'Kbps' is 1,000 bits per second not the 1,024 bits commonly used in computing**

RF Planning for Voice

- Separate Voice and Data
  - **By RF band:** e.g. reserve the 2.4GHz band for voice and move data clients to 5GHz
  - **By SSID:** do not mix voice and data on a single SSID (particularly if the security requirements are different)
- Capacity Guidelines
  - **802.11b AP:** plan for 6-7 simultaneous calls per AP
  - **802.11a/g AP:** plan for up to 20 simultaneous calls per AP
  - **802.11g AP in protection mode:** plan for 6-8 simultaneous calls per AP
  - Use CAC to limit the maximum number of clients/calls per AP
- Cell Size
  - **Low density voice deployments:** use fewer APs on high transmit power
  - **High density voice deployments:** use many APs at reduced transmit power
- AP Locations should be accurately known on a floor plan or map
  - To allow on-demand handset location from RingMaster
  - To allow accurate client location for compliance with E-911/Emergency directives

Radio Optimizations for Voice

- Radio Profile considerations
  - Configure APs for 802.11b radios only
    - Depending on the capabilities of the client devices
  - Do not use auto-tune
    - This may force an unnecessary roam when an AP changes channel
  - Do not enable rogue countermeasures on voice radios
    - Depending on the number of Rogues seen countermeasures may occupy a radio for up to 30% of the time
  - Enable WMM
    - The QoS method specified on the Radio Profile depends on the capabilities of the client devices