



Enterprise-Class Telephony on Wireless LANs

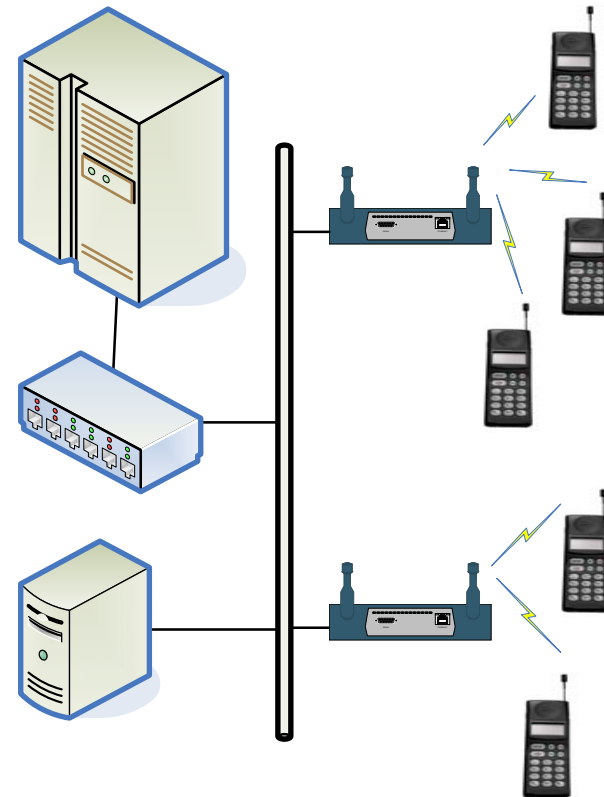
testing for the right choices

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The Leader in Wireless LAN Testing

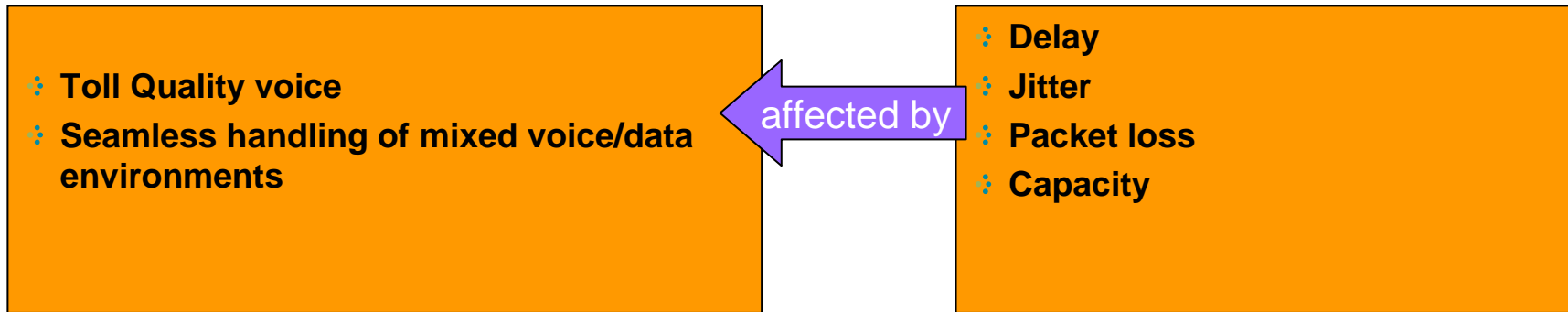
The Converging Network

- ❖ **Voice over IP (VoIP) enables convergence of traditional PBXs and enterprise LANs**
 - Advantages: reduced infrastructure, reduced operating costs, advanced services
- ❖ **Voice over WLAN (VoWLAN) drives further integration**
 - Adds mobility
- ❖ **Cellular/WLAN convergence on the horizon**
 - One phone / one number, anywhere
- ❖ **Equipment available today**
 - Cisco, Hitachi, Symbol, SpectraLink
 - IP-PBXs being installed
 - IP telephony protocols: H.323, SIP, Megaco

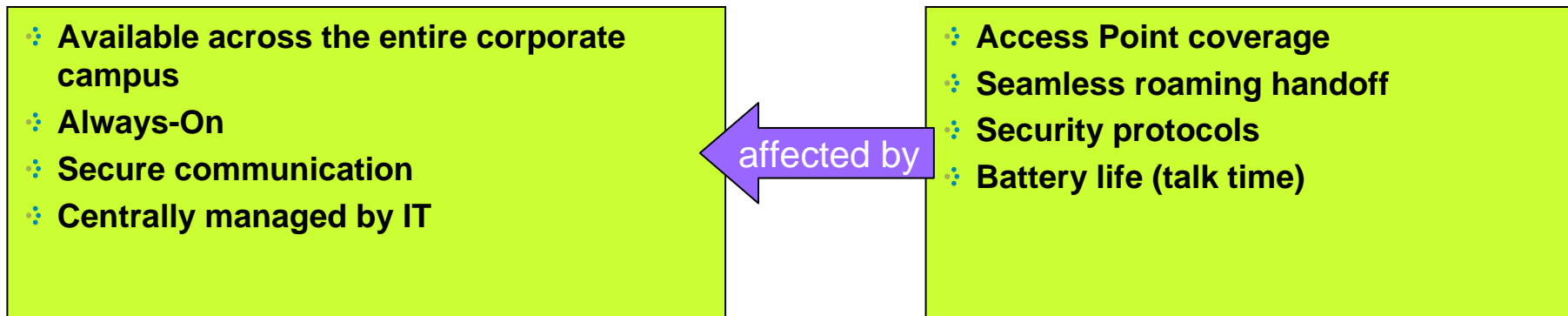


Enterprise Infrastructure Requirements

Performance



Reliability & Usability



Wireless vs. Wired

❖ **Wired network attributes:**

- High bandwidth
- Secure
- Isolated
- Predictable and fixed topology

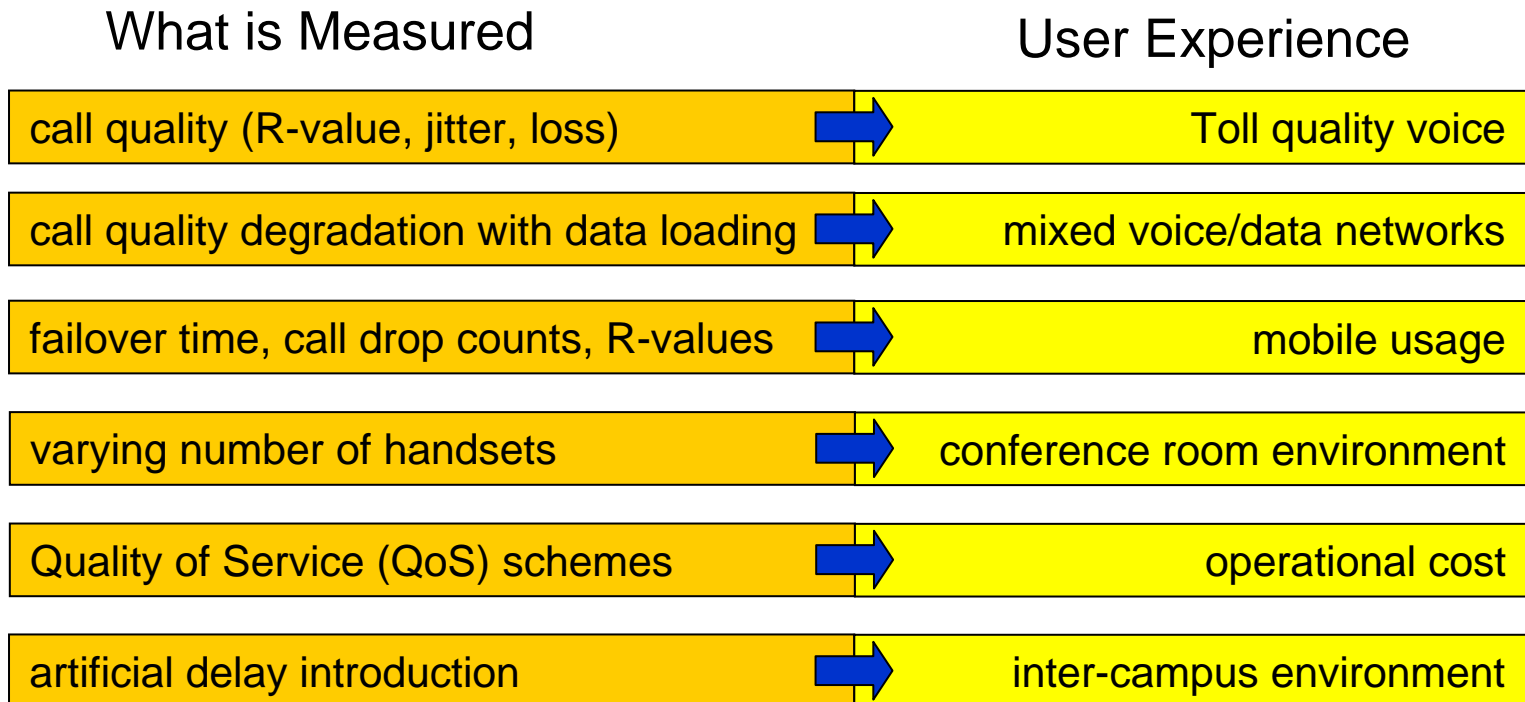
❖ **Wireless network attributes:**

- Limited bandwidth, shared among many users
- Insecure against both eavesdropping and Denial of Service (DoS)
- Prone to interference from other networks and from non-WLAN devices
- Highly dynamic topology with special mobility issues

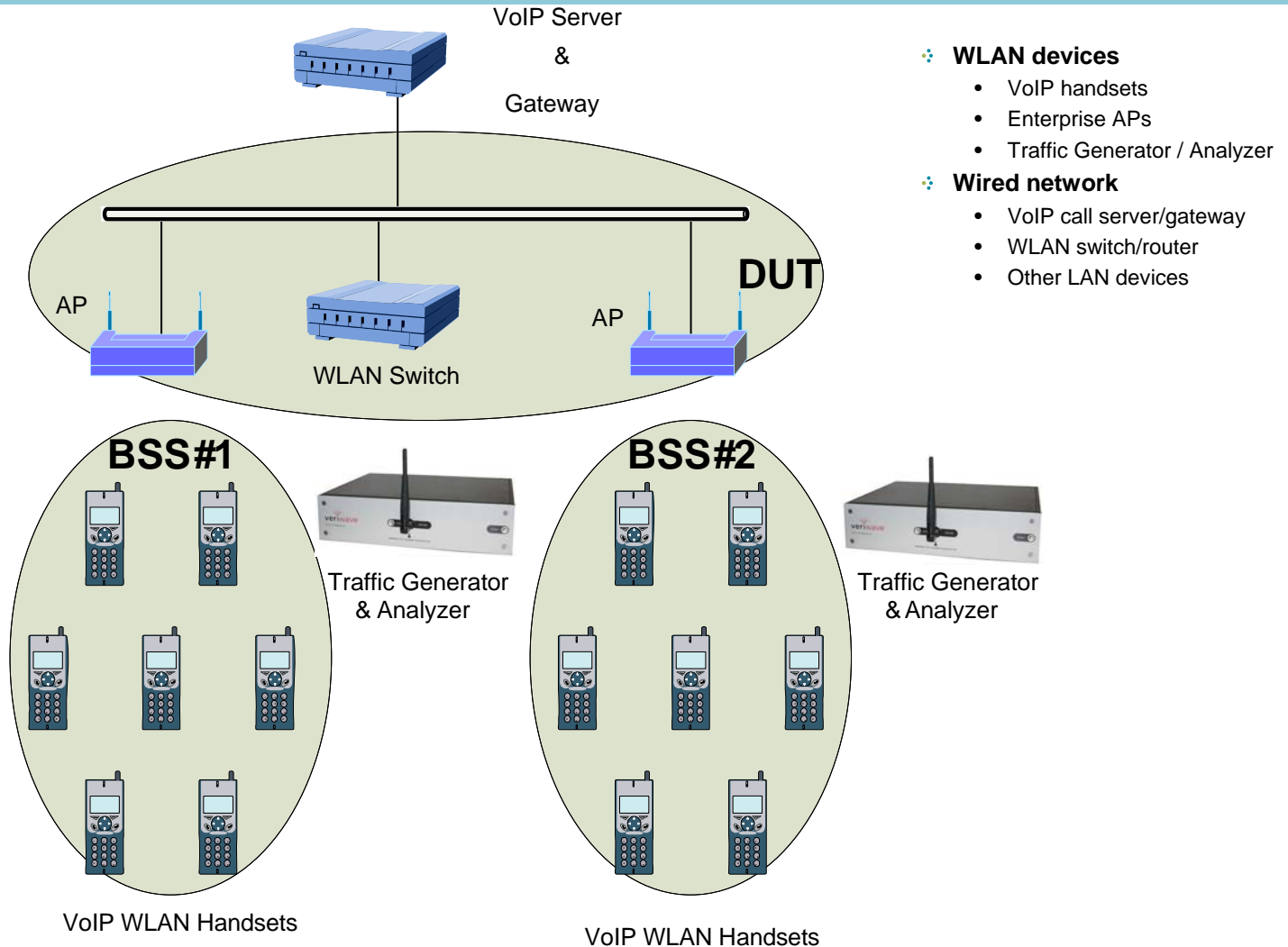
Measuring The Reality

❖ The goal: characterize network performance

- Real network: VoIP phones, Access Points & switch
- Enterprise-class voice and data applications



The Measurement Setup



The Performance Challenge

❖ VoIP places significant load on enterprise WLAN equipment

- Without QoS enabled, very few calls can be supported
 - Sometimes no more than 4-5 calls per AP

scalability

- With QoS, more calls supported, but frequent call drops and poor voice quality scores measured in some cases

voice quality

- Injection of small amounts of data (1 Mb/s) causes precipitous R value reduction, dropped calls

mixed networks

❖ High roaming times seen for failover from primary to backup AP

- On one particular enterprise WLAN switch:
 - Total time for 128 “golden” Layer 4 data clients to roam: 307 milliseconds
 - Average time for 14 VoIP handsets to roam: 4.324 seconds
 - **Worst-case handset roaming time >10 seconds!**
- Call outages and drops likely

mobility
veriwave

Selecting For Success

❖ **WLAN Access Points & switches are key**

- Must support QoS
 - Preferential treatment of voice over data
 - Minimize jitter and packet loss for VoIP traffic
 - Efficient use of wireless medium
- Fast roaming support is also essential
 - Minimize call drops when users move
 - Avoid dropped calls or dead times when backups take over on equipment failure

❖ **Network infrastructure must be matched to handsets and VoIP gateways**

- Handsets and APs work together to provide service
- Roaming is a co-operative function of *both* handsets and APs

The Future

❖ **WLAN QoS protocols**

- 802.11e QoS over WiFi
- Protocol also assists in better power management for handsets and clients – longer battery life

❖ **Faster roaming support**

- 802.11r Fast Roaming protocols
- 802.11k Radio Resource Management assists handsets in locating and selecting APs during roaming

❖ **Better security**

- 802.11i / WPA2 WiFi security protocol
- 802.11i provides for *pre-authentication* to speed up roaming