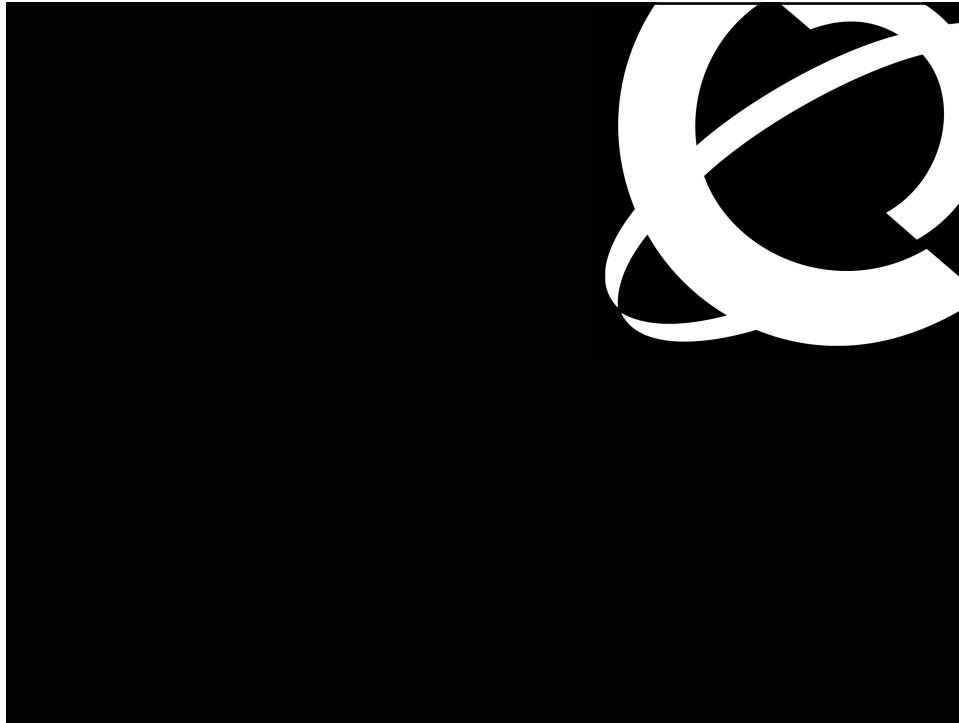




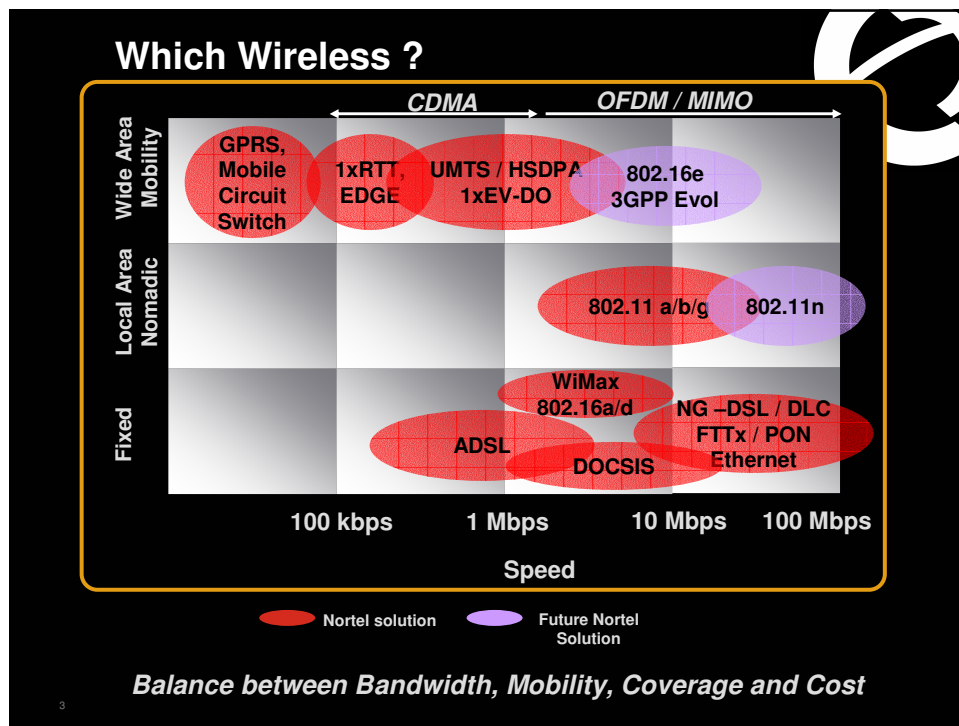
>THIS IS THE WAY

Enabling The Wireless Campus

Danny Ng
Director, Broadband Access, Nortel Asia
QuestNet 2005

>THIS IS NORTEL™

2



Campus Wireless Considerations

- > Physical
 - Area Size, Terrain, Building
 - Multi-Campus ? How Far Away ?
- > User
 - Indoor vs Outdoor
 - Mobile vs Fixed
 - Where are the 'Hotspots' ?
- > Applications
 - Internet/Intranet Browsing; email
 - Voice and Multi-media
 - Fully interactive groupware
- > Technology
 - WiFi ?
 - Hybrid (WiFi and what else ?)

Determines Network design and dimensioning

WiFi ?

> Plus

- Stable Standards with evolution forward
- Commodity level technology and prices
- Reasonable Bandwidth for today's applications

> But

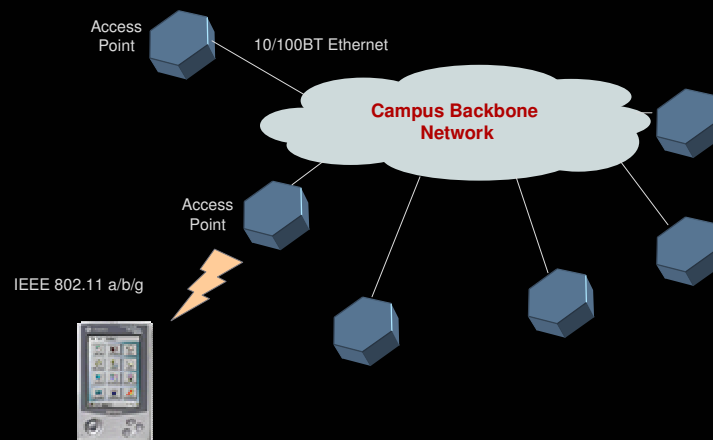
- Range and coverage limitations
- Restricted to deployment location
- Potential for interference
- Limited to No user Mobility

WiFi is excellent mechanism for enabling user access, but needs to be extended for general campus use

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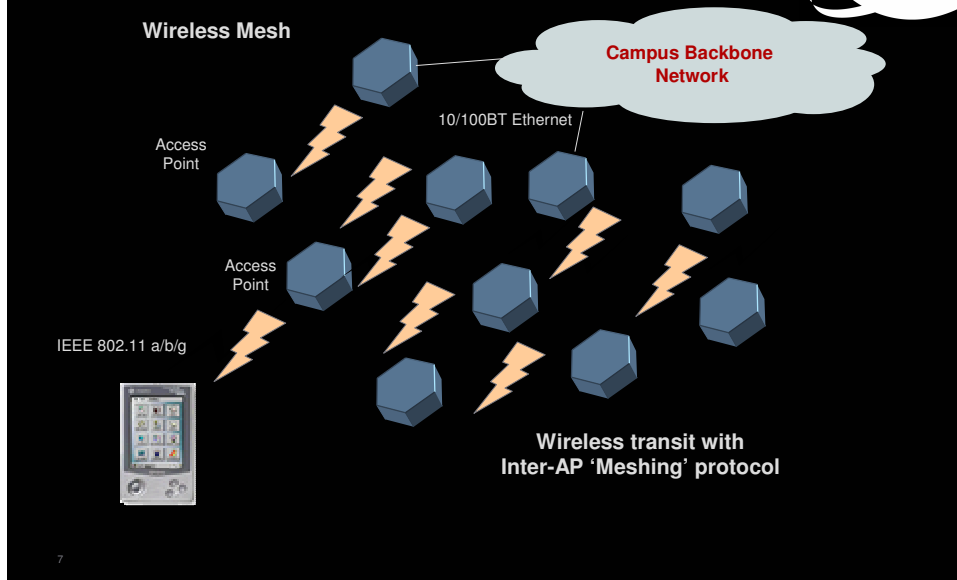
Traditional WiFi Architecture

Traditional WLAN Architecture

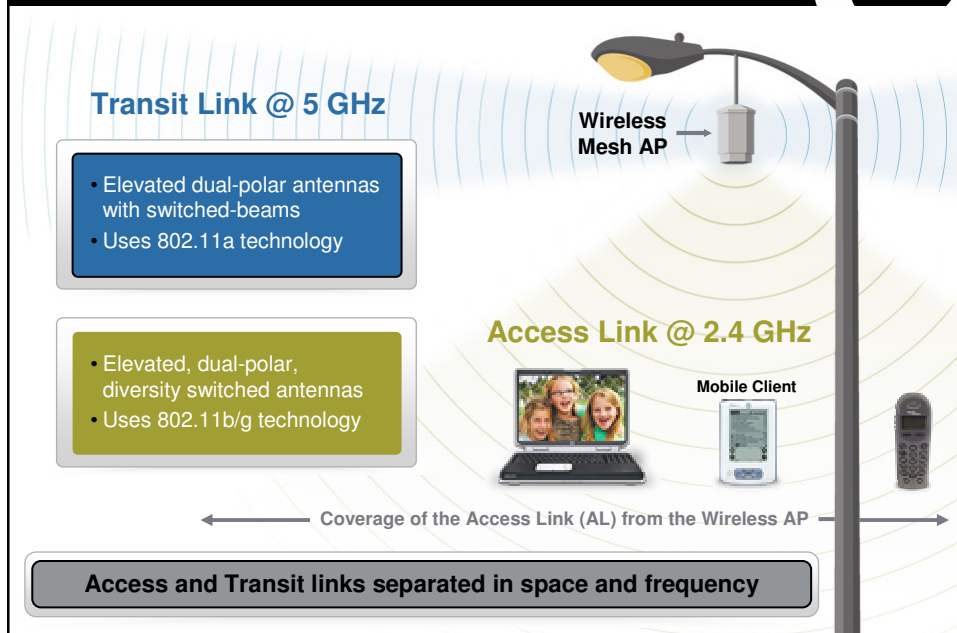


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Wireless Mesh Networking



Dual WiFi Radio Access Points



Typical Wireless Mesh Coverage

PHYSICAL ENVIRONMENT TYPE	Maximum Access Link Range (radius)	Maximum Transit Link Range (AP to AP)	Minimum Wireless AP 7220 Density (user data rates will vary with distance from the Access Point)
Outdoor: Open Space	240 meters/787 ft.	400-500 meters / 1315-1640 ft. (LOS)	6 per km ² / 16 per sq. mi. (Based on 400 meter AP spacing)
Outdoor: Suburban LOS	160 meters/525 ft.	320 meters/1050 ft. (LOS)	10 per km ² / 30 per sq. mi. (Based on 320 meter AP spacing. Will vary based on LOS limitations)
Outdoor: Urban LOS	240 meters/787 ft. (along corridors)	500 meters/1640 ft. (LOS, along corridors)	17 per km ² / 44 per sq. mi. (Based on common street spacing)
Indoor: Open Area	50 meters/164 ft.	70 meters/230 ft. (LOS)	4 Wireless AP 7220s per 1000 m ² / 10,000 sq. ft. (Based on limited LOS)

NOTE: High bandwidth and high user density may require higher density AP spacing

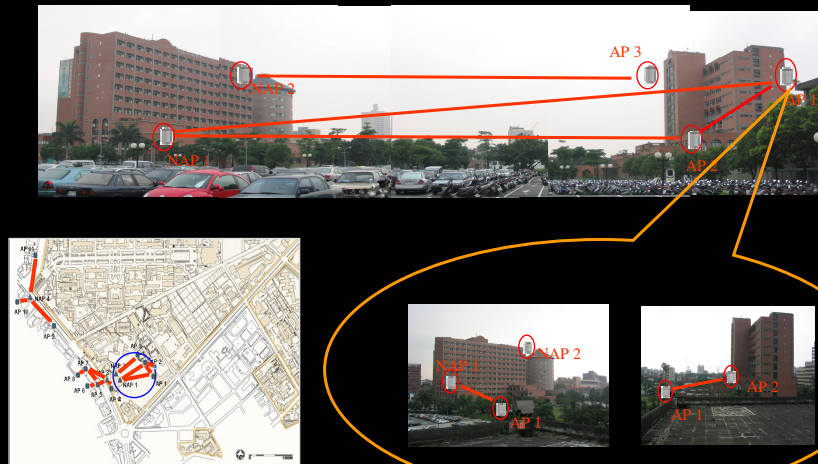
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Installation Examples – extending the Boundary of WiFi



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National Taiwan University

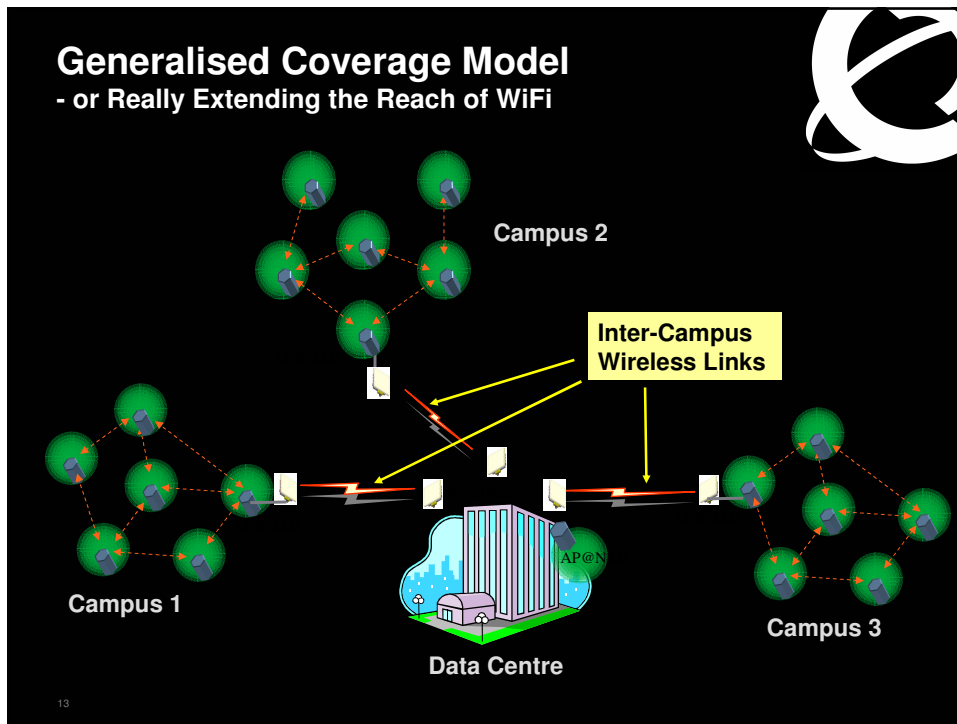


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Taipei – the extended campus !



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Inter-Campus Wireless Option 1

- WLAN Bridging

- > Use WLAN radio
 - But – prefer 802.11a at 5GHz for lower congestion and interference
 - Unlicensed – flexible deployment
 - Flexible antenna choice to extend range and shape propagation pattern
 - Point to Point and Point to Multipoint
 - Relatively low cost
- > Optimal Form Factor
 - Outdoor deployment
 - Integrated Antenna with provision for ext antenna
 - Power over Ethernet Powering
- > Performance
 - 17Mbps full duplex at up to 4kms with LOS

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Inter-Campus Wireless Option 2

- WiMax

- > IEEE 802.16 radio
 - But – likely to be pre-standard until 2006
 - Licensed and Unlicensed option
 - 2.5GHz, 3.5GHz, 5.8GHz
 - Bandwidth Control
 - Point-Point and Point to Multipoint
 - Relatively high cost
- > Form Factor
 - Decoupled electronics and RF/Antenna units
- > Performance
 - Range – 20+kms
 - Bandwidth – variable depending on number of channels available in operating band
 - Need some degree of RF planning



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Comparing the Technology

Properties	Wi Fi (including Mesh)	WiMAX today (fixed)	Future WiMAX (nomadic/mobile)
Standard	802.11a/b/g	802.16-2004	802.16e (future)
Service	Broadband access with pedestrian speed mobility	Fixed broadband access	Nomadic to mobile broadband service
Mobility	Seamless; pedestrian speeds	No	Nomadic in 2007; vehicular mobility in 2008
When	Available now	Late 2005	Nomadic 2007; Full mobility 2008
Primary applications	End User connectivity	Backhaul for Wireless Mesh Network hot zones; SMB access; rural End User access	End User connectivity
Current throughput	Up to 54 Mbps	Up to 35 Mbps	Not applicable
Future throughput	>100 Mbps	Up to 35 Mbps	Up to 50 Mbps

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Wireless Campus Application - VoIP over WiFi

Dual Mode PDA (GSM/GPRS and WiFi)



BenQ P50 Dopod 700 iPAQ 6365 AnexTek SP230 O2 XDA II

Single Mode WiFi SIP Phone



BCM WLAN600/660 Foxconn

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Wireless Campus Application - Surveillance and Monitoring

Applications

Police	Transportation	Fire	Media	Engineering
Intersection Real Time Monitoring	Real Time Image Monitoring	Fire Alarm Bird-view Monitoring	Internet Access Roaming	Public LAN Access

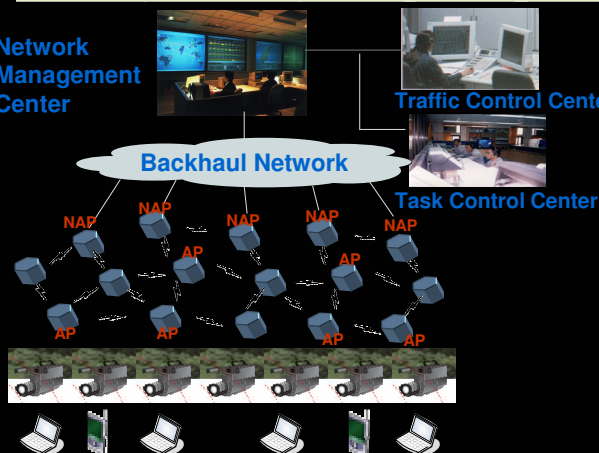
Center Control Center

Network Management Center

Traffic Control Center

Wireless Platform

Intersection Monitor, WLAN Access



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Summary

- > Many wireless access technologies
- > Economics and coverage considerations drives towards hybrid model
 - Wireless Access (WiFi) with some degree of Wireless backhaul
- > WiMax emerging quickly and should be considered as backhaul or pt-pt and limited pt-multipoint connectivity
- > New Applications driving Wireless penetration

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