Slide 1
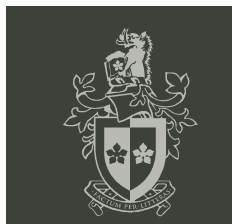
SWiN BUR NE

CENTRE FOR ADVANCED INTERNET ARCHITECTURES

Knowing the Limitations of Internet Technologies

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Slide 2

Talk overview

- Re-calibrating expectations
- "Last Mile" (network access) technologies
  - What are they, why do they matter?
- Economical access technologies
  - E.g. ADSL, Cable, 802.11
- Specific example – 802.11 wireless LANs for mobile networking

Slide 3

Recalibrating Expectations

- The Internet has evolved
  - 1980s…. Tiny cadre of academics and industry
  - Early 1990s… emergence of the web
  - Late 1990s…public awareness and adoption
  - Early 2000s… expanding public adoption
  - Now… all the rage, *IP-enabled* everything

Slide 4

Recalibrating Expectations

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  - Late 1990s…public awareness and adoption
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  - Now… all the rage, *IP-enabled* everything
- But a *reliable* Internet?
  - For some limited definitions of 'reliable', perhaps
  - It often depends on the underlying technologies

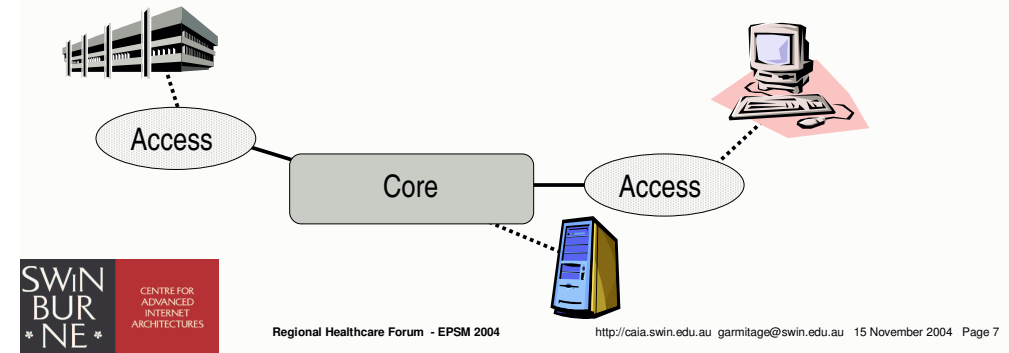# "Last Mile" Technologies

- The Internet Protocol (IP) is an abstraction that sits across disparate networking technologies
  - Designed originally for *connectivity*
    - Not *reliability* or *predictability*
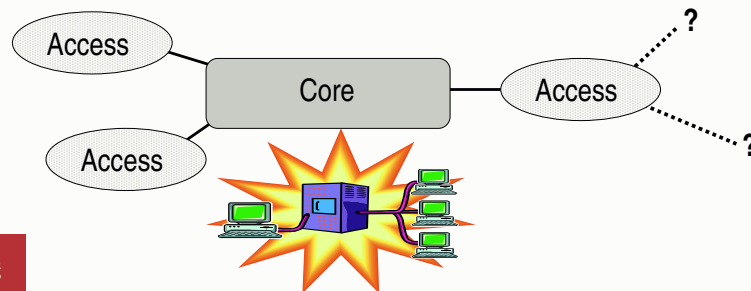

… to your PC or PDA

- Most of us can only choose our access, or "last mile", technologies, e.g.
  - E.g. Leased ISDN, ADSL or Cable modem to clinic


"Last Mile" Technologies

- The Internet Protocol (IP) is an abstraction that sits across disparate networking technologies
- Visualise a 'core' surrounded by 'access' networks
  - Core – high capacity, broad membership
  - Access – 'out at the edge', connects to core
    - Sometimes called "last mile" technologies

… to your PC or PDA

- Most of us can only choose our access, or "last mile", technologies, e.g.
  - Leased ISDN, ADSL or Cable modem to clinic
  - Cellular modem or 802.11 wireless LAN to PDA
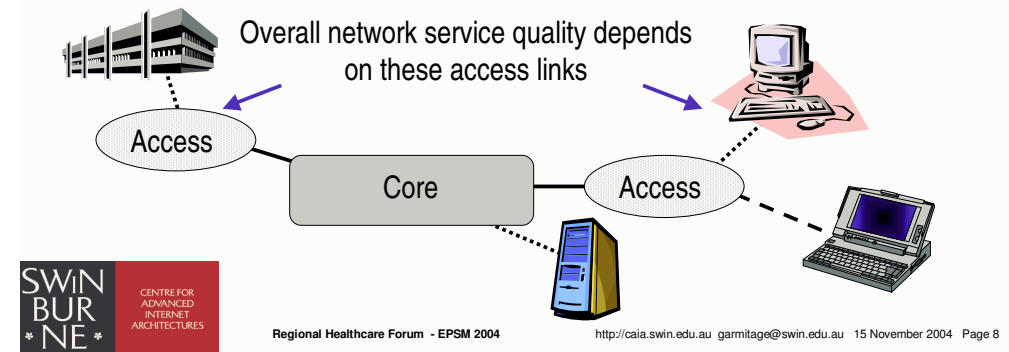
Overall network service quality depends on these access links

Speed & Reach of recent choices

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  - □ 128kbps up, 512kbps - 1.5Mbps down, limited to few kms from local ADSL-capable exchange

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- Cellular modems
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- 802.11 Wireless LANs
  - □ 11Mbps – 54Mbps, range 10s to ~100m

Consequences for applications?

- Cheap *and* accurate video consulting?
  - □ ADSL, Cable or cellular modems – not yet
    - □ Required 2-30Mbps is >> ADSL or Cable capacity
  - □ 802.11 has intra-building/site potential

What of 802.11 / WiFi ?

- Developed by IEEE (Institute of Electrical and Electronic Engineers)
- A number of evolutionary steps
  - □ 802.11 – 1 and 2 Mbps, 2.4GHz
  - □ 802.11b – 11Mbps, 2.4GHz
  - □ 802.11a – 54 Mps, 5Ghz
  - □ 802.11g – 54Mbps, 2.4Ghz

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- Document download/upload?
  - □ Possible with all, depends on your tolerance to transmission delay
  - □ Asymmetry of ADSL and Cable modems means you'll receive docs faster than you can send
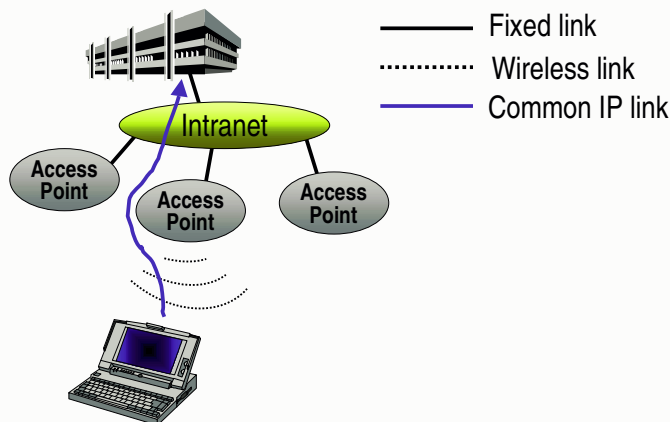 - □ 802.11 appears appealing for intra-site solution

Site-wide 802.11 ?

- Multiple access points (APs) can be interconnected by traditional Ethernet (wired) network to cover entire hospital campuses, clinic sites, etc

— Fixed link
···· Wireless link
— Common IP link

Intranet

Access Point
Access Point
Access Point

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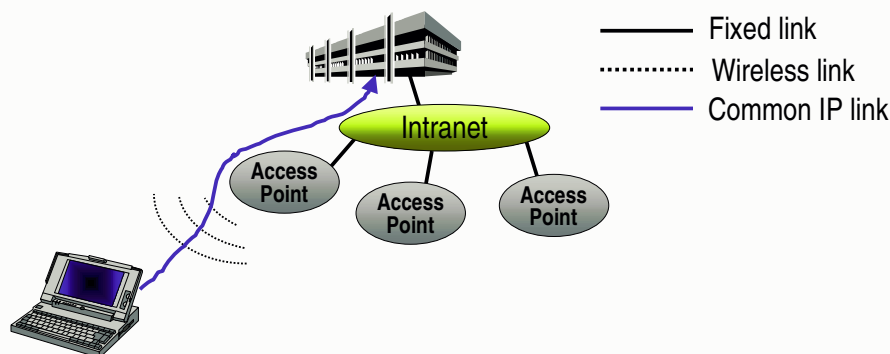Access Point

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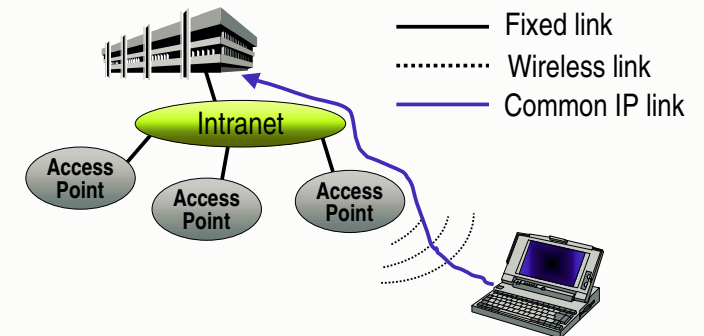
Let's be cautious, though…

- Security has been spotty
  - □ WEP (Wired Equivalent Privacy) broken a few years back – people can 'sniff' your traffic
  - □ 802.1X is new approach for secure Ethernet services, also WPA (WiFi protected Access)

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- 802.11a/b/g *speed* isn't well regulated
  - □ Shared among all clients (e.g. laptops, PDAs) accessing a given AP, non-linear decline
  - □ Some types of traffic (e.g. video conferencing) can disproportionately undermine other transfers (e.g. document up/download)
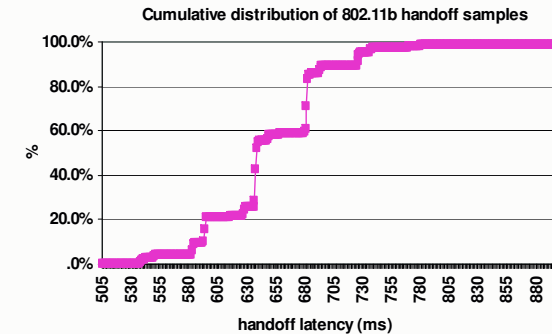
802.11b Speed degradation

- Even someone sending 'pings' through your 802.11b network can steal disproportionate amount of the nominally "11Mbps" capacity
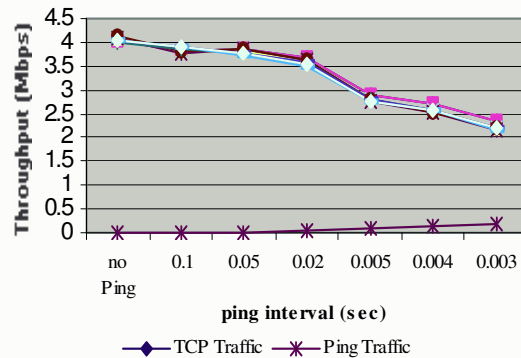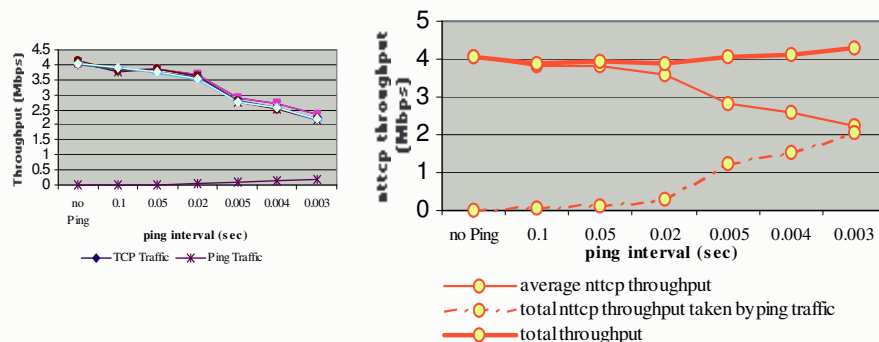

802.11b Intra-site handoff delays

- Be aware that as a laptop or PDA moves around your site, service disruptions up to 650-800ms can occur, slowing down file transfers or conferencing

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802.11b Speed degradation

- The apparent 'theft' is a known by-product of 802.11b's mechanism for sharing wireless link capacity….

Conclusion (1 of 3)

- IP networks can, in principle, deliver medical data in a timely and secure manner
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    - □ The opportunities to distribute information gathering and consumption around your hospital campus or groups of clinics is hard to pass up

Conclusion

- IP networks can, in principle, deliver medical data in a timely and secure manner
    - □ …. but push vendors for solid answers, because the default service quality is unlikely to be what you expected
- Access technologies are evolving, becoming cheaper and faster
    - □ The opportunities to distribute information gathering and consumption around your hospital campus or groups of clinics is hard to pass up
- Question the performance implications of growth in your use of any access technology