“Back to the Future” with Wireless Communications

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  • What is wireless?
  • The value of wireless.
  • Trends in wireless.
◊ Snippet of ANU/NICTA Wireless Research
Communication

Communication is the transfer of:

• Speech — “Talk to you later”
• Messages/Text/SMS — T2UL8R
• Fax
• Data (computer data)
• Video, Pictures, Sound, Multimedia
Communication (con’t)

- from person to person
- from person to machine
- from machine to person
- from machine to machine
Wired Communication

- Telephone lines (twisted pair copper cables)
- Fixed point to point communications
- Optical fibre
- Submarine cables between continents
- Printer, hard-disk, USB, Firewire cables, etc.
What is Wireless?

Obvious Examples

• Walkie-Talkie → Mobile Phone
• Satellite Communications
• Talking/Speech (without technology)
• Smoke signals, hand gestures, etc.
Less Obvious Examples

• Wireless Desktop
  – wireless mice
  – wireless keyboard

• Wireless Networking
  – WiFi, Airport, IEEE 802.11b
  – Bluetooth
Relevance of Wireless

• untetheredness (freedom)

• it is (mostly) about being human

• at one end of the communication link is a person (otherwise it probably doesn’t need to be wireless)
Relevance of Wireless (con’t)

• Retaining mobility and freedom — people, unless they are in prison, tend to move about in largely unpredictable ways.

• Why should a person change their lifestyle habits because of a (primitive) communication system such as wired/fixed telephones?

• Mobile phones are more intimately connected with people — especially younger people.
A Cover Shot

Nokia 3200 Phone

- Create your own Cut-out covers*
- Integrated camera
- Multimedia messaging
- Polyphonic ringing tones
- Wallpapers and picture editor
- Java™ games and applications

Available:
Planned in the 4th quarter of 2003

Shopper Assistance

- View All Phones
- Compare Phones
- Glossary

Club
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Join and enjoy the benefits at www.club.nokia.com or over WAP at mobile.club.nokia.com.

Forum
NOKIA

Tools and channels to market for mobile application developers at www.forum.nokia.com.
Food for Thought — Near Irrelevance of Technology

- When you buy a phone do you ask whether it uses CDMA or GSM, or whether it has better performance?
• Shape and appearance of the phone is critical.

• Mobile phones convey individuality in the same spirit as: watches, jewelry, clothes, spectacles, etc.

• The technology behind the phone is imperceptible (and that’s how it should be).
A Few Messages So Far

Lifestyle Enabling — Wireless helps realize the need for people to communicate with minimal impact on their lifestyle and workplace habits (much to the annoyance of others) — this means they can be less constrained in how they organise their lives.

People are on the move; wireless can keep them in touch.
Fashion and Individuality — Because mobile phones are carried almost constantly with a person then it as much a fashion accessory or individual statement as is a watch.
Near Irrelevance of Technology — Wireless technology is a secondary factor and will be less relevant, and certainly less perceptible, in the future.

If the phone clashes with your handbag it’s unacceptable irrespective of how well it works.
Where Are Mobiles Heading?

Size down, weight down, cost down, battery life up and running cost down...

“If we continue the trend of better, faster, cheaper and smaller, we could assume that next generation mobile phones would be as powerful as today’s desktop computers, and require so little power the battery would never need recharging, so cheap to be given away with Happy Meals, and probably small enough to present a serious choking hazard to the kids eating the burgers.”

If the battery runs flat throw it in the bin — almost.
What’s Currently on Offer

From the same people who wrote the manual for your VCR...
“Features”

Web at high speed and in living color on vibrant touch-screen display. Quick access to flight schedules, directions, e-mail, stock quotes, weather, scores, entertainment listings and more. PDA functionality you need to be more organized and productive.

Voice-activation. Collect your thoughts using the voice memo feature. Camera, streaming video, music player, games, etc. Programmable, expandable, upgradable, adaptive, learning, thinking, moody, ...

... and a phone (I think — perhaps they forgot it).
And Where Did We Come From?

Photo of Edwin Armstrong and his portable radio c.1923
Some Problems with Wireless

- Security (e.g., credit card details)
- Lowering cost (e.g., free calls)
- Privacy (e.g., where have you been)
- Interference and unreliability (e.g., call drop outs)
Security

Wires can be shielded — you can’t break a code/protocol/security if you can’t access the signals (this is good)

Wireless can’t be shielded — everyone can access the signals, so security is ultimately up to the encryption of the data sent

Wireless will never be perfectly secure
Lowering Cost

Think twice about getting excited about mobile phone call/SMS costs becoming cheap in the future.

SPAM isn’t restricted to email...
Privacy

*Becoming the number one issue for wireless.*

- Return to the human-centric view of wireless communications.
- Think of your mobile phone as something that is permanently with you, akin to your watch. You and your mobile are inseparable.
• Mobile phone locator technology might save your life in an emergency but will it cost you your privacy?

• Your whereabouts won’t be a secret if you are carrying your mobile phone.
Privacy Scenario 1: You attempt to enter a department store only to have it deny you access because it has detected who you are (the mobile phone’s biped) and determined, based on your past credit history, you are a risk.
Privacy Scenario 2: Walking down the street, your mobile phone rings.
Privacy Scenario 2: Walking down the street, your mobile phone rings.

It’s the store across the street offering you discount size 26 Jockey Y-fronts.
Privacy Scenario 3: Should your employer know that your call to say you’re too sick to come into work came from a ski resort?
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So the key to privacy might be to turn off your mobile?
Other Wireless Technology

RF-ID (Radio Frequency Identification)

Privacy Scenario 4: You walk down the street past a department store. A few days later you receive a special offer in the mail or via email (or to your mobile phone):

Blue Jockey Size 26 Y-fronts on special!
Question: How did the store know I wear Blue Jockey Size 26 Y-fronts?

And how did the store know I really did need some new ones?

I don’t even have a mobile phone!
Answer: My 8 year old Blue Jockey Size 26 Y-fronts that I was wearing told the store.
Answer: My 8 year old Blue Jockey Size 26 Y-fronts that I was wearing told the store.

That is, there is an RF-ID sewn into the seam of my Y-fronts. When I walked past the store they detected the “Blue Jockey Size 26 Y-fronts” signature from my old underwear.
RF-ID tags

- “bar-codes” of the future
- now miniaturized (0.4mm$^2$ chips)
- passive, i.e., need no batteries
- about 10 cents each in a few years

Designed for inventory use they can be used or abused for other purposes.
A Few More Messages

Tracking — In the near future, we could be tracked because of what we are wearing, eating and carrying.

Advertising Target — In the near future, because of the 20 or so RF-IDs on or near you, you could be (passively) broadcasting your tastes in clothes, food, music, etc.
Main objective of this research is to see how much data we can get from the sender to the receiver given limited resources in wireless communication. This ultimately means more data, more efficiently, at lower cost.

**Example** — using the same resources as today’s mobile phones: (frequency range/ spectrum/ size/ power/ time) could I transmit a DVD quality movie in real time to the mobile?
Point 1 — The answer has very little to do with technology, it is either fundamentally possible or impossible.

Point 2 — If it is theoretically possible then we may never know how to do it (but that is unlikely) or it may take too long (delay too great) or require too much computing power (be too expensive).
Advances being made in our ANU/NICTA research team relate to:

- the importance of size of mobile handsets, how many antennas can we deploy in a limited size
- how geometric aspects: “distances”, “shapes”, “sizes”, “orientation”, etc., can improve performance
• understanding the nature of scattering, i.e., reflections
A region in space can be viewed as an information sponge:
How much information can the sponge hold?

Where is the information? How do we tap it?
• Information comes via waves, radio frequency waves in this case.

• To determine the amount of information something like a mobile phone can collect in a given time relates to the number of different wave patterns it can be exposed to.

• The effective number of wave patterns is limited and depends on the geometry (size and shape) of the phone.

• How we tap the information is through multiple antennas.
• We need to understand waves, and how complicated those wave patterns can get.

• We can use analogies to better understand the issue.

• Ideally we’d like to be able to see what is going on at radio frequencies.
Waves in a limited region

How different are these wave patterns?
Concluding Remarks

Wireless Serves the Needs of People — People shouldn’t have to change their way of communicating because of the communication system. The communication system should be configured so people can communicate freely. When people are active, roaming, changing location, etc., wireless technologies can keep them in touch.

Technology Awareness — the less aware of a technology we are, the better it is. Wireless has still some way to mature in this regard.
Wireless Give and Take — greater personal security and convenience can come at the cost of less secure communications and a degree of loss of privacy. There are many challenges here looming to ensure your privacy is not abused. There is a fine line between being able to be found in an emergency and being tracked without consent.
Research into Wireless — our research is motivated by the more positive aspects of what wireless can provide: better wireless telephony (faster cheaper smaller), and wireless networking. The challenge of research is to find the limits (through theory) and thereby assess the technologies that push these limits through implementation. At ANU/NICTA we are finding what these theoretical limits are, for example, when we attempt to reduce the size of wireless devices.