Networking Futures and Physical Layer Begin

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Aspects of the Future

• Integrated Services (voice, video, data, telemetry)
• Increased Scale (users, required and available bandwidth)
• Mobility and Ubiquitous Computing
• Multicasting
• Better ways to access information and use the network
• Less trust and more security
• Accounting
Increased Scale

- More users being added to Internet per day. Control devices like car microprocessors, sensor devices. 100 devices per user?

- Increased bandwidth per user due to video, games, and publishing. Increased raw bandwidth due to Optical fibre.

- **Implications:** More addresses, scalable routing, user isolation, high performance router and end systems, fault-tolerance, autoconfiguration.
Mobility and Ubiquitous Computing

- Laptops, PDAs, Active Badges, sensor devices on the Internet, GPS.

- **Implications:** Add location finding and tracking to routing, huge amount of extra information. Maintaining access to services as you move. Transparency. Large dynamic range from low bandwidth infrared to high speed fibre.
Multicasting

• Conference calls and video and advertising on the net argue for cheap broadcasting on the net (single message to multiple receivers). MBONE.

• **Implications:** One more dimension of complexity beyond multicasting and delay guarantees!
Integrated Services

• Data applications are elastic. Voice, video less tolerant of delay.

• **Implications:** Networks have to start providing service guarantees (e.g., delay bounds).
Less Trust, More security

• In the beginning, a bunch of bearded Internet types would call each other when things went wrong and would personally hunt you down if you did something wrong.

• Now we have to deal with denial of service attacks (need tracing), wiretapping (need encryption, say PGP or IPsec), and less trust within protocols for defective implementations (Savage’s fast web client).
Using the Network

- All this information. It’s all on the net. What’s the best way to find it. Search Engines. Information Lens. Mail Filters,

- How best to program the network. Naive users programming on the network?
Accounting

• Transition from government subsidies to commercially funded.

• **Implications:** How to do accounting (per byte, per second?). Secure transactions. Fault-isolation and policing. Less anarchy?