The Internet

Geoff Huston
Telstra Internet
What can I say about the Internet.....

that hasn’t been said already!
What is the Internet

Impacts of the Internet

Internet Futures
Evolution of Silicon

- The evolution of the computer in the 80’s
  - single mainframe to many personal devices
- Data communications to link these personal devices are essential
Data Communications

- The objective is to transfer digital data without error between two computers:
  - break the data into “chunks” for transmission (packets)
  - add packet “header” containing
    - source
    - destination
  - transmit the header plus packet data
  - await “ack” of successful transmission of packet
Local Area Networks

- High Speed office networks
  - Ethernet - 10 / 100 Mbps broadcast
  - Token Ring 4 / 16 Mbps ring
  - FDDI 100Mbps ring
Internetworking

- Linking Local Area Networks
TCP/IP - the Internet Protocol

- unreliable datagram transmission with end to end coherency (stateless network)
- Functionally complete protocol architecture
- speeds from gigabit to bit
- can use any communications medium
- Openly (freely) available
- Simple and Sufficient
The Internet - Hosts & Routers

- Hosts
  - generate packets
  - retain packet until acknowledged by destination
  - retransmit packet is assumed lost

- Routers
  - switch packets
    - inspect packet header
    - decode destination address
    - lookup address table of destinations
    - transmit packet on next hop
  - or drop packets!
Internetworking

Host Data Source

Packet

Router

Router

Router

data flow

Host Data Receiver
Internetworking

Network link with multiplexed data traffic
Internets

- Composed of Routers and data links
The Internet

98 Countries
40+ Million Users

A network is added to “the net” every 20 minutes.
The Internet Service Model

Internet Applications operate host to host

Internetwork Domain

Data Path
Some Internet Applications

4 Electronic Mail
4 On-line Information Services (WWW, Gopher)
4 Bulletin Boards, Social Networks
4 Interactive Games
4 Distance Learning
4 File Transfer
4 Home Shopping
4 Internet Telephone
4 Video Mail
4 Video-conferencing
TCP/IP vs Telephony

- switching data packets, not dedicated analogue circuits
- adaptive flow control, not real time flow
- end to end absolute data integrity, not data distortion
- No defined level of service
- No coherent service provider structure
- No coherent administrative structure
The Internet World

- Communications capabilities as software loaded into the end device
- The end devices control the information flow across the network
- The network is just a “dumb” switch
- The services are loaded into the end devices
- Every receiver is a transmitter!
The Internet Environment

- Distributed information environment
- Diversity of consumer access devices
- Ubiquitous network service
- end-to-end service model
The Active Communications Model

- Capable user devices which can generate and receive services
- Passive Data Transmission Network
Internet Growth
**International Internet Capacity - A Selection of Projections**

*Linear Thinking in a Non-linear Era*

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**Total Peak Bandwidth**

- **10GB/s**
- **1GB/s**
- **100MB/s**
- **10MB/s**
- **1MB/s**
- **100kB/s**

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**Today**

- **444**
- **155**
- **68**
- **24**
- **11**
- **10**
- **6**
- **5**

**Sydney 2000**

- **698**
- **562**
- **27**
- **155**
- **24**
- **400**
- **5**

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**Sources**

- AV-CC “Charging Proposals for AARNet”
- AARNet acquisition business case projections
- Projection by Telstra Internet & NTG (Donnelly / Kennelly)
- Former IBU International Wholesale Product Management
- International Engineering (Kennedy)
- Capacity currently booked by Telstra Internet
- Concert - MCI proposal
- NTG Strategic Development Unit

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**Trend of Internet projections**

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**Anticipated Pessimistic**

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**Actual historical growth**

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**1990 1994**

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**1992**

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**1996**

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**Telephone Traffic**

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**Internet Traffic**

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**Concert - MCI proposal Jun 96**

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**International Engineering (Kennedy) 1996**

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**Anticipated Pessimistic**

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**Extrapolation**

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**Capacity currently booked by Telstra Internet**

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**Projection by Telstra Internet & NTG (Donnelly / Kennelly) Sep 95**

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**AARNet acquisition business case projections Sep 94**

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**Sources**

- AV-CC “Charging Proposals for AARNet” Aug 94
- AARNet acquisition business case projections Sep 94
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Futures
Communications Model - 1995

- Voice, Television, Radio and Print networks:
  - “Smart” content provider
  - “Smart” network
  - “Dumb” access device
- Data over Voice
Communications Model - 2000

- A Ubiquitous Internet
  - “dumb” network
  - “smart” access devices
  - service flexibility
  - no distinction between content provider and consumer
- Voice as one of many data applications
**Impacts**

- **Users are Clients and Providers**
  - no massive investment is required to generate content
  - each network user can generate content on their networked device.
Impacts

- No Strict Service model
  - services are defined within software
  - one device can map to multiple communications services
  - the network supports unicast, multicast and broadcast models simultaneously
  - the network supports synchronous and asynchronous communications models
Populating the Internet World

- Content provision is easy
- Abundance of
  - content
  - trading environments
- Content navigation is difficult!
- Directory and Navigation technologies critical
Impacts

- Communications Service Enterprises?
- Publication Industry?
- Media?
- Business and Information Flow?
- Transaction Industry?
- Finance?
By 2001

- 1 billion connected devices
- 1 million component networks
- Voice as a data application
- Thousands of applications
- Underpin the global communications environment
- Alter institutional, financial and political boundaries
And Beyond

Silicon thrives on volume!