

Outrageous Opinion: Vision for the Internet

<http://www.cs.cmu.edu/~prs>

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What Did the Internet Look Like in 1984?

- Very small number of hosts.
- Very simple applications.
- Small user community of experts.
- Relatively clean architecture.

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What Factors Caused the Internet to Change?

- **Moore's law: cheaper, faster, ...**
 - » Reduction in cost of bandwidth (e.g. optical)
 - » Improved endpoints
- **Richer applications: web, e-commerce, ...**
 - » Easier to use
 - » Useful to a much broader population
- **Commercialization: ISPs, content providers, ...**
 - » Very wide-spread deployment
 - » More complex architecture

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Trends

Copper technology: coax, twisted pair, ..	→	Optical technology: fiber, optical amp, ..	→	Incremental evolution: ubiquitous wireless, harder VCs, ..
Limited end-points: Mainframes, workstations	→	Richer End-points: PCs, servers, PDA, ..	→	Specialized endpoints: video, audio, games, ..
Simple applications: telnet, ftp, ..	→	Richer applications: web, e-commerce, ..	→	RT/interactive applications: Virtual(ized) reality, ..
Simple architecture: IP class driven, packet-based, ..	→	Complex architecture: policy, middleboxes, soft VCs, ..	→	More complexity: more middleboxes, ..

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Quality of Service

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Quality of Service

- People's expectations about service quality increase.
- Applications become more sophisticated and interactive.
- Providers are looking for value-added services.
- The Integrated Services QoS model no longer looks that far fetched!
 - » Existing standards
 - » Mathematical basis

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The End

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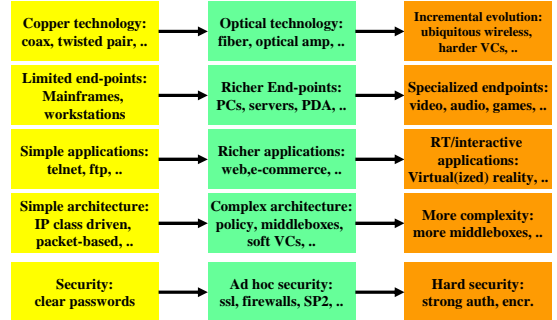
Let Us Try Again

- Did we miss something?

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Trends Revisited



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Factors that will Drive Changes

- **Incremental changes in the infrastructure.**
 - › Improve efficiency, throughput
 - › Similar to other mature industries
- **Providers have to make money.**
 - › Must be able to add value to commodity throughput
 - › Must be able to differentiate from competitors
- **Security will drive architecture.**
 - › Captures authentication, DOS defenses, privacy, ..
 - › But your grandparents/parent/kids must be able to use it
- **People are willing to pay for quality.**
 - › See "providers have to make money"

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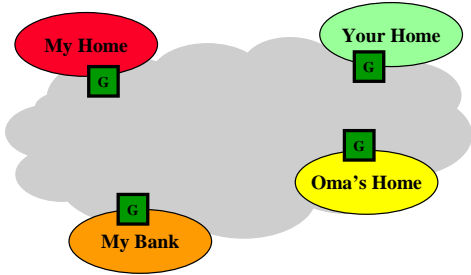
What Might Happen

- **Islands with limited connectivity to Internet.**
 - › Keep the bad guys out
 - › Lots of internal connectivity
 - › Rich applications
 - › High degree of self-configuration and self-management
 - › Home/office islands: integrated with sensor networks
 - Island structure reflects physical infrastructure
- **Application-level gateways.**
 - › Help in security at island boundaries
 - › Provide application-level support
 - Help with loss of connectivity caused by NAT/firewall
 - Value-added features!

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Home Environment Example



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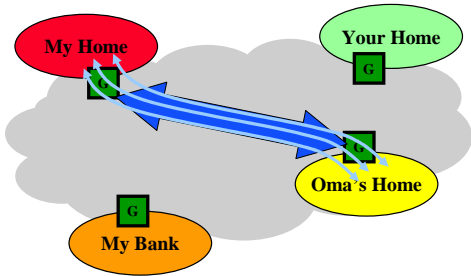
What Might Happen

- **Automated secure sessions.**
 - › Connect known/trusted islands
 - Different methods for un/less trusted islands
 - › Hierarchical: connect individual or groups of applications
 - › Automated – invisible to most users
- **Some quality of service.**
 - › Wireless, e.g. home networks
 - › Value added service in the wide-area network
 - Value-added for providers
 - Driven by application gateways
 - › Likely to be just be per-island (not end-to-end)

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Home Environment Example



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