What is the full cost of net neutrality?

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Workshop on Network Neutrality:
American and European Perspectives
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Overview

- What is network neutrality ("NN")?

- What might network neutrality regulations prohibit in terms of:

    - IP network capabilities and services
    - Economic subscription cost and consumer take-up
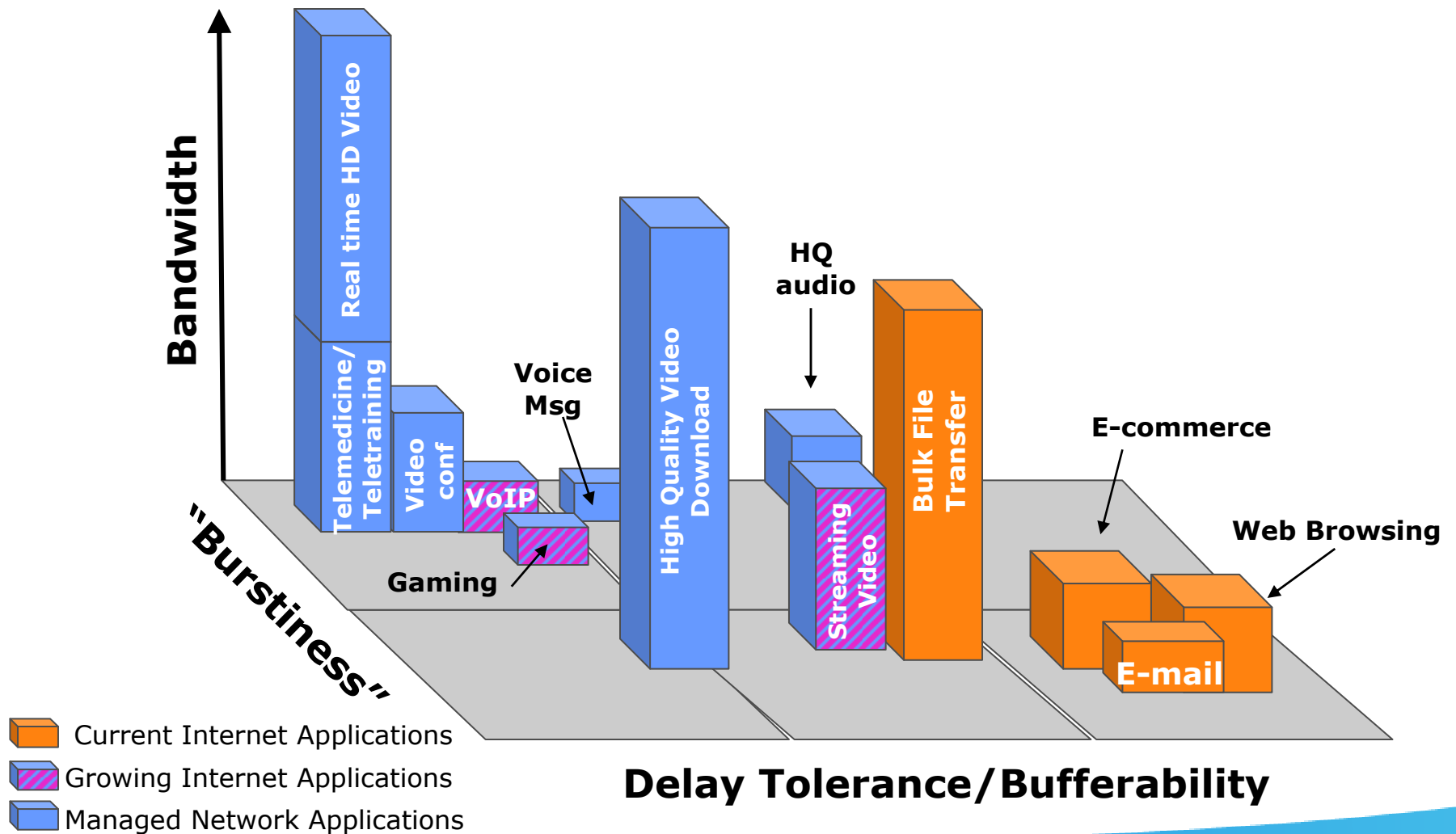   - Internet security
    - Innovation

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Proposed NN restrictions

- No blocking, prioritization or preference for packets associated with operator-affiliated services over nonaffiliated services (all traffic should be best-effort)

- No preference given to packets supporting a given application unless the same preference is provided gratis to packets supporting all similar types of applications

  - Some moderate this rule to: no service capability provided to one customer unless identical capability is offered to all other customers at nondiscriminatory rates – but not Dorgan-Snowe

- No upstream charges for packet delivery

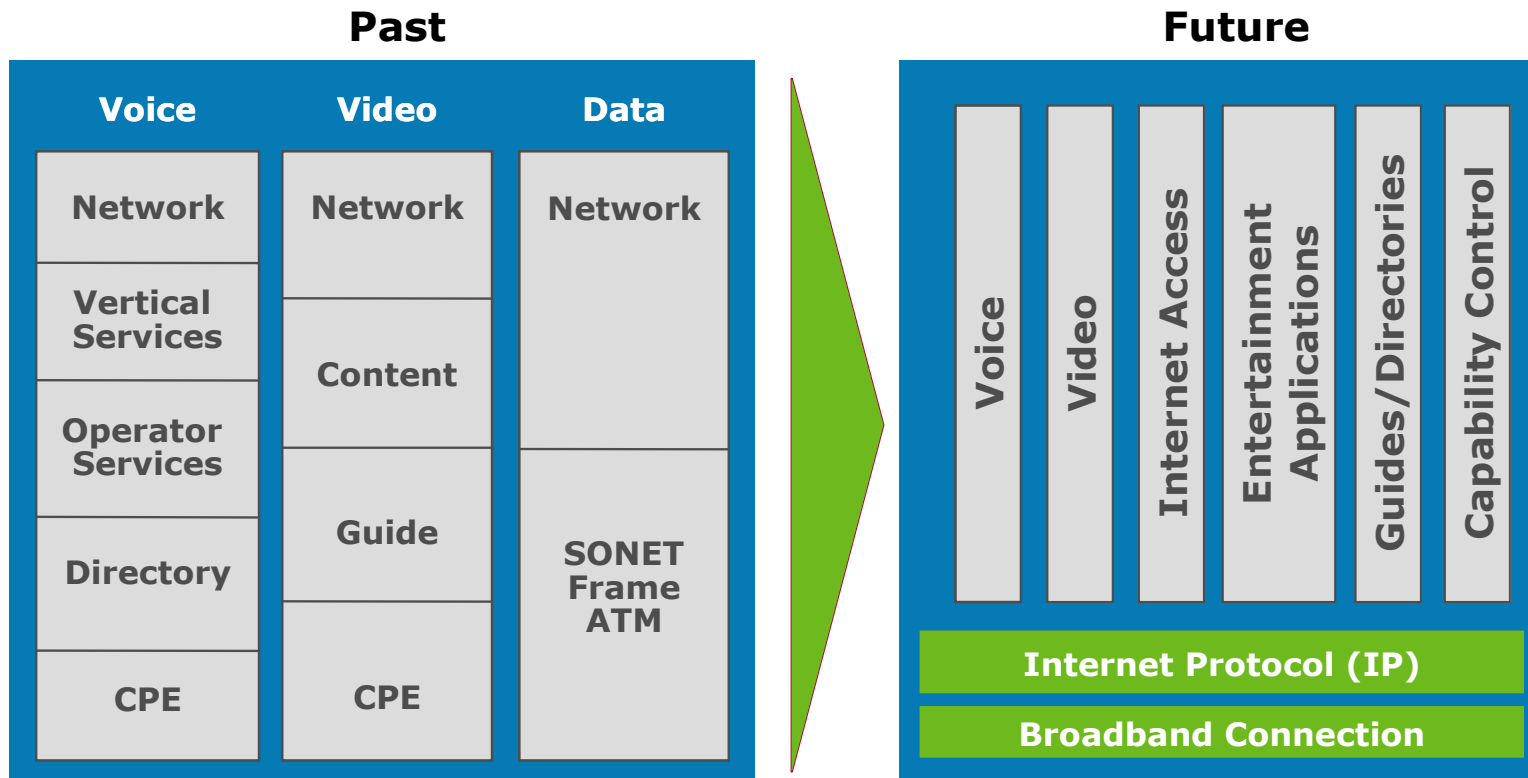 - All broadband access costs and service quality decisions are the responsibility of end users

See Dorgan-Snowe "Internet Freedom Preservation Act" at: http://dorgan.senate.gov/documents/newsroom/net_neutrality.pdf

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Desired IP network capabilities

Bandwidth

"Burstiness"

Real time HD Video

Telemedicine/ Teletraining

Video conf

VoIP

Gaming

Voice Msg

High Quality Video Download

HQ audio

Streaming Video

Bulk File Transfer

E-commerce

Web Browsing

E-mail

Delay Tolerance/Bufferability

■ Current Internet Applications

⬛ Growing Internet Applications

⬛ Managed Network Applications

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Desired IP network capabilities

■ Ability to offer multiple services on a converged network

Past

Voice	Video	Data
Network	Network	Network
Vertical Services	Content	
Operator Services		
Directory	Guide	SONET Frame ATM
CPE	CPE	

Future

Voice | Video | Internet Access | Entertainment Applications | Guides/Directories | Capability Control

Internet Protocol (IP)

Broadband Connection

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Uniform treatment is inadequate

- Many high bandwidth or real-time applications do not perform well in a best-effort or slow-speed environment
  - Real-time applications like VoIP or IPTV need always to "see" an open pipe
  - High bandwidth applications like video downloads may need extra-fast connection speeds to be satisfactory to the user
  - This is especially true of applications demanding <u>both</u> high bandwidth and real-time performance like mission-critical corporate VPNs and telemedicine

- But many IP applications tolerate packet loss, delay and jitter quite well

- Should all applications be treated equally in terms of service quality, pricing structures and levels?

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Uniform treatment is inadequate

- NN regulations would dictate uniform treatment and pricing of different applications – unless end users provide specific and nondiscriminatory directions to the contrary

- But required network service qualities are often best-known to the applications provider, not to the end-user

  - NN would prohibit the applications provider from ordering (or paying for) any service quality enhancements

  - Thus, video service providers could be prohibited from securing necessary enhanced transport quality from the end user's network

- The alternative of providing all applications with network service quality adequate to meet the requirements of the most quality-needy application is highly inefficient

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"Best effort" for all traffic is inefficient

- Study of required extra capacity (REC) in a classless IP network to achieve same service quality as in a differentiated class-of-service network
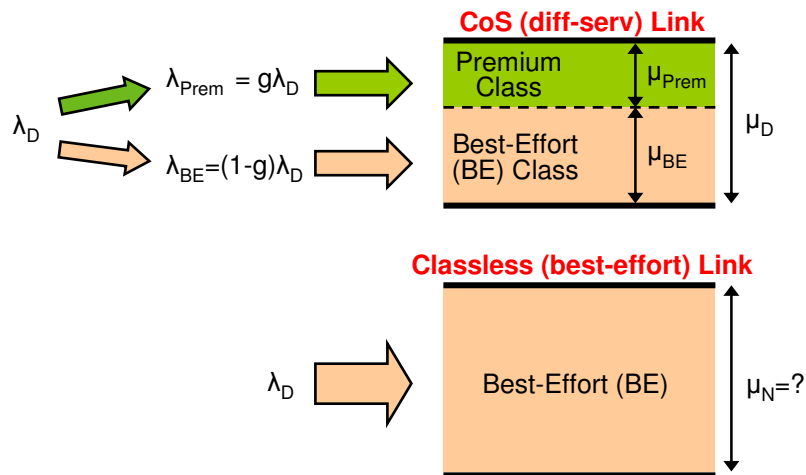
- Percent REC $= 100(\mu_N/\mu_D - 1)$
- Typically 60% or more
- May range up to 100 to 200%
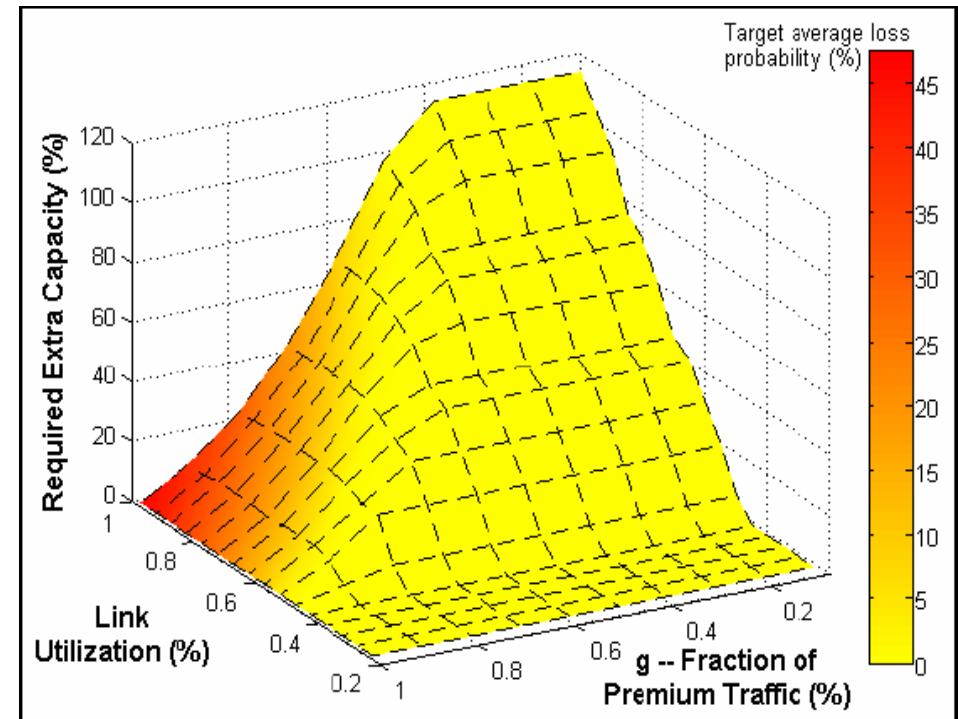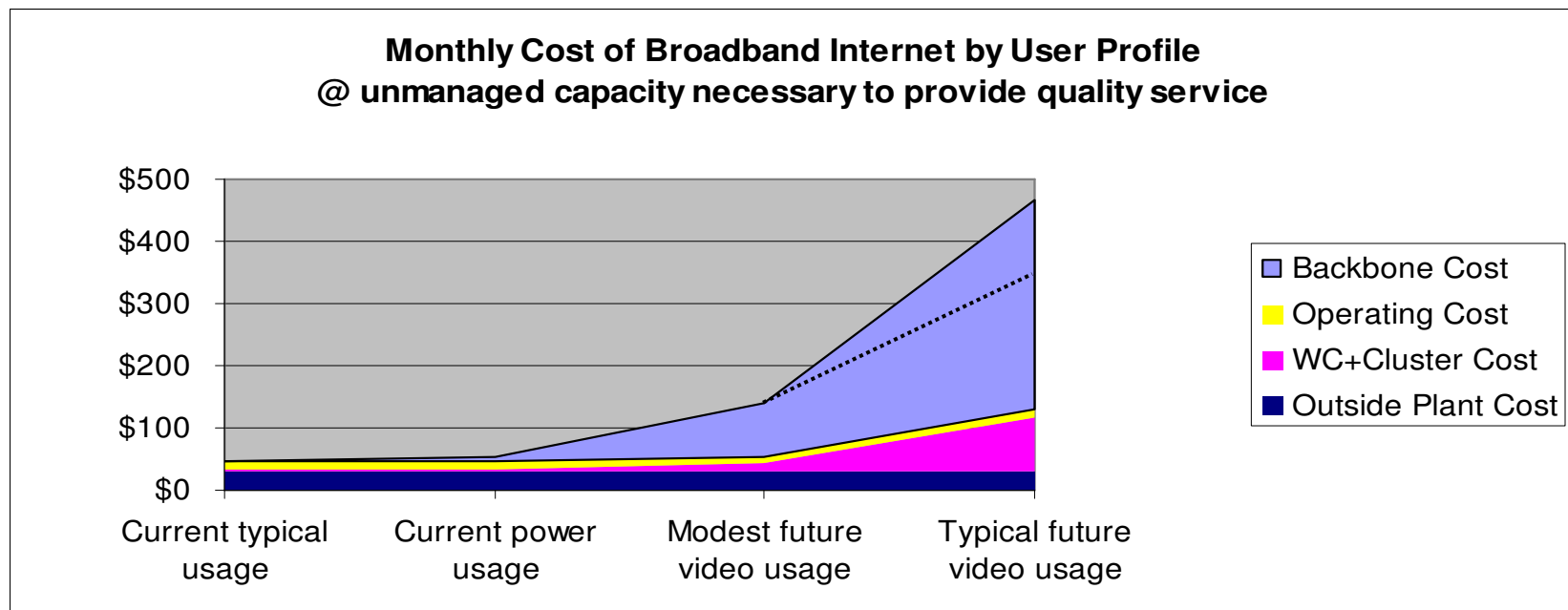
Unmanaged services are too costly

- **Network management is more than just class-of-service packet scheduling**
  - Network services such as multicast could be effectively prohibited by NN regulations
  - If this occurs, high bandwidth real-time services like IPTV could become impossible

- **Clarke study of *Cost of Neutral/Unmanaged IP Networks***
  - Models cost of broadband access, backhaul and backbone networks
  - Assumes that NN nondiscrimination requirements would dictate use of unicast for entertainment video distribution

    See http://papers.ssrn.com/sol3/papers.cfm?abstract_id=903433

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Unmanaged services are too costly

- ■ End user subscription costs would be enormous

Monthly Cost of Broadband Internet by User Profile
@ unmanaged capacity necessary to provide quality service

Legend:
- Backbone Cost
- Operating Cost
- WC+Cluster Cost
- Outside Plant Cost

X-axis: Current typical usage | Current power usage | Modest future video usage | Typical future video usage

Y-axis: $0, $100, $200, $300, $400, $500

- ■ Even use of private caching would not mitigate greatly these costs *See* Norton paper on *Video Internet: The Next Wave of Massive Disruption to the U.S. Peering Ecosystem at* http://www.apricot2007.net/presentation/conference/interprovider_stream/peering-Internet_Video_Next%20Wave_of_disruption_v1.3.pdf
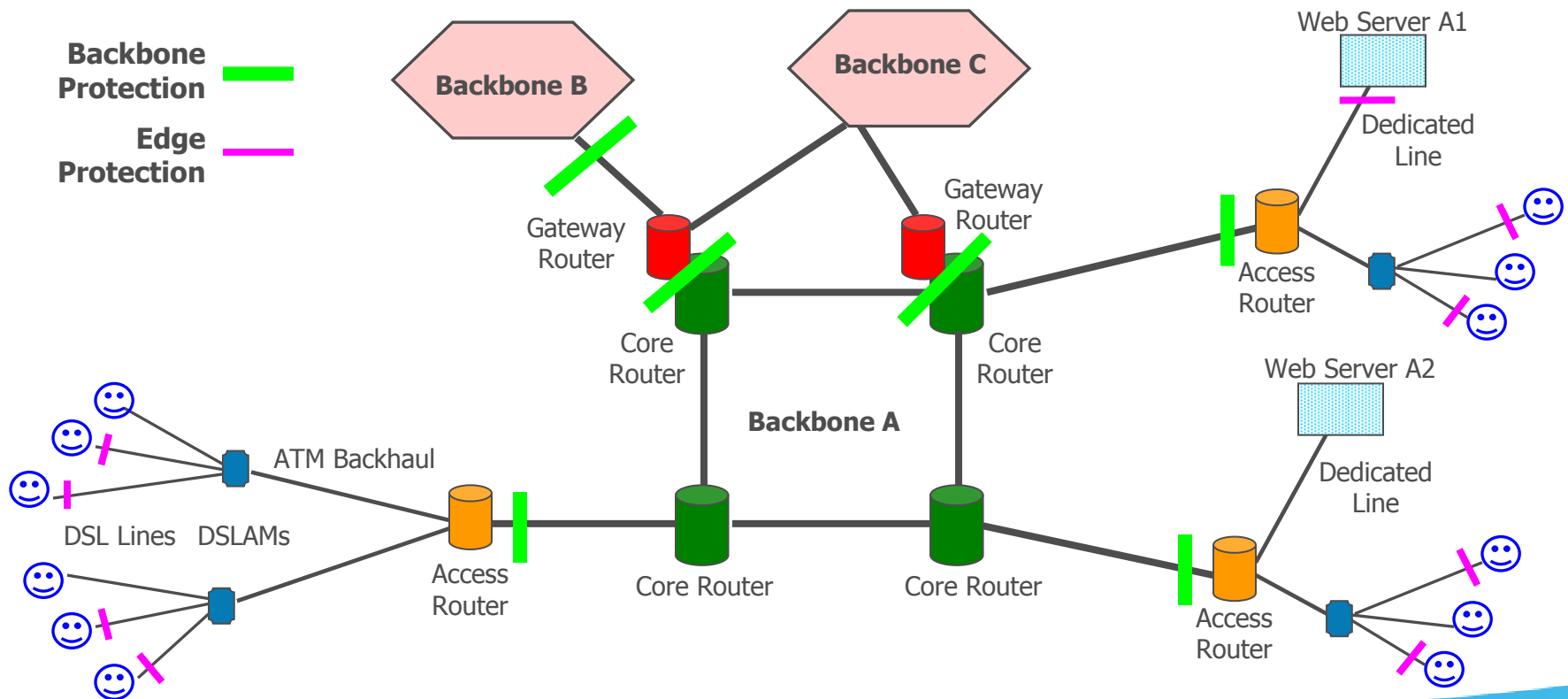
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Inadequate network security

- Huge portions of Internet traffic are unwanted
  - 80% of email is spam
  - Much traffic crossing the network is generated by malware in the form of spyware, adware, bots, viruses and worms, etc.

- This unwanted traffic:
  - Causes network congestion for all users
  - May harm or disable users' servers, PCs or applications
  - May be enabling crimes (PayPal account pfishing, identity theft, illegal computer access, etc.)

- There is both private and social value in controlling or limiting the spread and/or effects of malware traffic

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Inadequate network security

- Protection can take place within IP networks, or only at the customer "edge"

Backbone Protection

Edge Protection

Backbone B

Backbone C

Web Server A1

Gateway Router

Gateway Router

Dedicated Line

Core Router

Core Router

Access Router

Backbone A

Web Server A2

ATM Backhaul

Dedicated Line

DSL Lines   DSLAMs

Access Router

Core Router

Core Router

Access Router

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Inadequate network security

- Protection at the edge works well only if:
  - Adoption is universal
  - 1+ billion nonmalicious PC operators are willing to be 24/7 network security administrators
  - But even if this occurs, IP networks still need to be "large" enough to carry malware across them – only to be blocked at destination edge
- Protection within the network is:
  - Professionally managed
  - Easier to make universal
  - May take place either on network ingress or egress

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Inadequate network security

- NN regulations may limit operators' flexibility in offering certain network protections – such as only on egress at the direction of the receiving customer

  - Would require unwanted traffic to consume bandwidth across the network before being controlled

- Many network-based security services are currently being provided to corporate users

  - Why shouldn't similar services be available to residential users?

- Malware creators are constantly evolving their capabilities, why should the types of opposing security methods be pre-emptively limited by NN regulation?

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Innovation

- **NN advocates argue that:**
  - All Internet innovation should take place at the network edge
  - Further innovation within the network is not desirable – only more dumb bandwidth
  - Moore's Law will quickly solve all technical and cost issues related to this expansion of bandwidth
- **But:**
  - These principles have not been continually true in the past
  - Who really knows the future?
  - Why should we expect Moore's Law to continue to hold if we allow NN regulation to outlaw whole classes of technical innovations?

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Conclusions

- Customers increasingly want the Internet to do more for them (exaflood is coming)

- The Internet is an ecosystem
  - Innovations by network operators have benefited applications providers and innovations by applications providers have benefited network operators

- Both network operators and applications providers want to:
  - Bring further services and innovations to the Internet
  - Reduce the cost of receiving Internet-enabled services and increase broadband subscription

- Why reduce the opportunity to receive these benefits by restricting ways in which the Internet may operate?

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