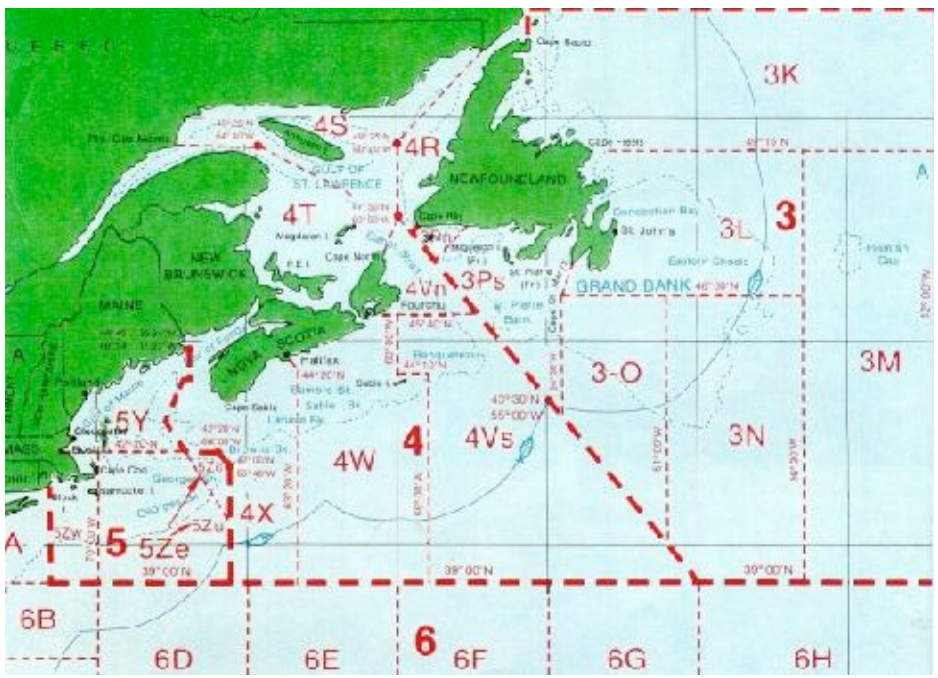
# Perfect Storms, Internet Economics, and the Future of the Internet

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http://www.1-4-5.net/~dmm/talks/apricot2007/perfect_storm

# Agenda

- Background and Context
- So what is the "Perfect Storm"?
- Three Pieces of the Puzzle
- A Few Considerations
- Discussion

# Background & Context

- I'd been spending a lot of time around things like
- NGN and IMS
  - http://www.1-4-5.net/~dmm/talks/NANOG33/ims
- And studying complexity
  - http://www.1-4-5.net/~dmm/talks/NANOG26/complexity_panel
  - RFC 3439

# Background & Context

- So I started wondering where all this is going
  - And how technologies like IMS (or more generally, NGN) interacted with the Internet Architecture
  - And what the implications of the growing number of *policy based networks* really was
- And in particular, I wondered about the implications of tying (perceived) high margin application revenue directly to the packet transport
  - We'll see why this is an interesting question in a moment

# Background & Context

- And as you might imagine (given my background/sensibilities), I was skeptical about what those technologies might mean for the Internet
- In analyzing the space a bit, I proposed a scenario that became known as "Meyer's Telecommunications Perfect Storm", or TPS
  - “You name it, you own it”
- The rest of this talk reviews the TPS scenario and its implications

# What Exactly is the TPS?

- First, TPS is deeply multi-disciplinary
  - Involves economics, public policy, and the Internet technology
- TPS is based on the Internet Architecture
  - In particular, the end-to-end (e2e) principle
  - We can argue (like everyone else) about what the e2e principle actually states...
    - http://www.chiappa.net/~jnc/tech/end_end.html
- However, the key feature of the e2e principle here is that it implies that
  - *IP packet carriage is a commodity business*

# What Exactly is the TPS?

- TPS is based on *three basic ideas*
  - Someone learns how to run a *low margin yet profitable* packet carriage business
  - Access monopolies are *weakened or cease to exist*
  - A set of peer-to-peer applications emerge that *co-opt the incumbents revenue streams*
- Let's look at each of these in detail...

# Low Margin yet Profitable Packet Carriage Business

- First, remember that the hypothesis here is that packet carriage will always be a low margin business as a direct consequence of the e2e principle
  - Note that some providers are already building "simple" networks in an attempt to lower OPEX
  - And lower OPEX is something you'll need if you want to get to a profitable low margin business
- And BTW, there is the question as to whether we're optimizing these networks for the "right" thing in the first place..
  - 80/20? (Or is it more like 95/5?)
  - Consider "convergence" (in the holy grail sense)
    - See e.g., http://www.potaroo.net/ispcol/2006-02/congconverged.html

# Low Margin yet Profitable Packet Carriage Business

- Lighting (even inexpensive) fiber is still expensive
  - Well, it was...
  - OPEX, however, still dominates margins
- And we need to watch out that our economic models are not based on "glut economics" or the availability of "distressed assets"
  - But even that is changing (rapidly)

# Low Margin yet Profitable Packet Carriage Business

- So what this is really about is...
  - *The convolution of the Internet technology with the economics of IP packet transport*

- And BTW, in case you were wondering, we understand the economics of all of this about as well as we understand complexity
  - So we need to encourage research in this area

# Aside: On Commodity Businesses

- Commodities tend toward low margins
  - In particular, in those cases in which the incremental cost of providing a unit of the commodity goes to zero is the point at which it makes sense to price your commodity just below the price set by your competitor(s)
    - What is the incremental cost of forwarding a packet in the core of the Internet?
  - In any event, a "race to the bottom" ensues
- Which is exactly what our industry has experienced over the past few years

# On Commodity Businesses

- A classic commodity also has the property that the incremental cost of providing the good or service approaches its marginal cost of production
  - *So what is the marginal cost of forwarding an IP packet in the core of the Internet?*
- Well, there are high fixed capital costs (routers, circuits, etc)
  - and high OPEX
  - and very small marginal cost
    - i.e., the incremental cost of forwarding a packet

# On Commodity Businesses

- *So what is the marginal cost of forwarding an IP packet in the core of the Internet?*

- Answer: Approaching zero
- So what does this say about pricing power that an SP has in the market?

# On Economic Realities[1]

## capital distribution problem

(the ones who need to innovate in the core don't have capital)

| INNOVATOR | EPS ($) | MKT CAP ($B) |
|---|---|---|
| MCIW | -11.22 | 6.5 |
| SPRNT/NXTL | -0.31 | 34 |
| VERIO/NTT | 1.98 | 71.6 |
| LEVEL3 | -0.74 | 1.9 |
| SBC/T | 1.41 | 78 |
| QWEST | -0.45 | 7.7 |
| COGENT | -7.42 | 0.2 |
| GLBC | -13.84 | 0.3 |
| SAVVIS | -0.90 | 0.12 |
| ABOVENET | n/a | n/a |
| WILTEL | n/a | n/a |
| TELEGLOBE | -0.74 | 0.2 |
| C&W | 0.70 | 4.7B |
| TWTELCOM | -1.12 | 1.0 |
| (TWARNER) | 0.48 | 82 |
| XO | -2.18 | 0.4 |

| INNOVATOR | EPS ($) | MKT CAP ($B) |
|---|---|---|
| CISCO | 0.87 | 108 |
| GOOGLE | 3.41 | 97 |
| AMAZON | 1.25 | 19 |
| YAHOO | 1.07 | 49 |
| EBAY | 0.73 | 51 |
| JUNIPER | 0.53 | 13 |
| APPLE | 1.56 | 47. |
| INTEL | 1.33 | 141 |
| VERISIGN | 0.93 | 6.15 |
| DELL | 1.27 | 76.3 |
| MICROSOFT | 1.12 | 269B |

source: finance.yahoo.com, 25 oct 2005

[1] Chart courtesy kc claffy

# Summary: Low Margin Yet Profitable Packet Carriage

- The Internet Architecture, and in particular, the end-to-end principle, suggests that packet transport is a low margin, commodity business
- If you buy this, then one needs to question whether "policy-based" architectures can ever yield the higher margin transport infrastructures they promise

# Access Monopolies are Weakened/Cease to Exist

- Say, due to the emergence of technologies like WiMAX
  - or just competition in the access
- Truth in advertising #1: This is controversial (shocking)
- Truth in advertising #2: We still don't have a (inexpensive) wireless technology that could deliver 100s (or even 10s) of HDTV channels (in the access)

# Access Monopolies are Weakened/Cease to Exist

- Competition makes it much harder (impossible?) to profitably field policy-based access networks
- Why? Well, consider the cost (OPEX) of running one of these networks
  - and given the complexity, its reliability
- And there is no way your SP is going to be able to innovate at the same rate as the *entire Internet*
- Consider the success of AOL or other attempted "walled-garden" providers
  - But then, what about IMS?

# Access Monopolies are Weakened/Cease to Exist

- Bottom line
  - *Policy-based networks cost more to build and operate, are less reliable, and are (ironically) less "service rich"*
- And who buys that if there is choice?
- And we can talk about the "bundling argument" if we wind up with time...

# Access Monopolies are Weakened/Cease to Exist

- So what this is really about is...
- *The convolution of the Internet technology with public policy*
- Related to what is being called *Net Neutrality*
  - http://www.potaroo.net/ispcol/2006-03/content.html

# Aside: Wall-Gardens What's the Problem?

- Innovation on the edges forces walled garden providers to let the new service through
  - Their customers demand it (consider ports 80/443)
  - This is part of the reason why the existence of competition in the access is a critical component of all of this
- So now *everything* can be tunneled over those (now open) ports
  - e.g., skype
  - plus encryption + anonimzation + lots of app developers

# Wall-Gardens, cont.

- And BTW, you can't really find this stuff with, say, a DPI engine
- Why, you ask?
  - Well, because while you may be able to find the signature (e.g.) of encrypted voice (today), you basically have to block everything that you can't identify
- The implication is that most applications that are "over-the-top" must be treated by default logic
- Conclusion: *You can't effectively stop over-the-top services*
  - If there is competition in the access
- This is a classic arms race

# Applications Emerge that Target Incumbent Revenue Streams

- Third piece of this puzzle is that a set of peer-to-peer (p2p) applications emerge that attack the incumbents revenue streams
  - "attack" in the capture-the-revenue sense (contrast DDOS)
  - Key: decentralization
- Starting with voice
  - Large easily attacked revenue stream
  - cf. Vonage, skype, etc...
  - But also video, FMC, presence, IM, ...

# Applications Emerge that Target Incumbent Revenue Streams

- *So this is about a convolution of the Internet technology and its end-to-end nature and the creativity it unleashed, with traditional carrier architectures and business models*
- In particular, while traditional carrier networks were vertically integrated (*the network was the application*), the Internet is horizontally integrated
  - This has the effect of making many of the *services* the vertically integrated networks provided into *applications* on the Internet
    - Canonical example: Voice

# IPv6, The Perfect Storm Driver?

- So what happens if the IPv6 "everything networked" dream becomes reality, and everything is connected to the network?
- How much will I be willing to pay to have my teapot online?
  - My guess: Not much
    - I'll just want someone to provide cheap transport for my 1000s of network connected gadgets
    - And someone will provide that service
- *So is IPv6 really a perfect storm driver?*

# Summary

- So, what happens if we wind up with...
- *Low margin but profitable packet transport*
  - Emergence of "new world players"
- *No (or weakened) access monopolies*
  - Competition and/or new technologies
- *Large scale co-opting of traditional service provider revenue streams*
  - p2p (or other) applications target revenue

# Summary

- How many of these three basic conditions are already occurring?

- And finally, what if we can't find a way to make a commodity internet profitable?

# What's An ISP To Do?

- Stop trying to make the packet network into a circuit network?
- But more seriously...
  - Be realistic about the complexity-opex tradeoffs
    - "Be Rational" -- Vijay Gill
    - We need better tools here (we have little or no analytic capability in this space)
  - Keep in mind that the governmental intervention is the "trump card
  - Work with the vendors and the open source community to build platforms that have the needed properties

# What's An Vendor To Do?

- Stop trying to make the packet network into a circuit network?
- But more seriously...
  - If the perfect storm scenario materializes, then vendors that are used to high margins may be able to preserve those margins for certain customers
  - However, if what evolves is the need for low margin interfaces (perhaps riding the "ethernet cost/performance curve"), then a hedge strategy may need to be developed.
    - Just how many core routers are there on the entire planet?

# So Where To From Here?

- Stop trying to make the packet network into a circuit network :-)
- But more seriously...
  - All of this is just a (the?) scenario in which the e2e Internet that we all know and love continues to grow and thrive
    - Contrast with the "value-added-transport" position
    - Noting that *everything is Over-the-Top* on the Internet
- Continued education, of ourselves, our employers, and our public representatives is essential
- And perhaps controversially, smart engineering on our part

# A Few Final Thoughts

- We need to be teaching and informing the community at large
  - Where "community" includes SPs, enterprise operators, content providers, researchers, vendors, ...
- A bad (tm) outcome would be to find ourselves in a situation in which
  - Service Providers can't be profitable enough to continue bandwidth upgrade cycles
  - Service Providers then attempt to choke off innovation for (perceived) self-preservation
    - via legislative/regulatory action, and/or by technical means

# Questions/Comments?

# **Thanks!**