

# What is the Internet Paradigm

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# General Topics to be Covered

- **About Shifting Paradigms**
- **Some Internet History**
- **What does the Internet mean?**
- **What about the Future?**
- **Interruptions are expected!**

# Paradigm Shifts Happen!

- **Individually, one person at a time!**
- **Sudden period of Luminosity...**  
**With a POP! (Like Popcorn)**
- **Groups pop one person at a time!**
- **Cultures pop one person at a time!**
- **Popped people speak in tongues; which unpopped cannot understand!**

# So, What is the Internet?

**It's a Bird!**

**It's a Plane!**

**It's a Highway!**

**It's a Cloud!**

**It's just a Point!**

**Well.....**

# **Actually, it was an Accident!**

## **Collision of Military Need & Academic Research**

- Yielding a new kind of Community;**
- A New Information Economy; and**
- A New Business Model**
- Major Paradigmatic Shifts (Note the Plural)**
- Chaos abounds ... Fun, Fun, Fun;-)...**

# Internet Provides Raw Power

To Do More of WHATEVER You Want To Do

More trouble ...

More fights ...

More procrastination ...

More distraction ...

More gossip ...

More rumors ...

More bureaucracy ...

More laws ...

More insecurity ...

More security ...

More Complexity...

More Simplicity ...

... and more Real Production Too?

# The Internet is an Amplifier...

- **It's neutral to all that stuff on the last slide.**
- **Puts Raw Power in the Hands Of Workers...**
- **Requires More Discipline in the Workplace**
- **Problem: Self-Discipline is in Short Supply!**  
**Arguably “The Critical Missing Ingredient!”**
- **Not Provided by Automation or by the Internet!**  
**...or by your Government!**

# Where to get more Discipline?

- **Powerful Workers Need Powerful Management!**
- **Look to Management of Incentives!**
  - **Reward Results**
  - **Reward Self Discipline**
- **Accept that Reality is just Bounded Chaos**
  - **Evolution Will Not Stand Still...**

(a bit more about this later;-)



# **A Brief History of Computer/Communication**

**1960's = A Decade of Dreams**

**1970's = The Decade of Connectivity**

**1980's = The Decade of Interoperability**

**1990's = The Decade of Interworkability**

**Each brought a major Paradigm Shift!**

**It is not clear why each took ~10 years!**

# Brief History of the Internet

- **1960's: Research on Survivable Networks –  
“Route Around Damage” Model Researched**
- **1970's: ARPAnet Proved basic Concepts &  
Discovered “interoperability” Problem (*BLUPR*)**
- **1980's: Internet Technology Proven...  
TCP/IP, et al, Solved Interoperability Problem**
- **1990's: The Internet came of age...  
Only took 30 years... So, now what is next?**

# What is Interworkability?

**Suppose you call Tokyo,  
and the person who answers says:  
“Sorry, I do not speak English.”  
And you do not speak Japanese!**

**The phone system is INTEROPERATING!  
But, you are not INTERWORKING!**

# A New Kind of Community

- **Raw Material of Information Trade is Ideas!**
- **Currency of Information Trade is also Ideas!**
- **Research Communities Exchange Ideas**  
**To Receive: You must Contribute Freely...**  
**To Follow: You must Participate Freely!**
- **If you must follow, Why not follow a Leader?**
- **But, who is leading that we can follow?**

# Some Interesting Paradigms

- **Computing (fetch/execute, read/write)**
- **Networking (two ends using protocol)**
- **Internetworking (no single owner)**
- **Interworking (people working together)**

**Each includes its predecessors...**

# Computing – No Connectivity

- **Fetch/Execute from Memory**
- **Read/Write to a Single File System**
- **One Ended Networking... (zero ended?)**
- **Application Program Interfaces are Key**
- **Mainframes, TimeSharing, Multiprocessors, and LANs**

# Networking – Connectivity

- **Two Autonomous Ends on Connections.**
- **Protocol state machines at each end.**
- **One owner of whole net; shortcuts work.**
- **Homogeneous Connectivity is a big Key.**
- **DECNET, IBM-SNA, ARPANET, ... All Extinct**
- **Looks a lot like an INTRANET ;-)...**

# Internetworking: System Interoperability

- **Two Autonomous Ends for Connections; With protocol state machines at each end.**
- **A Network of Networks, with many owners; BUT, no single control point! Edge Controlled!**
- **Heterogeneous System Interoperation is Key**
- **TCP/IP and OSI...???**
  - **“OSI is a Beautiful Dream, and TCP/IP is Living It.”**



# Interworking: Application Object Interoperability

- **Many Autonomous Ends;**  
**We easily send single E-Mail Msgs to Millions.**
- **WEB Access is available to Hundreds of Millions.**
- **Senders have no control over Receivers' Facilities, And Vice Versa!!!**
- **Key: Application Information Object Interchange**
- **Few Standards Exist! - A BIG PROBLEM!**  
**MIME offers standard Tagging & Bagging**

# **90's Marketing Battle Cry**

**We Work Together Better  
With Everyone  
Than Anyone!**

**(This is happening in spite of MS!)**

# **Internet = Massive Private Collaboration**

- **Looks very much like an Open Economy**
- **Net Offers Massive Global Interconnection**
- **The Most Interesting Connections  
Have Different Owners!**
- **Very Hard to Do Anything by Yourself!**
- **Everyone Needs a Cooperating Other End.**

# Should Anyone Own the Whole Internet?

- **No One Owns an Economy (anymore;-)**
- **No one can own a Free Market (successfully)**
- **No one owns the Global Telephone Network**
- **No one owns the Global Banking Network!**
- **So why should Someone Own The Internet?**
- **End game of Capture is Anti-Trust Breakup!**
- **Unless you want Governments to own it!**

# Internet Arithmetic...

- **Idea: Let's take over the Internet ...**
- **Let's form a consortium & take control!  
1 + 1 = 2 or more; But, does it really?**
- **A consortium is still one party; thus it must collaborate with the rest!  
So, 1 + 1 = 1 in the Internet!**
- **The Internet Cannot Be Taken Over...**

# What Holds The Internet Together?

- **Why does it not fly apart?**

**Answer: Mutual Self Interest**

**Internet Value Stems From Mass Reachability**

- **Each New User Adds Value to All Others**

**Even when they are your competitor!**

- **Actually, competitors need each other ...**

**Just like any open economy or free market!**

# IntraNets and ExtraNets

- **IntraNet:**

**A wholly owned network that uses Internet technology (TCP/IP, SMTP, HTTP, FTP, ...)**

- **ExtraNet:**

**A wholly owned network with one or a few guest hosts of other companies included.**

# Let's Look at IntraNet Security

- **Lesson #1 is that the greatest security risks come from inside!**
- **With the doors closed, internal security becomes paramount.**
- **But, your Firewall induces reduced security for Internal systems (Servers and Clients)!**
- **This is a pathological result!**



# Will an ExtraNet Solve IntraNet Interworking Problems?

- **When you open the door, then the door is open ;-)... Sorry bout that...**
- **Another pathological result!**
- **ExtraNets entail working across major organizational boundaries.**
- **And this requires open doors.**

# Commerce on the Internet

- **“Without Commerce – The Internet will become the CB Radio Craze of the 90's “**  
...David Farber
- **Payment Systems must arise;**  
**So They Have... (*Not all survived!*)**
- **Many candidates are in development...**
- **Commerce is a dominant activity, and the Internet will expand to entire world.**

## **Now, Let's look at Banking...**

- **Banking “networks” are really authorization systems dating to the origin of banking.**
- **Associations then formed to deal with scale.**
- **Association Networks were built and they charge per transaction because transactions are easy to count.**
- **Enter the Internet! Looks like A Buss Bar ... (Shunts across the banking Intranets & allows banks to interwork directly over the Internet)...**

# Internet Business Model?

**What is the business model, if any?**

- **The Internet has more than 300,000 owners.**
- **Ownership doubles every 13 months ...**
- **Bilateral agreements are not possible!**  
 **$(300,000) * (300,000 - 1) / 2 = 4.99985e+10$**
- **There are tens of thousands of ISPs...**  
**Too many to use bilateral agreements.**

# Internet Business Model

- **Service Providers Mutually Agree to Exchange Traffic via some "Mythical Middle".**
- **Each End Pays for all Sending & Receiving.**
- **No Settlement for Directional Differentials,  
Because there are no such differentials!**

# The Mythical Middle?

- **Internet Service Providers form a mesh:**

USERS<>Local-ISP<>Transit-ISP<>BackBone-ISP<>MIDDLE

- **Users pay for "Access-to-the-Middle"**

May be local: USER<>Local-ISP<>MIDDLE

Or nearby: USER<>Local-ISP<>Transit-ISP<>MIDDLE

- **ISPs sell global access, via Mystical MIDDLE**

**Interesting to note that the middle is not ownable!**

# Quality of Service – QOS

- **Some say ‘Internet has no QOS’ because Service Providers cannot make it reliable.**
- **Or, because some parts are unreachable from time to time.**
- **These two things are not the same:**
- **IP is unreliable; TCP adds reliability at ends.**
- **No Internet of 100,000 networks is up 100%.  
*(Including the telephone network;-)...***

# The Black Hole Story

- **Each end point is responsible for its QOS**
- **If your end is not working, then the whole Internet looks like a black hole to you;**
- **But the net sees a small hole at your end.**
- **The rest of the net does not care if you want to live in a black hole...** Already too big!
- **So, your destiny is in your own hands!**



# **What is wrong with Evolution? If Anything is Wrong with it!**

- **All this looks perfectly normal to me!**
- **The Internet has spawned chaos, and per chaos theory, has self organized into a region of bounded chaos which yields a rich array of new species, of which many will die, while some will adapt and grow strong enough to replace the current ways of doing business in our biosphere ...**
- **There was never any way to stop it, once the Internet technology genie escaped the bottle!**

# It Was Inevitable!

- **We are “At Home In The Universe”**  
**As Stuart Kauffman explains in his book of the same title ...**
- **The laws of nature, by themselves, spawn speciation of life forms with evolutionary properties that cause new species to arise which in turn cause extinctions to occur.**
- **New species create new choices and thus change our value systems! Internet is Alive! It is just a natural consequence of evolution!**

# So, what is the future to be?

- **More of the same I fear;-) ... More Fun!**
- **More Chaos ...**
- **More Speciation ...**
- **More Extinction ...**
- **More Life ...**
- **More Self Organization ...**

**Remember... Commerce & Society Self-organized themselves in the first place!**

# **So, What is our Assignment?**

**We must embrace complexity and allow our self generated chaos to organize itself.**

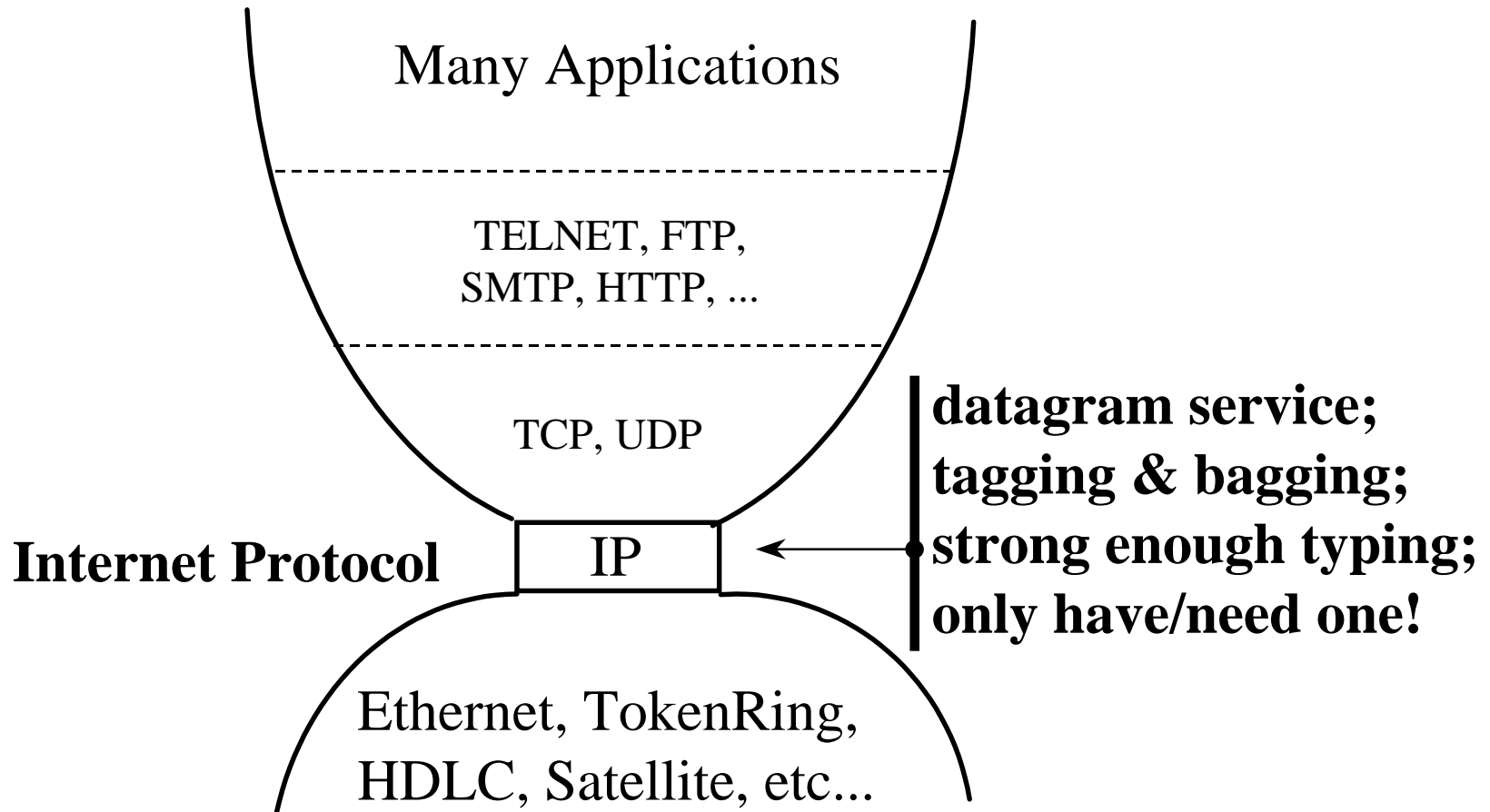
**We must interpret and apply the lessons of the Internet:**

- 1. Keep the Core Simple!**
- 2. Relegate Complexity to the Edges!**
- 3. Work Around Problems!**
- 4. Avoid Centralized Control!**
- 5. Employ Open Governance Modes!**

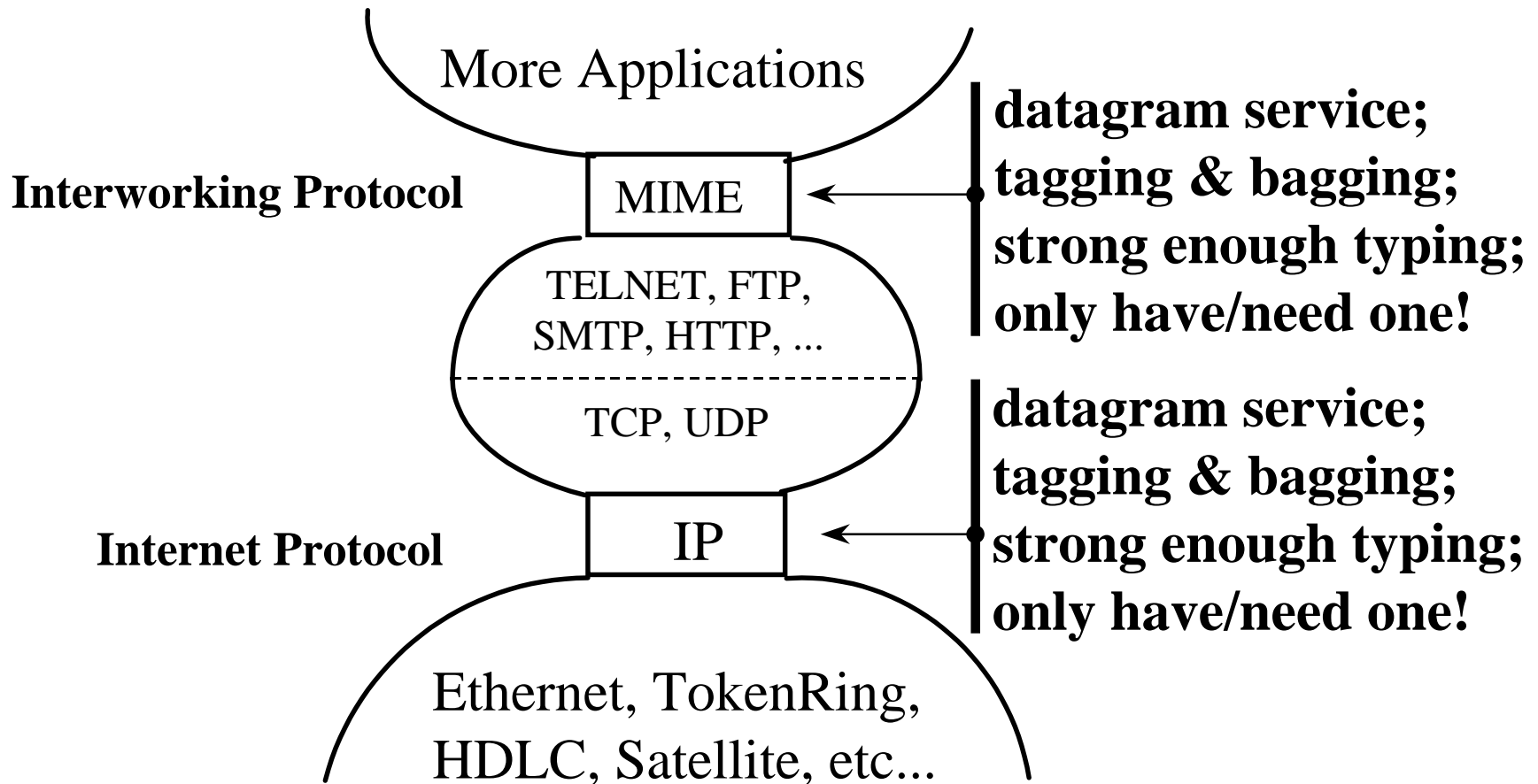
# The Architectural Question

	<b>Core</b>	<b>Edge</b>
<b>Simplicity</b>	<b>Good</b>	<b>Bad</b>
<b>Complexity</b>	<b>Bad</b>	<b>Good</b>

# Internet Paradigm Offers SubLayer Independence



# Internet + Interworking Paradigms Offers More Sublayer Independence



# The Future is Bounded Chaos!

- **Just like the long term past ...**
- **The Internet is only the prelude ...**
- **We must learn to manage our affairs in the midst of Bounded Chaos, and the Internet has given us some initial training for it!**
- **It is futile to think of restoring order!**
- **The past only looks ordered! Not so!**



# Some Books to Read

- **Stuart A. Kauffman, “At Home in the Universe: The Search for Laws of Self-Organization & Complexity”,** New York, Oxford University Press, 1995, ISBN 0-509599-5
- **Tom Stoppard, “Arcadia: A Play in Two Acts”,** New York, Samuel French, Inc., ISBN 0-573-69566-0
- **Gay Hendricks & Kate Ludeman, “The Corporate Mystic: A guidebook for Visionaries with their feet on the ground”,** Bantam Books, ISBN 0-553-09953-1

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