
GRID-2-GRID
Peer-2-Peer

Acknowledgements

Material & Review by:

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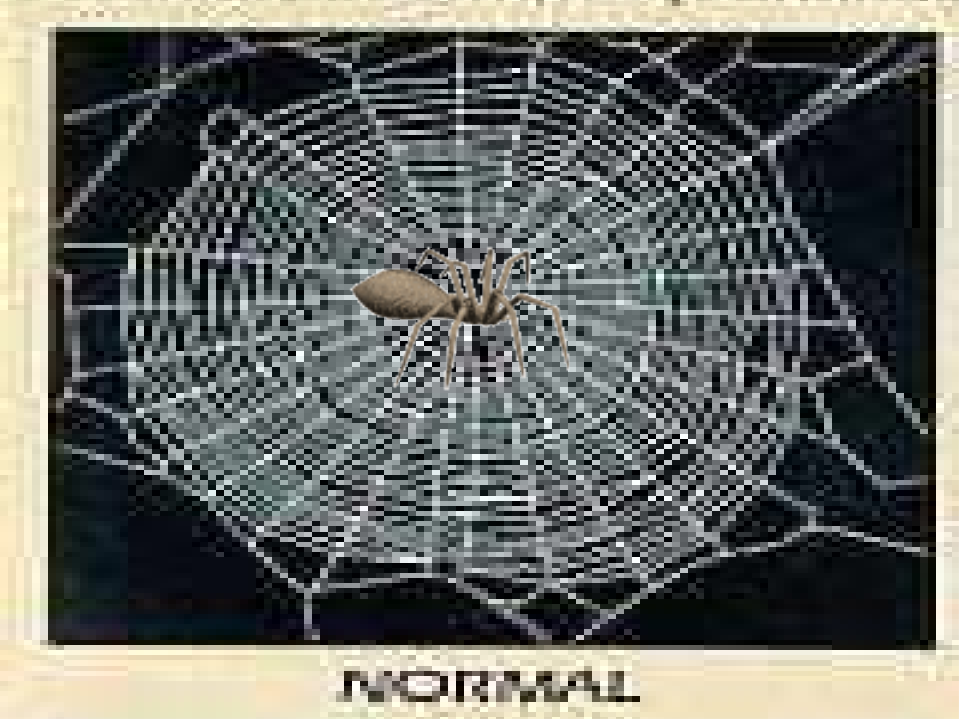
University College London

Brian Carpenter, IBM

IPv6 – Speeding Up The Uptake

eInfrastructure - technology and policies

"Mario Campolargo, HoU, DG INFSO F3"



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CAFFEINE

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MARIJUANA

NAT

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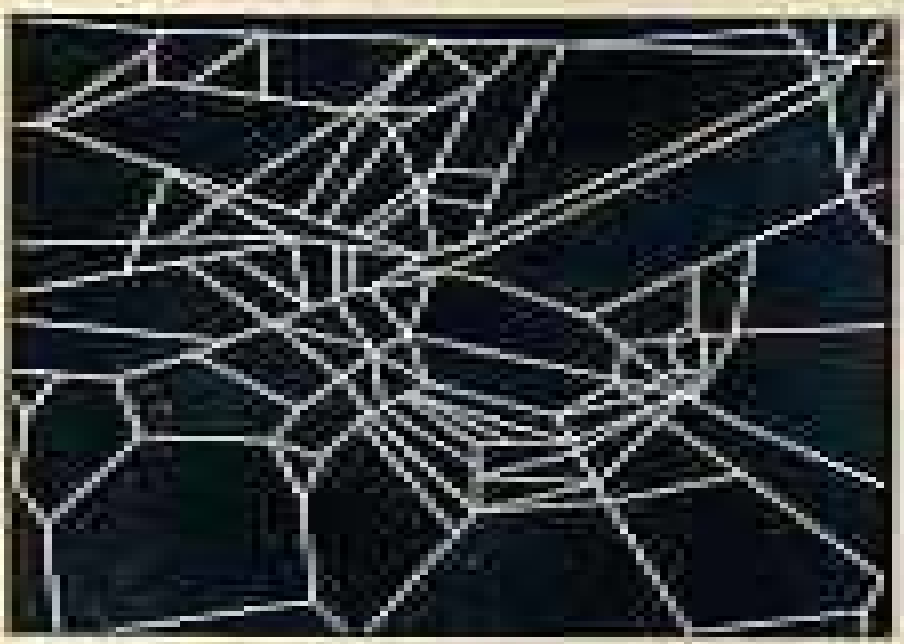

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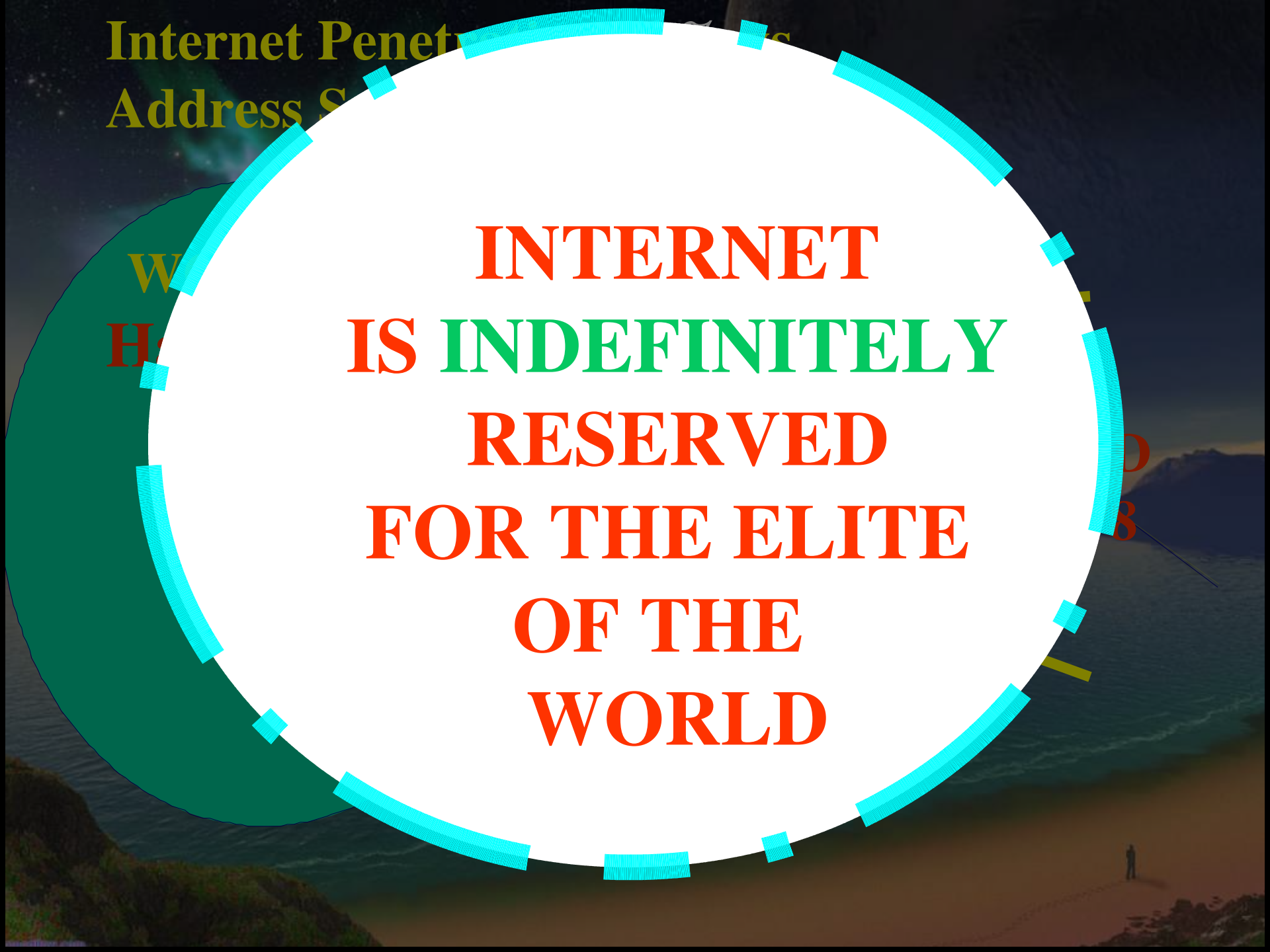
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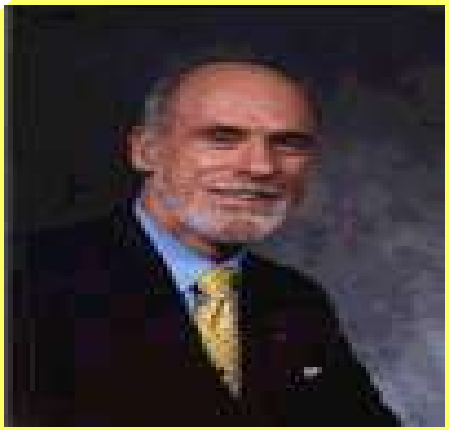


”Running out IP Addresses is like running out Oil!”

Vint Cerf 2004

No Urgency

Some Urgency

Emergency

Lost Features of the Internet
Aging & Decaying of Networks Today

- Transparency (e2e Internet Model)
- Robustness of Global Connectionless View
- Dynamic Routing
- Unique Addresses
- Always-On Service without Middle Boxes
- A Peer-2-Peer Communication Model
- Application Independence
- End-2-End Secure Trust Model
- Prohibits Global Network Virtualization of Applications

So, Why Bother?

E2E – The Best Kept Secret

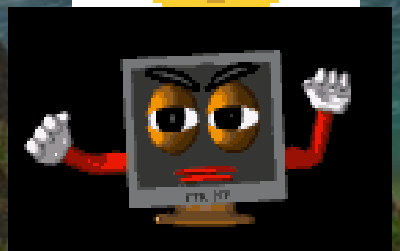
Complexity rises as technology exceeds its design limits

Maintenance costs become excessive

Workarounds become endemic

Logical End-to-End model sacrificed

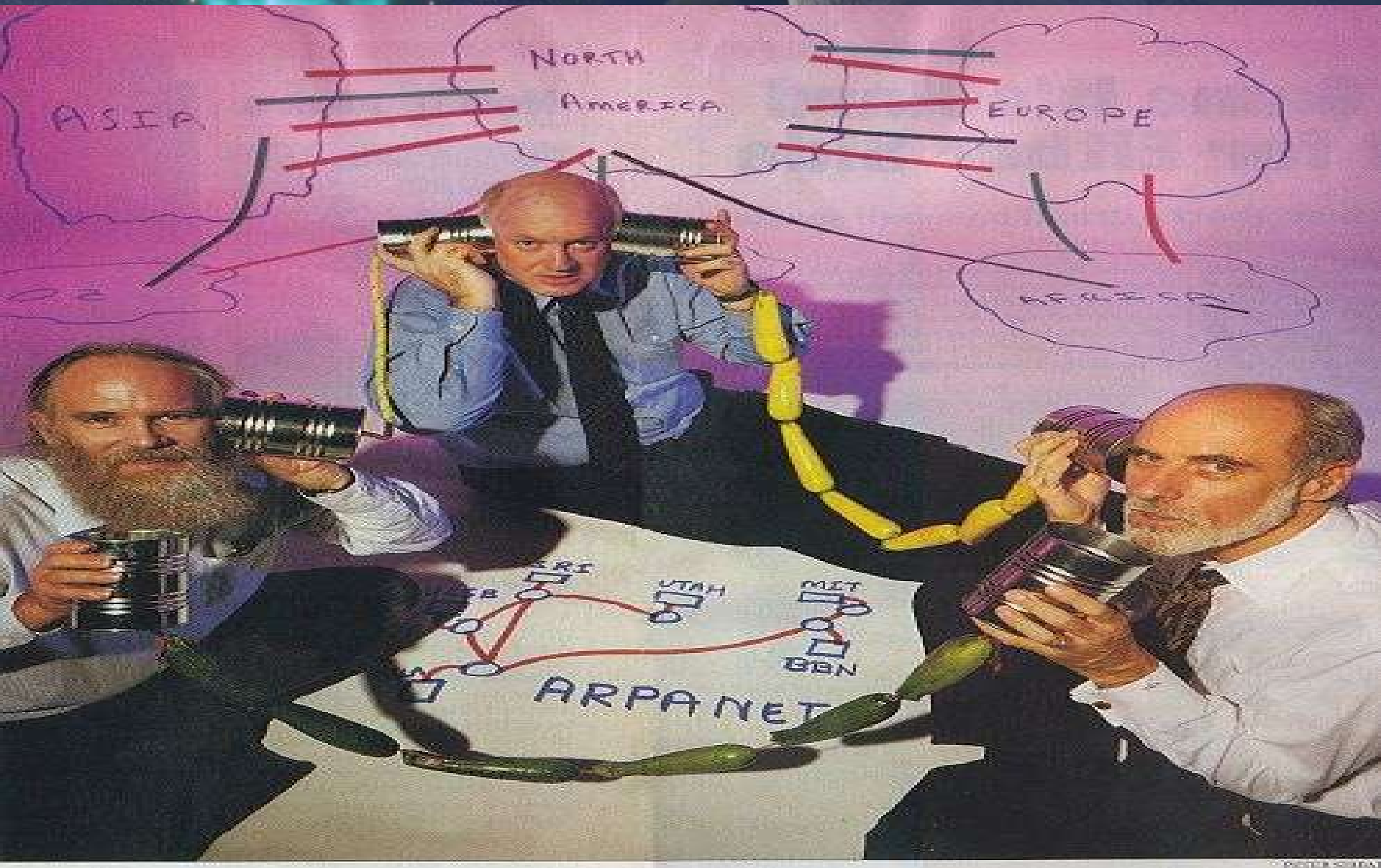
Phone Call + Call back



E2E IP Multimedia Connection

So, Why Bother?

E2E – The Best Kept Secret




The Future of the Internet
Inter-NET or Inter-NAT
NAT is about Control
IPv6 is about
Freedom !

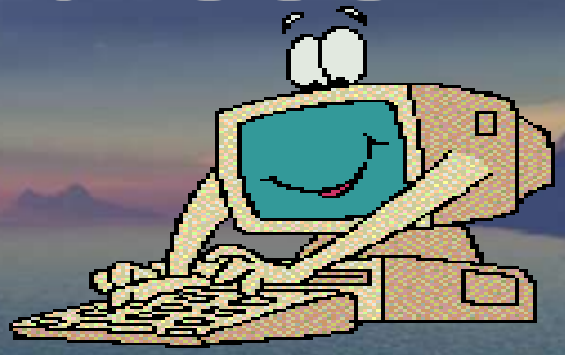
End 2 End Muscle

IPv4 → IPv6 Vision

250 M → 10 Billion Nodes

Always-on

Autoconfig



Mobility

Always-on
Security
Privacy

The New Internet

Symmetric

Filesh&ring

Ressource Sharing

Instant Communication

Interactive

€2€

Collaborative Computing

Wide Open Again for INNOVATION


Addressing The Edge
Secure
Always-On
Connection
Power To The Edge

Killer Apps

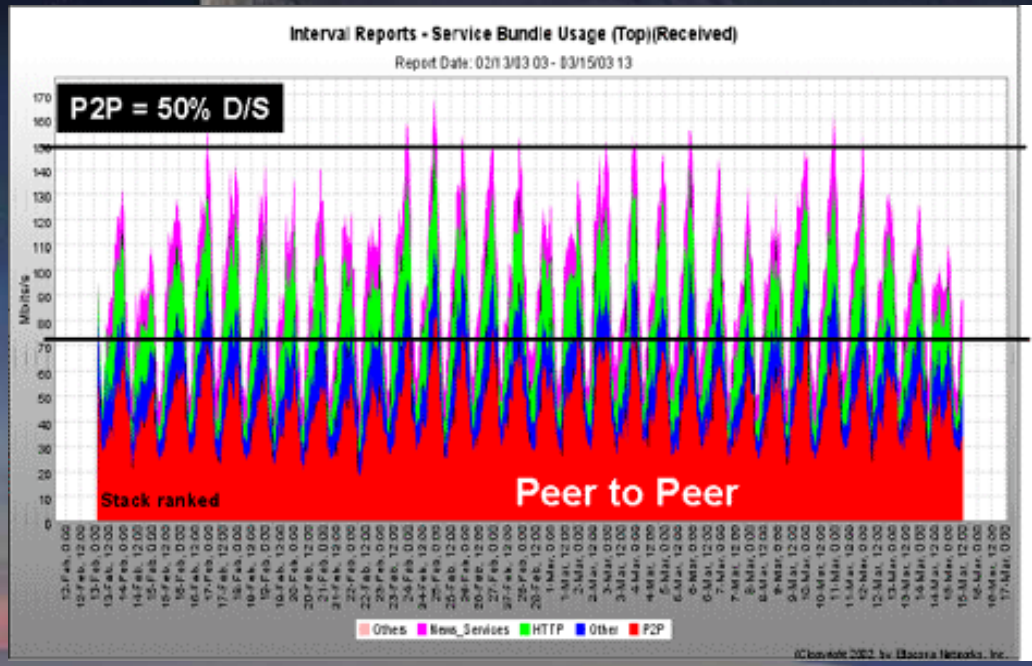
Is GRID IPv6 Ready?

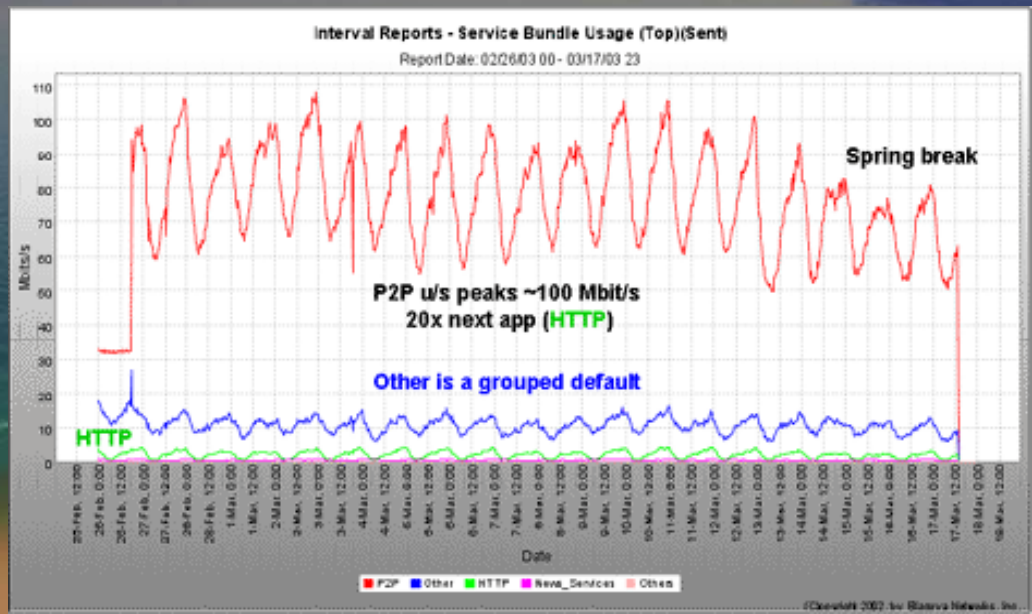
Is P2P Really P2P?

Traffic Evolution

Applications – Server/Client, P2P, GRID – generate different traffic patterns than Client/Server

- **Symmetrical** – as much upstream as downstream traffic (users become servers as they deliver contents)
- **Very long sessions** – Always-on devices may be left unattended. Streaming applications can run for a long period of time.
- **Sustained high bandwidth** – many devices can now use all bandwidth available. Multiple video sessions require high bandwidth capacity.
- **Non-local** – Traffic travels globally, and between ISP networks, hence putting load on the peering points (est. 60% of traffic) and expensive long haul links.





P2P & GRID

P2P

- Anonymous individuals
- No implicit incentives for good behavior

Impact:

- No trust
- Free ride
- Implicit incentives to cheat:

GRID

- Established communities
- Good behavior:
  - –Implicit incentives
  - –Means to enforce it

Impact:

- Trust
- Well-defined “tax base”
- Less flexibility?

P2P & GRID Resources

P2P

- Computing cycles
- Less powerful
- Intermittent participation
  - –Gnutella: avg. lifetime 1h (‘01)
  - –MojoNation: 1/6 users always on
  - –Overnet: 50% nodes available 70% of time over a week (‘02)
- Variably connected
- Some technical support as community effort

Impact:

- Ease of integration of new resources an early priority

GRID

- More diverse (in type):
  - –Files, storage, computing power, network, instruments
- More powerful
- Good availability
- Well connected
- Technical support

Impact:

Costly resource integration

P2P & GRID Applications

P2P

- Some
  - –File sharing
  - –Number crunching
  - –Content distribution
  - –Measurements
- "Toy" applications only?
  - – Albeit very popular "toys"!

Impact:

- –Complexity often derives from scale

GRID

- Often complex & involving various combinations of
  - – Data manipulation
  - – Computation
  - – Tele-instrumentation
- Wide range of computational models: - Embarrassingly ||
  - - Tightly coupled
  - - Workflow

Impact:

- – Complexity often inherent in the application itself
- – (Inevitably?) Complex infrastructure to support apps

P2P & GRID Scale & Failure

P2P

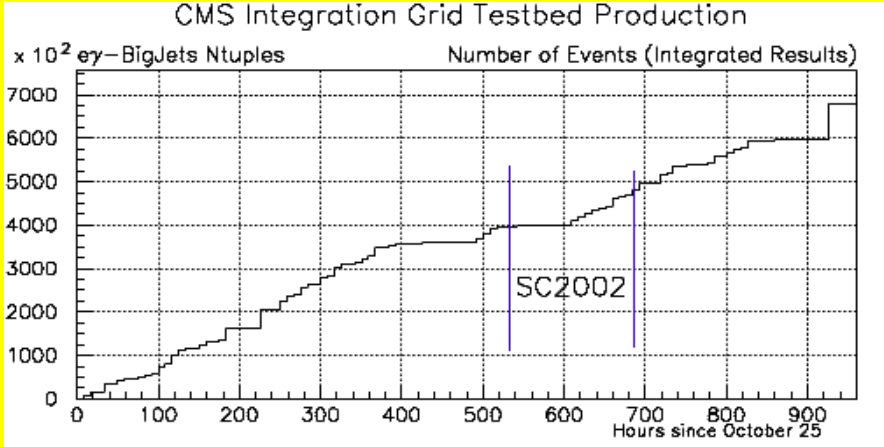
- **Large numbers of entities:**
  - **Millions of users**
- **Moderate activity**
- **1-2 TB in Gnutella ('01)**
- Diverse approaches to failure
  - Some centralized (SETI, …)
  - Some highly self-configuring

eDonkey2K	**3,390,821**
FastTrack	**2,655,327**
Gnutella	**1,343,576**
Overnet	**688,128**
DirectConnect	**320,310**
MP2P	**251,137**
Filetopia	**4,265**

(www.slyck.com, **April 20, 2005 - 23:00**

GRID

- *Moderate number of entities*
  - *10s institutions, 1000s users*
- *Large amounts of activity*
  - *4.5 TB/day (experiment)*
- Approaches to failure reflect assumptions
  - centralized components



P2P & GRID Service & Infra.

P2P

- Each application defines & deploys completely independent "infrastructure"
- JXTA, BOINC, XtremWeb?
- Efforts started to define common APIs, albeit with limited scope to date
- Use of NAT !
- NO IPv6 !

Impact:

- New install per application
- Interoperability & code reuse not achieved
- No Scaling !

GRID

- Standard protocols (Global Grid Forum, etc.)
- De facto standard software (open source Globus Toolkit)
- Shared infrastructure (authentication, discovery, resource access, etc.)
- Use of NAT !
- NO IPv6 !

Impact:

- No End to End security
- Interoperability not achieved
- No Scaling !

What Can GRID Learn From P2P ?

P2P

- Scalability
- Autonomy
- Light-weight implementations
- Inclusion of desktop and smaller resources
- Intermittent operation, highly dynamic connectivity

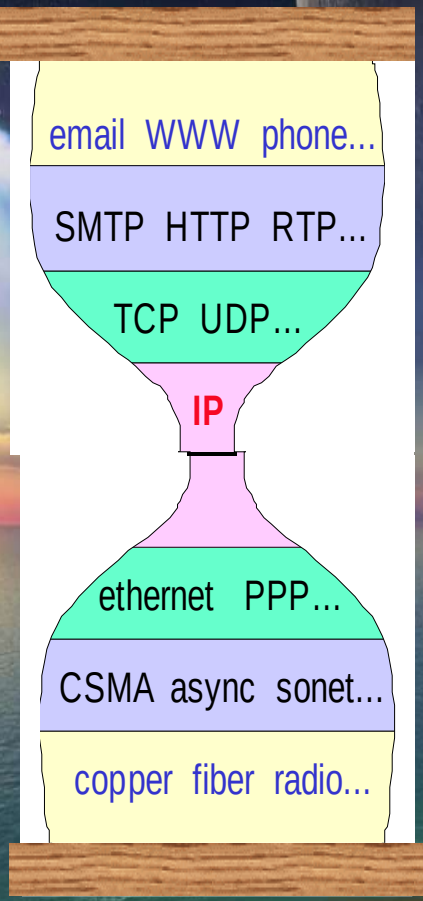
GRID

- Well some Security – more than encryption
  - –Authentication, access control, trust models, virtual organizations, cross organization interactions, etc.
- Naming and binding
- "Industrial strength" architectural support (OGSA)
- Resource management strategies
- Policy negotiation

Staying with IPv4/NAT

- Address Space Depleting
- No End-to-end addressing
- No Auto-configuration, renumbering
- No Mobility Solution
- No Modular design with clean extensibility
- No Additional hooks for QoS – Flow Label

Oops! An Accident

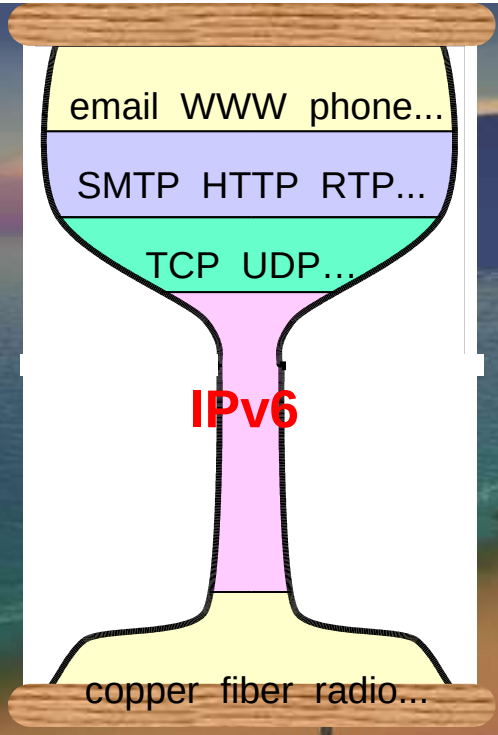


- NATs & ALGs used to glue the broken pieces
- lots of kinds of new glue being invented—ruins predictability
- some apps remain broken, since repairs are incomplete

< Source: Steve Deering, "IPv6 Addressing the future", Global IPv6 Summit Korea, 2001>

GRID Moving to IPv6

- **Bigger Address Space**
  - Massive scaling potential >> 4 Billion(IPv4) nodes
- **End-to-end addressing**
  - Reduce need for NATs, Proxies etc
  - Enables full network level security (IPsec)
- **Auto-configuration, renumbering**
  - Simplifies network (re)configuration
- **Complete Mobility Solution**
- **Modular design with clean extensibility**
  - Streamlined processing, effective header compression etc
- **Additional hooks for QoS – Flow Label**



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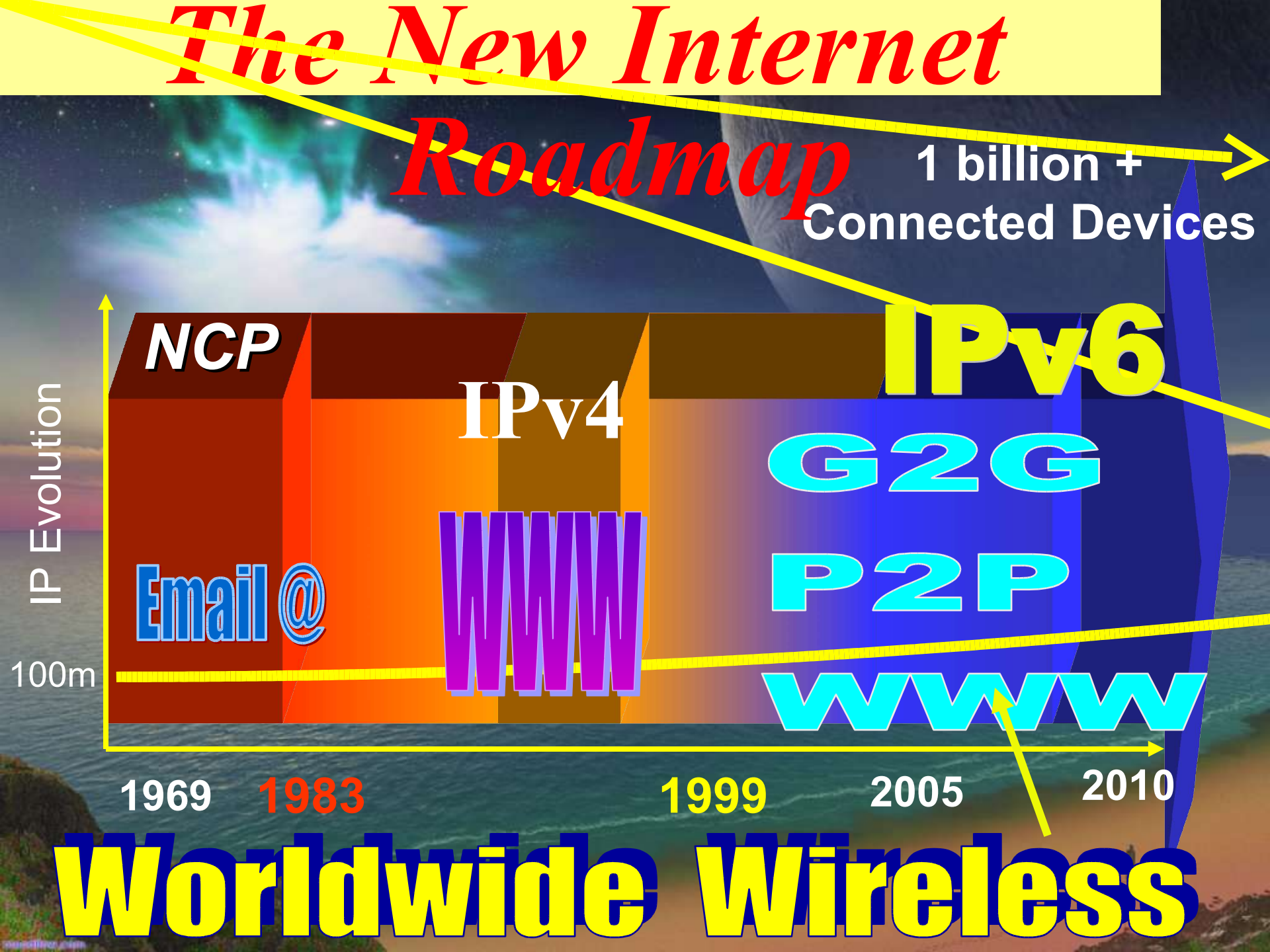
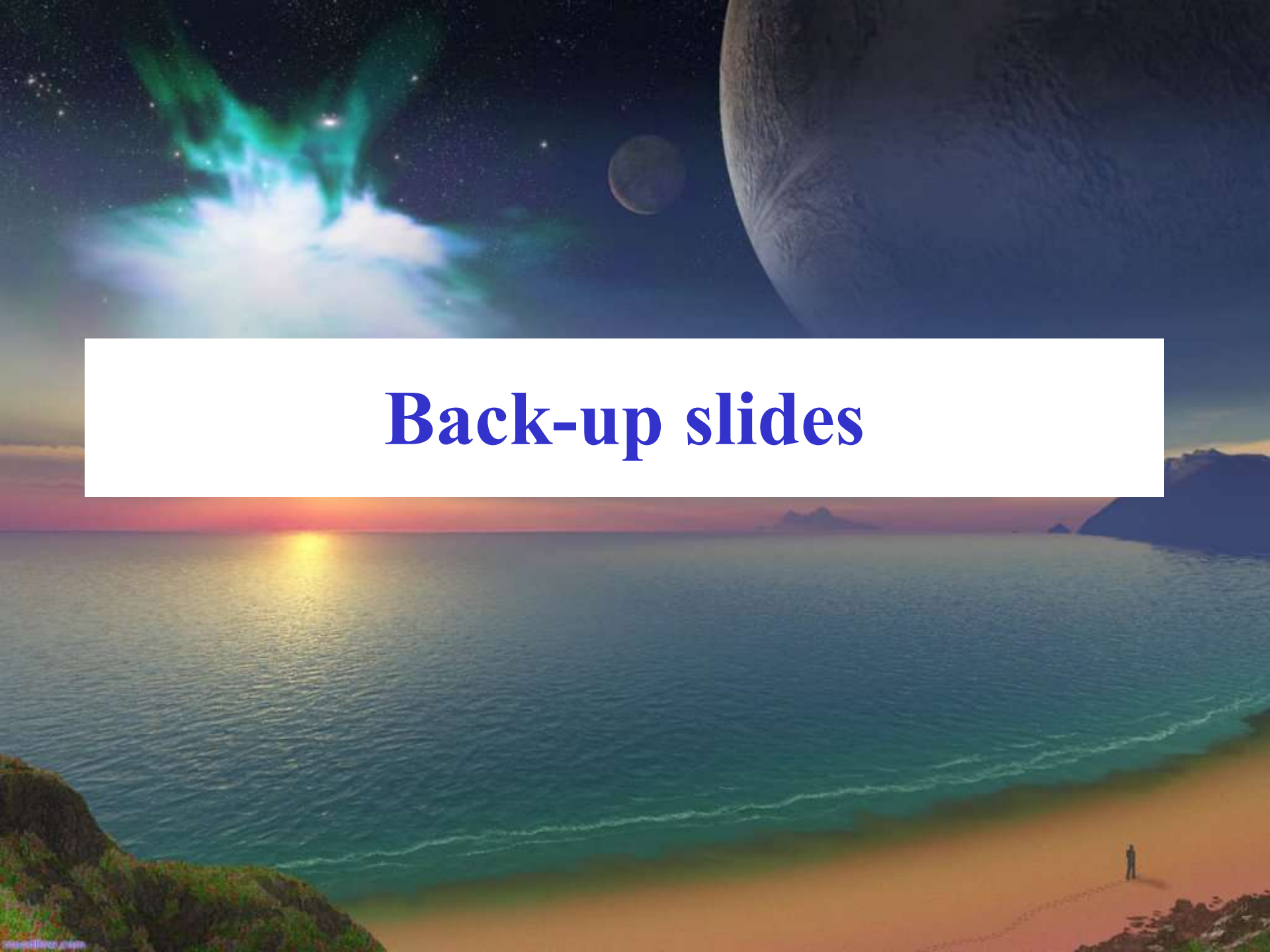
The Seamless GRID Vision

- Internet IS your Network (e2e)
- GRID should be truly Global (e2e)
- Applications Just Work (IP-agnostic)
- All Communications Authenticated
  - Connection –by-Connection
  - Access controlled by identity
- Trust Boundaries defined by Policy instead of Topology
  - Traffic management at the edges
  - Network immune systems
- Mobile GRID

The New Internet Roadmap




IPv6 is an Iceberg
The End-User
will not see but
feel all of it !



Back-up slides

Protocol Modification For IPv6 Support

- A few protocols needed to be modified to suit IPv6 protocols
  - For example, Grid-FTP
- Correspondingly, the specific implementation needs modification
  - UCL has contributed to code changes in Globus core for IPv6
  - ANL developing XIO architecture for GridFTP with IPv6 capability

GGF IPv6-Working Group

- Setup and co-chaired by 6NET:IBM and UCL
- Global Grid Forum (IPv6-Working Group) http://forge.gridforum.org/projects/ipv6-wg/
  - IP version dependencies in GGF specifications
  - Guidelines for IP independence in GGF specifications
  - Status for Java Developers Kit API for IPv6

Current IPv6-WG documents

- Out of 88 documents surveyed 24 had some form of dependency
  - 60% failed to reference IPv6 URL RFC2732
    - e.g. http://[2001:0DB8::CAFE]/sofia/
  - 24% IP dependent textual material
  - The rest contained other dependencies
- Guidelines for IP independence in GGF specs
  - IP independence in specifications, Implementation
  - Implications for new features
- Status for Java Developers Kit API for IPv6
  - Add support for Flow Label and IPv4-mapped

Status & Way Forward

- > Globus 2 IPv4-only?.
  - Korean Kreonet2 ported GT2 to v6
  - Japanese 6Grid ported GT2 to v6
  - UCL-6NET abandoned GT2 work (Sheng JIANG)]
  - Sheng JIANG introduced modified globus_io code online. However, never tested.
- > Globus 3 is partly based on C libraries and partly on Java which is OK for v6.
  - Most part of GT3 is on Java, which has included UCL IPv6 modification
  - since version 3.2. GridFTP is based on c-code globus_io. Not IPv6-enabled,since it is planned to be replaced by Globus_XIO.

> Status of a the new I/O package (XIO).

- In Jan/Feb 2005, tested Globus_XIO with the new GridFTP (coming with the GT4-beta, also known as GT3.9.*). It does support dual-stack.
- However, there is no any official documentation from ANL mention/introduce v6 part of it yet.
-

Status & Way Forward

- OGSI vs. WSRF ?.
  - Good intro documentation from Globus Project on this.
  - http://gdp.globus.org/gt4-tutorial/multiplehtml/ch01s01.html
- Status of Globus 4, will it suppport WSRF and XIO. Will it happen in 2005?
  - Most of GT4 services are implemented on top of WSRF, while GT4 also includes some services that are not implemented on top of WSRF and arecalled the non-WS components. Its C parts is using Globus_XIO. The alpha version of GT4 first was released Aug. 2004. The final version of GT4 is expected to be released later of this month (Apr. 2005).
  - GT4 has been released with IPv6 enabled, including core, webcontainer, WS-GRAM, Globus_XIO and GridFTP. Online guideline: How-to IPv6 in GT4
  - (http://www.cs.ucl.ac.uk/staff/s.jiang/webpage/How-to-IPv6-in-GT4.htm)

Status & Way Forward

> What should be the way forward and steps to get GRID deploy IPv6?

- One of the important steps is collaborating with all Grid implementation groups (we should not limit ourselves with Globus only)