Living in an Imperfect World –
Disasters and Service Interruptions
Large and Small

Robert Gezelter Software Consultant
35 – 20 167th Street, Suite 215
Flushing, New York  11358 – 1731
United States of America

+1 718 463 1079
gezelter@rlgsc.com

Monday, November 8, 1999
1:30 pm – 2:50 pm
Room 10

Fall 1999 US DECUS Symposium
San Diego Convention Center
San Diego, California
"Sooner or later, it was bound to happen. On June 30, 1908, Moscow escaped destruction by 3 hours and 4,000 km – a margin invisibly small by the standards of the universe. On February 12, 1947, another Russian city had a still narrower escape, when the second great meteorite of the 20th century detonated less than 400 kilometers from Vladivostok, with an explosion rivaling that of the newly invented uranium bomb.

In those days, there was nothing that men could do to protect themselves against the last random shots in the cosmic bombardment that had once scarred the face of the Moon. The meteorites of 1908 and 1947 had struck uninhabited wilderness; but by the end of the twenty-first century, there was no region left on Earth that could be safely used for celestial target practice. The human race had spread from pole to pole. And so, inevitably ...

At 0946 GMT on the morning of September 11 in the exceptionally beautiful summer of the year 2077, most of the inhabitants of Europe saw a dazzling fireball appear in the eastern sky. Within seconds it was brighter than the Sun, and as it moved across the heavens - at first in utter silence - it left behind it a churning column of dust and smoke.

Somewhere above Austria, it began to disintegrate, producing a series of concussions so violent that more than a million people had their hearing permanently damaged. They were the lucky ones.
Moving at 50 kilometers a second, a thousand tons of rock and metal impacted on the plains of northern Italy, destroying in a few flaming moments the labor of centuries. The cities of Padua and Verona were wiped from the face of the Earth; and the last glories of Venice sank forever beneath the sea as the waters of the Adriatic came thundering landward after the hammer blow from space.”

— Rendezvous with Rama
Arthur Clarke
copyright 1973

Or, if you prefer the real world –
World Trade Center,
New York, New York
12:18 EST, 2/28/93
50 years ago:

Power – 1 week outage not unusual
Telephone – rarely present
Computers – non-existant
40 years ago:

*Power – 1 week outage not unusual
Telephone – 1 week outage not fatal
Computers – non-existant*

30 years ago:

*Power – 1 day outage unusual
Telephone – outage inconvenient
Computers – rare*
20 years ago:

*Power* – 1 day outage unusual
*Telephone* – important, outage impairs normal business
*Computers* – common, but not mission critical in most businesses

10 years ago:

*Power* – 1 hour outage unusual
*Telephone* – mission critical
*Computers* – any interruption impairs business;
Arrival of PC
Today

Power – "Normal" outage less than 5 minutes
Telephone – absolutely vital for most businesses
Computers – mission critical, any unavailability has severe impact
Networks – absolutely vital to all business operations

Today:

PCs/Workstations
Servers/Superminicomputers
PBX/Phones
LANs/WANs
Today:

- No phones
- No E-mail
- No Voicemail
- No Customer Information
- No Inventory
- No Charge Cards
- No Databases

Service interruptions, like Death & Taxes, are a Fact of Life
The Issue:

*Computers inspire visions of omnipotence. The reality is quite different.*

When designing any type of network your control over the network infrastructure is limited.
Common Hazards

Custodial personnel
Trades personnel
Common carriers

Acts of Clod

Common Hazards (Cont’d)

Weather
Earthquakes
Floods
Auto, Rail, Plane Incidents
Structural failure

Acts of God
Any hazard, in an instant, can turn your perfectly functioning high-speed network into a useless collection of inert copper wire and glass fiber.

Hardware and Human Factors:
Live Wire Cut – AT&T 1/4/91
Power outage at NYC Switching Center – AT&T 9/17/91
Hinsdale Fire – Illinois Bell 5/9/88
Second Avenue Fire – NY Bell, 2/27/75
Software Failure

Arpanet Naturally Occuring Virus
– 10/27/80
Switch Failures in three major cities
– DSC 6/91

Conclusion:

There are tigers in the woods!
The world is a nasty place, you can get hurt!
Amateurs study tactics, Professionals study logistics.

– Red Storm Rising
Tom Clancy
copyright 1986

Lesson from World History

Supply lines are your umbilical cord. England, Japan, Hawaii, North Africa. Long Supply lines are fatal
The longer your umbilical cord – the greater the danger

99% uptime = $n \times 0.01$ probability of failure
where there are $n$ links in the chain
Your PC is:

connected to the LAN
3 servers
bridged to 4 other offices
each server has its own connections

Very quickly, in realtime terms, your data becomes unreachable
Possible Solutions:

Backup Connectivity (partial)
Realtime independence

Backup Connectivity
"Last Mile" problem
The Data still exists, yet is unreachable.
Backup of Data on other systems
Avoids loss of data.
No answer to "Last Mile"

Last Mile Problem

Most connections generally go through a single routing for the last mile (or kilometer). A single accident has a high probability of disrupting all paths.
Solution to Last Mile Problem

Data required in realtime must be in the local facility, within the campus, building, floor, or workgroup.

Example Applications: Electronic Mail

OpenVMS Mail normally requires the local node and remote node online, and a connection path between them to send a message.
**Drawback**

*If any link in the chain is down, you cannot send Electronic mail. In a large network, some link or node is always out of service.*

**Alternate:**

*Store and Forward Systems e.g. Internet Mail*

*Mail program spools message into system spool directory (mailbags) for transmission (possible later) to next link in chain.*

*Mail Exchangers*

*Process continues until destination*
Conclusion:

Store and Forward permits even severe outages to disappear from outside view. Front office requirements for long distance online connections MUST be viewed in context.

Principles:

Constant Online Access
- Local Data
Occasional, non-realtime Access
- Remote via deferred Store and Forward facilities
Network component failures are inevitable. Planning must take these failures into account when configuring the network.

It is possible to provide extremely high levels of availability IF proper precautions are taken. However, 100%, 7 day a week, 24 hour a day availability for every network component is unrealistic and not cost effective.
Questions?

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