Data

=> Information

=> Wealth

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Senior Program Director,
Advanced Networking Infrastructure
Introduction

Think about how the advanced network infrastructure will function and what this means in terms of wealth for

- The globe
- The countries
- The enterprise
Premises

- The new “global information economy” is real (in spite of the dot-com issue)
- The ENTERPRISE is a management object focused on increasing wealth

And
- If you cannot measure it you cannot manage it

* SEE “The Lexus and the Olive Tree” – by T. L. Friedman
Measure it (IT?)

- Global size in meters
- Population size & distribution
- Components of global wealth
- Data organized is information
- Data sizes
- Network sizes (rates)
Look at Some Measurements of Space, People and Economies

- Measurements can prevent us from seeing the meaning behind the numbers
- Let us look at numbers and extract some meaning

Count in Powers of ten – $10^0, 10^1, 10^2...$
$10^8 = 100,000,000 \text{ m}$

$10^7 = 10,000 \text{ km}$
According to the International Programs Center, U.S. Bureau of the Census, the total population of the World, projected to 7/1/01 at 5:18:35 GMT (7/1/01 at 1:18:35 AM EDT) is

\[ 6,157,447,141 = 6.2 \times 10^9 \]

http://www.census.gov/cgi-bin/ipc/popclockw
Population Distribution

US & Canada = 310M (5%)
Europe = 729M (12%)
Asia = 3.68B (61%)
Latin America & Caribbean = 519M (9%)
Africa = 784M (13%)
Oceania = 30M (0.1%)

SOURCE = UN (Summer 2000) = http://www.un.org/Depts/unsd/
If the Global Population
Was a Village of 100 People

- 57 Asians, 21 Europeans, 14 western hemisphere, 8 Africans
- 52 female, 48 male
- 70 non-white, 30 white
- 70 non-Christian, 30 Christian
- 89 heterosexual, 11 homosexual
- 6 people would possess 59% of the entire world's wealth
- 80 live in substandard housing
- 70 would be unable to read
- 50 would suffer from malnutrition
- 1 near death; 1 near birth
- 1 college education
- 1 would own a computer

* P.M. Harter, MD, School of Medicine, Stanford U.
Wealth Of Nations Triangle Index

Updated semiannually since its introduction in March 1996, the world times wealth of nations triangle index is a 63-variable measure of the

- Economic factors
- Social factors
- Information-exchange factors

Environments of 40 emerging economies. (Weighted sums on a triangle.)

Http://www.worldpaper.com/WNIndex/indxintr.html
## ECONOMIC EVIRONMENT Variables

<table>
<thead>
<tr>
<th>NATIONAL ECONOMY</th>
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<tbody>
<tr>
<td>GDP growth rate</td>
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<td>Consumer price parity</td>
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<td>State owned enterprises (as % of GDP)</td>
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</tr>
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<td>(excl.gold)/imports</td>
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- Annual inflation rate
- Gross domestic savings rate
- Government deficit/surplus (% of GNP)
- Current account balance
- External debt/GDP
- Debt service/exports
- Foreign reserves
- (excl.gold)/imports
## SOCIAL ENVIRONMENT Variables

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# INFORMATION EXCHANGE Variables

<table>
<thead>
<tr>
<th>INFORMATION APTITUDE</th>
<th>INFORMATION INFRASTRUCTURE</th>
<th>INFORMATION DISTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspaper readership (per 1000 inhabitants)</td>
<td>PCs (residential) in use (per 1000 inhabitants)</td>
<td>Radio ownership (per 1000 inhabitants)</td>
</tr>
<tr>
<td>Literacy rate</td>
<td>Number of independent daily newspapers published</td>
<td>Television ownership (per 1000 inhabitants)</td>
</tr>
<tr>
<td>Students completing the tertiary level of education</td>
<td>Cable TV available?</td>
<td>Telephone mainlines (per 1000 inhabitants)</td>
</tr>
<tr>
<td>College students studying abroad (%)</td>
<td>Satellite television coverage?</td>
<td>Telephone ownership (per 1000 inhabitants)</td>
</tr>
<tr>
<td>English as primary language for business?</td>
<td>Telephone quality</td>
<td>Faxes in use (per 1000 inhabitants)</td>
</tr>
<tr>
<td></td>
<td>Average price of telephone call</td>
<td>Cellular telephones in use (per 1000 inhabitants)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Government IT expenditure (% of GDP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Press Freedom Index</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Books published annually (per 100,000 inhabitants)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of internet hosts</td>
</tr>
</tbody>
</table>
Top 10 Internet Penetrated Countries...

<table>
<thead>
<tr>
<th>Country</th>
<th># Hosts</th>
<th># Users (x 10³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>80569.0</td>
<td>181748.</td>
</tr>
<tr>
<td>Japan</td>
<td>6404.0</td>
<td>47541.4</td>
</tr>
<tr>
<td>Germany</td>
<td>4183.5</td>
<td>36256.1</td>
</tr>
<tr>
<td>UK</td>
<td>4298.8</td>
<td>48443.1</td>
</tr>
<tr>
<td>Canada</td>
<td>5874.90</td>
<td>26745.8</td>
</tr>
<tr>
<td>Australia</td>
<td>1880.39</td>
<td>11601.8</td>
</tr>
<tr>
<td>Finland</td>
<td>1016.5</td>
<td>3219.67</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1942.9</td>
<td>11676.9</td>
</tr>
<tr>
<td>Sweden</td>
<td>1607.39</td>
<td>6834.6</td>
</tr>
<tr>
<td>France</td>
<td>1633.9</td>
<td>11739.7</td>
</tr>
</tbody>
</table>
Measurement – caution!

- The globe and people are concrete objects so *meaning* is easier.

- Information and communication are less concrete--The numbers we use to describe them can have *less meaning*.
# Data Sizes

<table>
<thead>
<tr>
<th>Bytes (8 bits) = B</th>
<th>KB (1000 bytes)</th>
<th>MB (1 000 000 bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 bytes: A binary decision</td>
<td>1 Kilobyte: A very short story</td>
<td>1 Megabyte: A small novel OR A 3.5 inch floppy disk</td>
</tr>
<tr>
<td>1 byte: A single character</td>
<td>2 Kilobytes: A Typewritten page</td>
<td>2 Megabytes: A high resolution photograph</td>
</tr>
<tr>
<td>10 bytes: A single word</td>
<td>10 Kilobytes: An encyclopedic page</td>
<td>5 Megabytes: The complete works of Shakespeare OR 30 seconds of TV-quality video</td>
</tr>
<tr>
<td>100 bytes: one sentence</td>
<td>50 Kilobytes: A compressed document image page</td>
<td>10 Megabytes: A minute of high-fidelity sound OR A digital chest X-ray</td>
</tr>
<tr>
<td></td>
<td>100 Kilobytes: A low-resolution photograph</td>
<td>20 Megabytes: A box of floppy disks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 Megabytes: A digital mammogram</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 Megabytes: 1 meter of shelved books OR A two-volume encyclopedic book</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200 Megabytes: A reel of 9-track tape</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500 Megabytes: A CD-ROM OR an old hard disk of a PC</td>
</tr>
<tr>
<td>Data Size</td>
<td>Examples</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| **Gigabyte (1,000,000,000 bytes)** | - 1 Gigabyte: A pickup truck filled with paper OR A symphony in high-fidelity sound OR A movie at TV quality  
- 2 Gigabytes: 20 meters of shelved books OR A stack of 9-track tapes  
- 20 Gigabytes: A good collection of the works of Beethoven OR A VHS tape used for digital data  
- 50 Gigabytes: A floor of books OR Hundreds of 9-track tapes  
- 100 Gigabytes: A floor of academic journals OR A large ID-1 digital tape |
| **Terabyte (1,000,000,000,000 bytes)** | - 1 Terabyte: All the X-ray films in a large technological hospital OR 50,000 trees made into paper and printed OR Daily rate of EOS data (1998)  
- 2 Terabytes: An academic research library  
- 10 Terabytes: The printed collection of the US Library of Congress  
- 50 Terabytes: The contents of a large Mass Storage System |
| **Petabyte (1,000,000,000,000,000 bytes)** | - 1 Petabyte: 3 years of EOS data (2001)  
- 2 Petabytes: All US academic research libraries  
- 20 Petabytes: Production of hard-disk drives in 1995  
- 200 Petabytes: All printed material  

**Exabyte (1,000,000,000,000,000,000 bytes)** | - 5 Exabytes: All words ever spoken by human beings. |
Some Network Numbers

- Pots\(^*\) = 56kbs
- DS0 = 64kbs
- ISDN(L) = 128kbs
- T1(ds1) = 1.544mbps
- T3(ds3) = 45mbps
- Oc3 = 155mbps
- Oc12 = 622mbps
- Oc24 = 1,244mbps
- Oc48 = 2,488mbps
- Oc192 = 10,000mbps
  = 10gbps

\(^*\) Plain Old Telephone Service
The OLD Information Network and in Action
(Producing New Wealth With Client/server)

H. Miller inc, Zeeland MI, (founded 1923)

Old way
- Customer orders chair, file, desk
- Faxes sent to suppliers
- Built in 3 plants at 3 times
- Distribution center gathers 3 items
- Customer gets receives the order

New way
- Online order for 3 items
- Order transmitted to plants and supplies synchronized
- 3 items built in synch
- No storage of 3 items – one delivery
- Customer tracking available during entire process
NOW a New Network is Emerging

- NOT multiple connected computers

- Connected DEVICES delivering web services to each other

- Change rate? -30 years the internet, 5 years the WEB –

5 years for a NEW net? (DRIVING FUNCTION is market force of 6 billion customers for cell phones, movies, etc.)
New Net Technology

- Old technology = electronics
  10mbps
- New technology = photonics
  - Optical – 1gbps
  - Wireless

Also -- dramatic Protocol changes
Network Capacity increasing dramatically (32 lambdas/fiber, 100Ghz-10Ghz separation)

Theoretically, the capacity of glass fiber is almost limitless: since 32 wavelengths represent less than 1% of an optic fiber's capacity,

Global net is already optical, many metro areas are quickly becoming optical

Device (computer) level optical soon

SEE ---- “Next Generation Internet: Creating Advanced Networks and Services” --- by Joel Mambretti ; Andrew Schmidt
Enable communities ("virtual organizations") to share geographically distributed resources as they pursue common goals—in the absence of central control, omniscience, trust relationships—*Ian Foster*

SEE – *"The Grid: Blueprint for a New Computing Infrastructure"* by Foster & Kesselman

ALSO – Distributed Terabyte Program - NSF
CONTENT and MPLS

- GOOGLE now searches 1,346,966,000 web pages
- NAPSTER = ??
- VIDEO = ??

As MPLS replaces SONET) => Audio, video, text go to Streaming on protocol independent lambdas
(End to End circuit returns and maybe A “Lambda” to each person at Birth?)
WILL THE NETWORK BE THERE?

- SECURITY? REGULATIONS?
- PHYSICAL CONNECTIONS?
- PROTOCOL CHANGES?
- BANDWIDTH?
**Investment**
- Installed and announced systems
  - 1991: $4.2-billion
  - 1993: $8.5-billion
  - YE 2000: $41-billion
  - Thru 2003: >$65-billion
- Additional facilities: ~$7-billion

**Technology**
- **Current Systems:**
  - 4 to 8 fiber pairs per sheath
  - 2.5 to 10 Gbps per wavelength
  - 16 to 64 wavelengths per fiber pair
- **Soon to be deployed for commercial SFOCs:**
  - 40 Gbps per wavelength
  - 128 wavelengths per fiber pair

**Industry Status**
- Fast Growing (but slowing down):
  - Major expansion of Transatlantic cables occurred in 1998-99
  - Major expansion of Transpacific cables in 2001-03
  - Major Expansion around Africa in 2002-04
  - Middle East lags in capacity growth
- Private investment financing growth
- New systems are terabit, self-healing rings
- Potential for rapid expansion of commercial grid for Global Contingency operations
Global SFOC Systems Evaluated

- Global Crossing **HQ: NJ**
- FLAG Telecom **HQ: London**
- Tycom Global **HQ: NJ**
- 360Networks **HQ: Vancouver**
What This All Means

- The network is a wealth generator for enterprise systems
- Connectivity within your enterprise and to the globe will be a factor in determining enterprise wealth
- Think service connection between devices – *globally* - for your enterprise
- **Measure** the amount of information and device connectivity in your enterprise network as variables in the wealth of your enterprise
Conclusion

The network is undergoing rapid change –

- We need faster, broader thinking about the enterprise information systems

- NOT client/server, NOT computer/computer, BUT rather service/service

- Enterprise systems must be placed in a global s-s framework –
The INFORMATION REVOLUTION rate of change is at the speed of light (not the industrial revolution mechanical speed of sound)

\[ C = 299,792,458 \text{ m/s} \quad s = 331 \text{ m/s} \]

\[ \Rightarrow \quad 10^6 \]

P. S. Is this a real vision????
Or all nonsense & hype ????

see CISCO & MICROSOFT PLANS at

Thank You !
Other URLs of Interest

- **Physical sizes**

- **Data sizes**
  - Http://www.cacr.Caltech.edu/~roy/dataquan/

- **Global wealth**

- **Global population**

- **Global networks**

- **The Grid**
  - Http://www.gridforum.Org/

- **Optical technology**
  - Http://www.iec.Org/tutorials/opt_net/