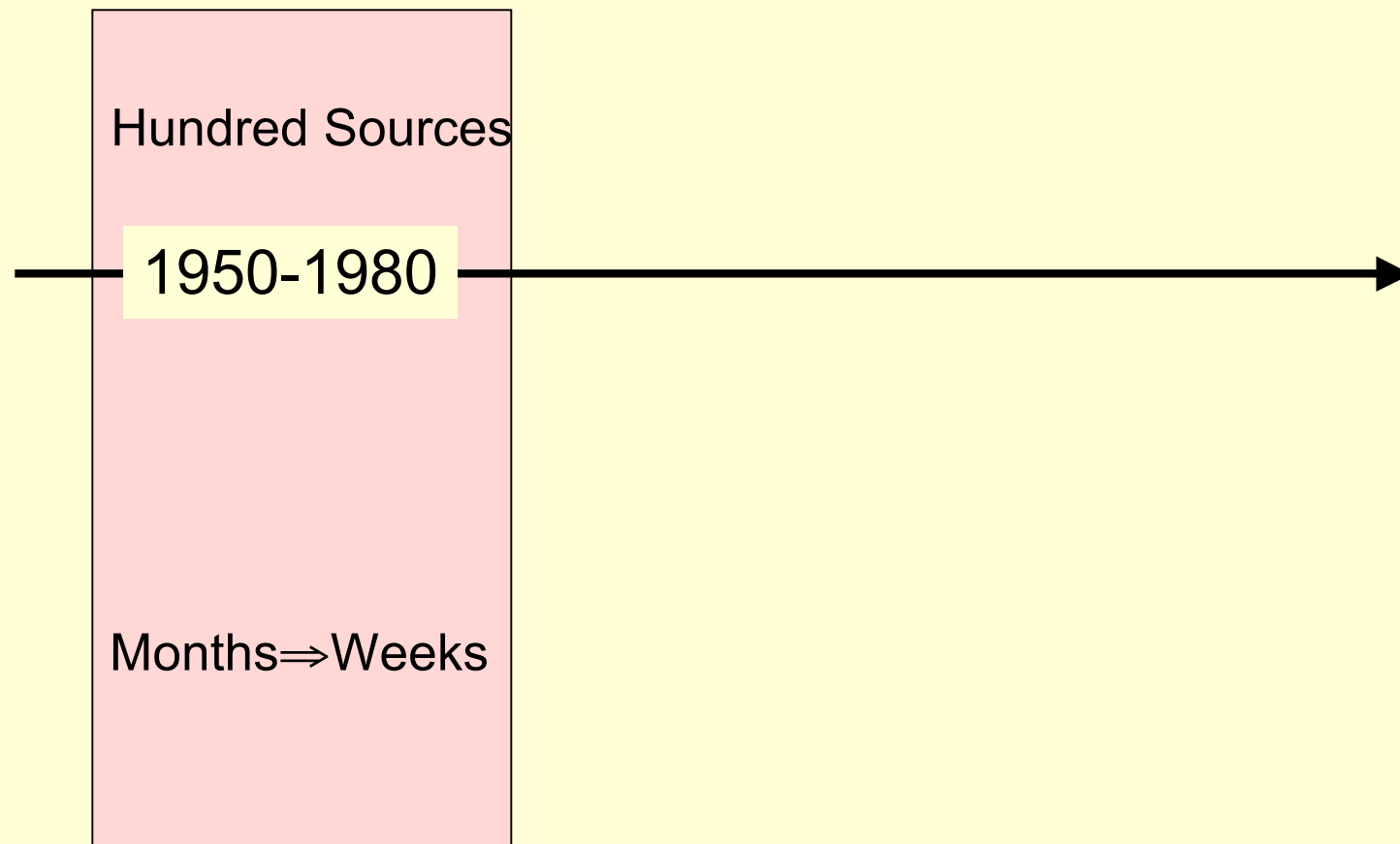




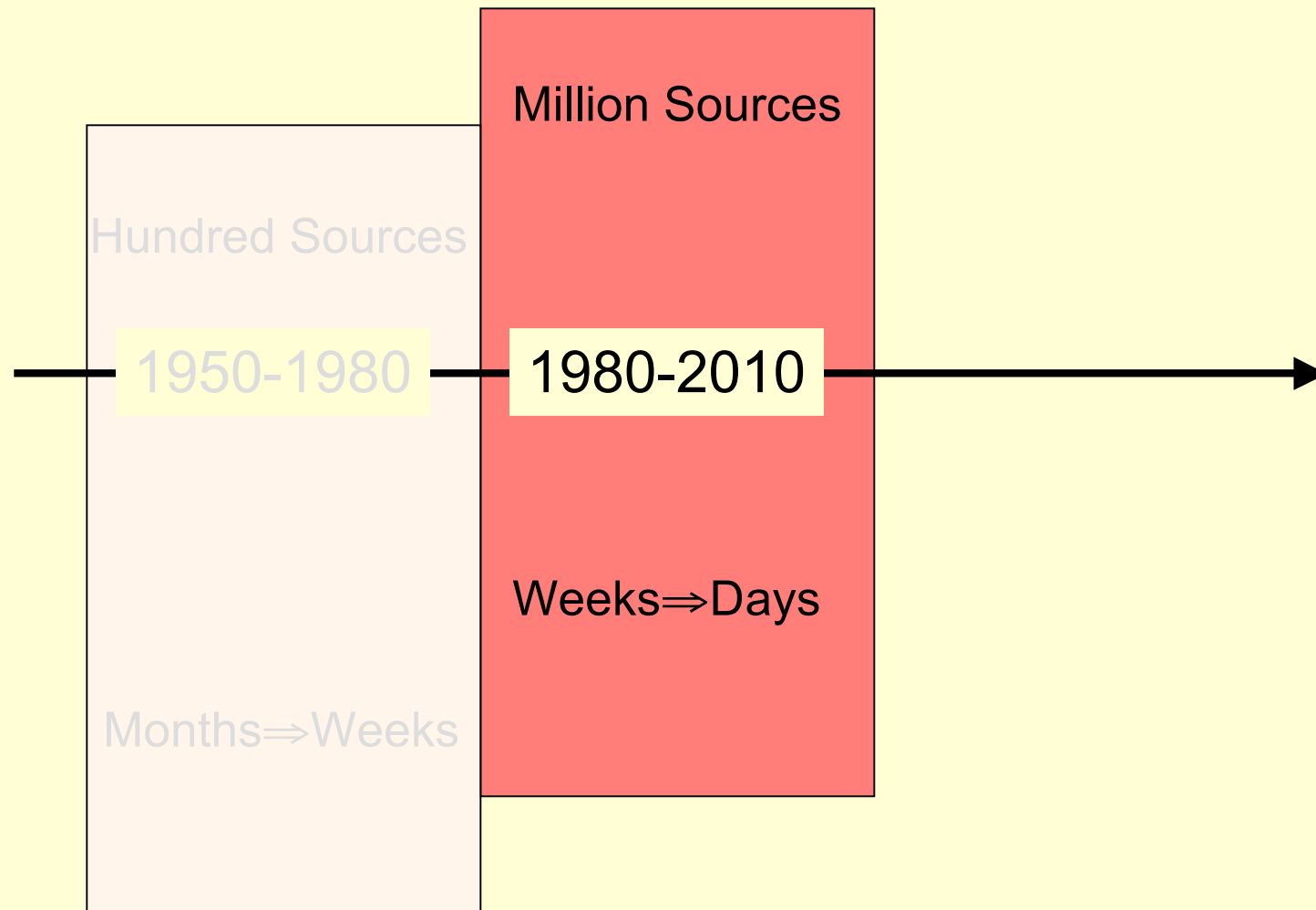
A Model for the Systems Architecture of the Future

***Prof. Paul A. Strassmann
George Mason University, December 5, 2005***

Data-Centric Era; IBM Dominates

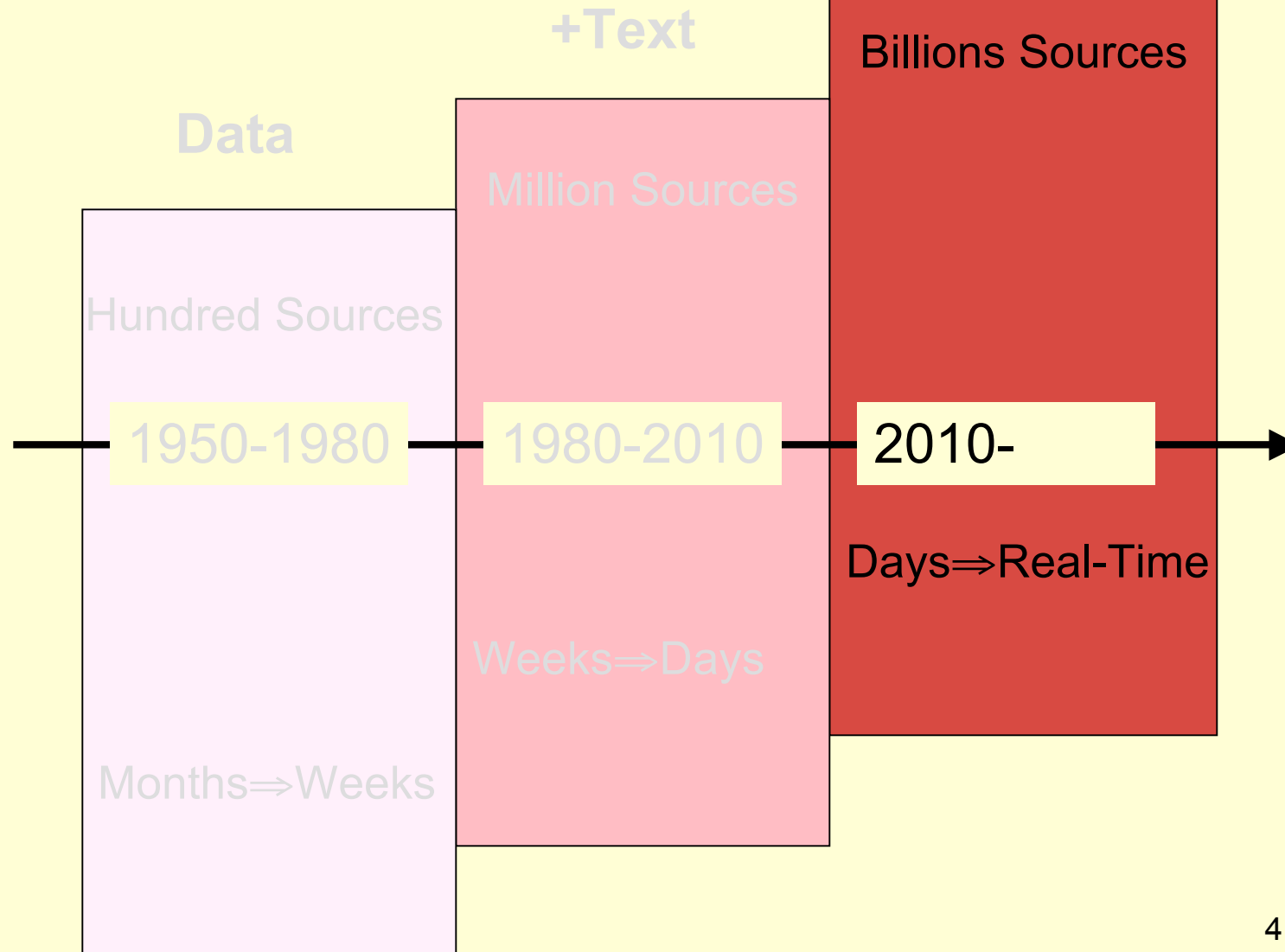


Workgroup-Centric Era; Microsoft, INTEL Dominate

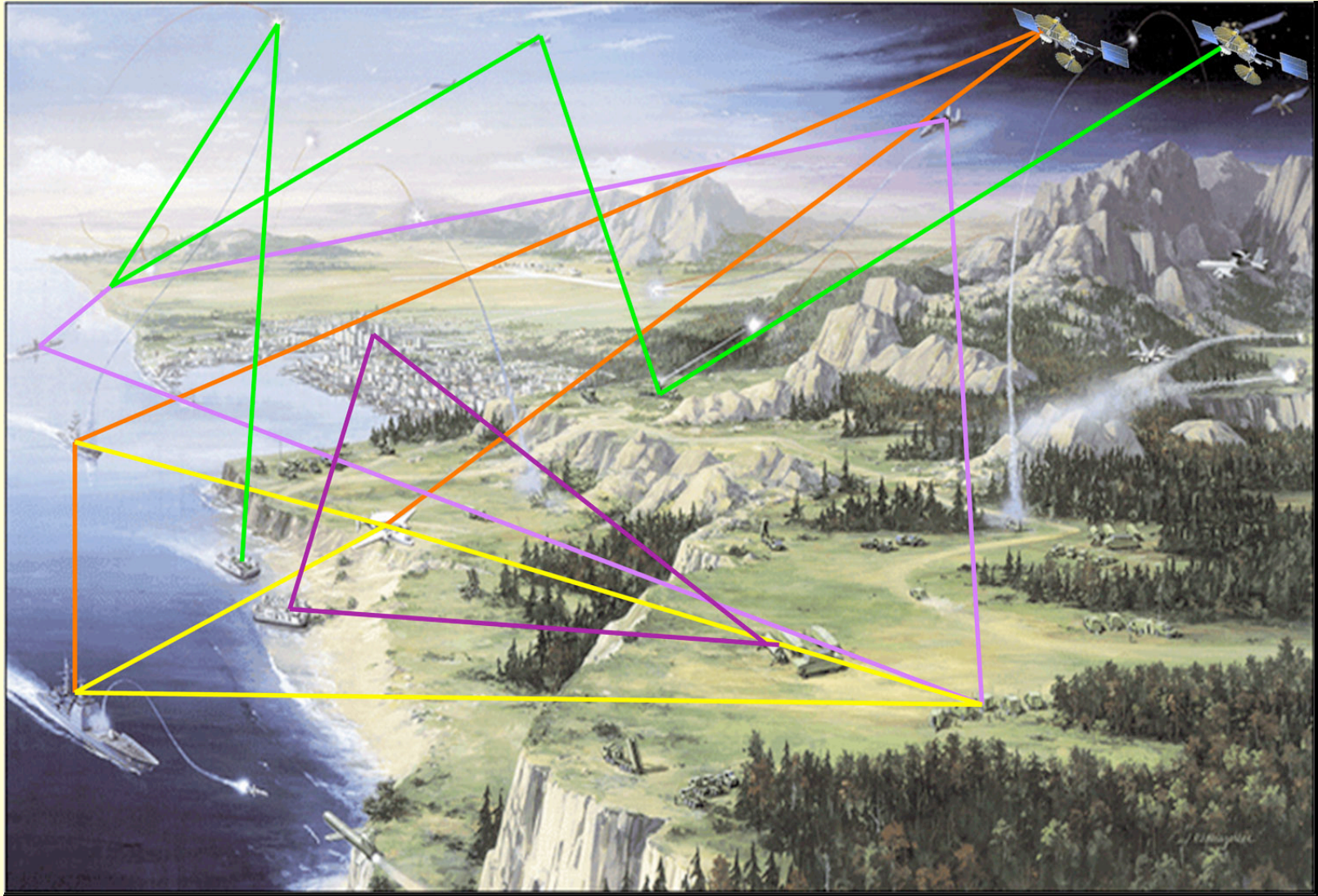


Network-Centric Era; Google and Cisco?

+Multi-Media



Example of a Network-Centric System



Network-Centric Requirements (2010)

- Downtime (< 5 min/yr);
- Display (200 Billion ops/sec);
- Connectivity (> 1 Gigabyte/sec);
- Access (< 0.25 sec);
- Innovation (< 1 day);
- Security (> 8 sigma).

Performance (2005)

- Infrastructure = > 50% of spending;
- Security = ?;
- Integration = > 50% of applications;
- Network downtime = > 1 hour/year;
- Innovation = > 1 year.

Conclusion

- Network-Centric systems cannot be built on Workgroup-Centric architecture.

Network-Centric Principles (Google)

1. Build & operate protected information network;
2. Offer universal connectivity for:
 - Collection, processing and storing of information;
 - Provide secured communications.
3. Maintain shared data models;
4. Require continued upgrading & innovation.

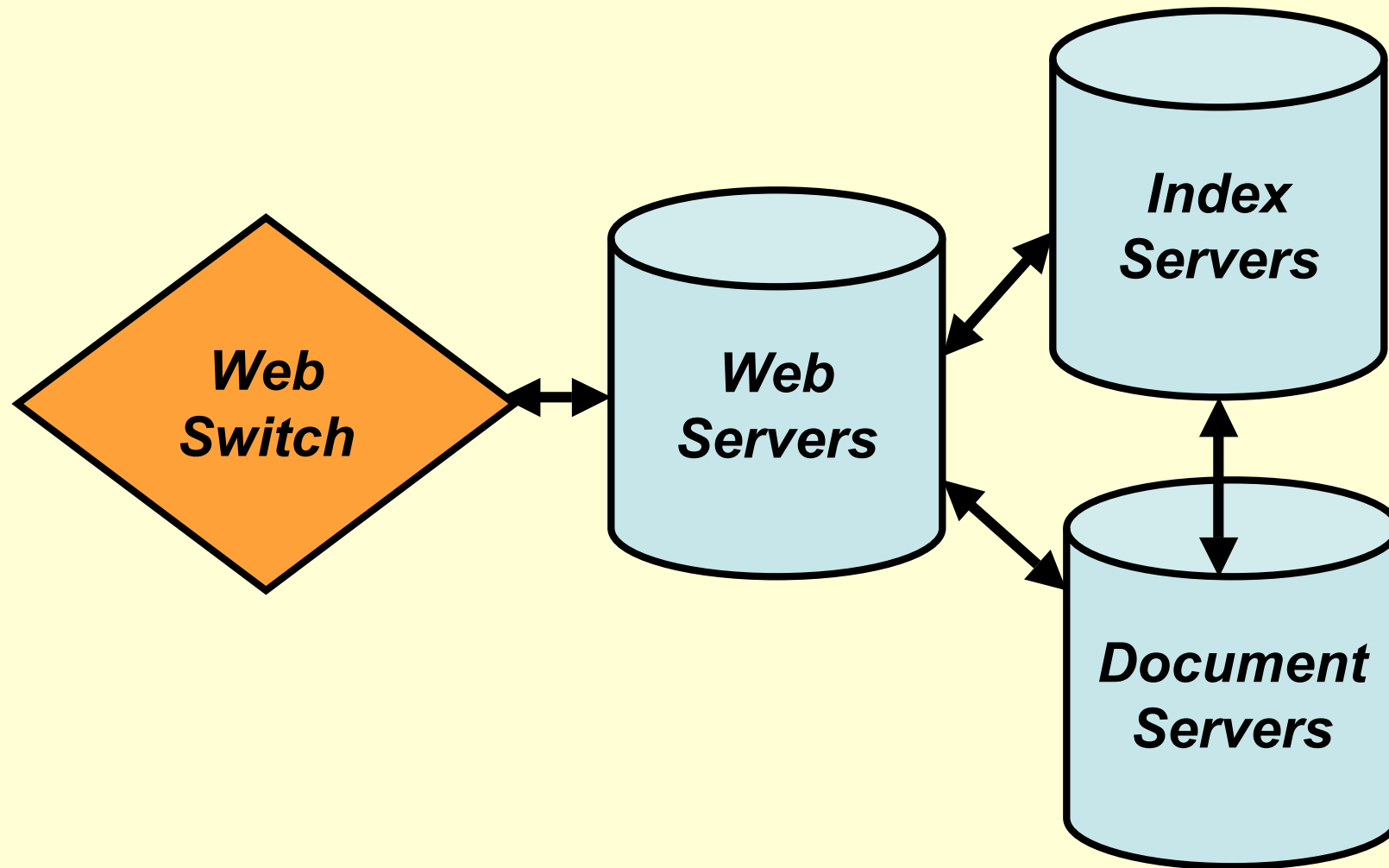
Google Principle #1

Build & operate protected information network

Standard Google Clusters Operate Net

- 359 racks
 - 31,654 machines
 - 63,184 CPUs
 - 126,368 Ghz of processing power
 - 63,184 Gb of RAM
 - 2,527 Tb of Hard Drive space
-
- Appx. 40 million searches/day

Clusters Have Identical Architecture



Google Cluster Set-Up = Three Days



Google Infrastructure: Key to Growth (1)

- **>200,000 custom-built commodity servers;**
- **Acting as one parallel supercomputer;**
- **Fault tolerant hardware.**
- Storage capacity >5 petabytes; low response latency (0.2 sec); >80GB per server, distributed;
- Indexed >8 billion web pages; Indexing is computationally complex (>500M * > 2B matrix)
- Capital and operating costs at fraction of large scale commercial servers; traffic growth 20-30%/month; data centers (>12); in US, Europe and Asia.

Google Infrastructure: Key to Growth (2)

- >200,000 commodity Linux servers built to custom specifications; distributed cluster architecture; acting as one parallel supercomputer; scaleable;
- >50,000 requests/sec; fault tolerant (no single point of failure); diverse hardware; stripped version of Red Hat;
- **Storage capacity >5 petabytes;**
- **>80GB per server;**
- **Indexed >8 billion web pages;**
- **Indexing is complex (500M x 2B matrix)**
- Capital and operating costs at fraction of large scale commercial servers; traffic growth 20-30%/month; data centers (>12); in US, Europe and Asia.

Google Infrastructure: Key to Growth (3)

- >200,000 commodity Linux servers built to custom specifications; distributed cluster architecture; acting as one parallel supercomputer; scaleable;
- >50,000 requests/sec; fault tolerant (no single point of failure); diverse hardware; stripped version of Red Hat;
- Storage capacity >5 petabytes; low response latency (0.2 sec); >80GB per server, distributed;
- Indexed >8 billion web pages; Indexing is computationally complex (>500M * > 2B matrix)
- **Capital and operating costs a fraction of commercial servers;**
- **Traffic growth 20-30%/month;**
- **Data centers (>20), in US, Europe and Asia.**

Architecture for Reliability

- Replication (3x+) for redundancy;
- Replication for proximity and response;
- Reliability with software and architecture, not with hardware.

Indexing for Response

- Dynamic indexing of 8B+ pages;
- Dynamic indexing of 1B+ images;
- Indexing of 1B+ messages;
- Index broken into “shards” and distributed across data centers.

Query Serving Infrastructure

- Processing a single query may involve 1000+ servers;
- Index Servers access Index Shards;
- Document Servers access Doc Shards;
- Response times monitored to assure <0.25 sec latency.

Google MapReduce System (1)

- **Coordinates servers in real-time;**
- **Automates distribution of workload;**
- Fault tolerance and service reconstitution;
- Systems-wide I/O cluster scheduling;
- Status and performance monitoring.

Google MapReduce System (2)

- Coordination of servers in real-time;
- Automates distribution of workload;
- **Fault tolerance & service reconstitution;**
- **Systems-wide cluster scheduling;**
- **Status and performance monitoring.**

Google Principle #2

Universal connectivity

Multi-Lingual Services


Use the Google Interface in Your Language

Set the Google homepage, messages, and buttons to display in your selected language via our [Preferences](#) page. Google currently offers the following interface languages:

- [Afrikaans](#)
- [Albanian](#)
- [Amharic](#)
- [Arabic](#)
- [Armenian](#)
- [Azerbaijani](#)
- [Basque](#)
- [Belarusian](#)
- [Bengali](#)
- [Bihari](#)
- [Bork, bork, bork!](#)
- [Bosnian](#)
- [Breton](#)
- [Bulgarian](#)
- [Cambodian](#)
- [Catalan](#)
- [Chinese \(Simplified\)](#)
- [Chinese \(Traditional\)](#)
- [Corsican](#)
- [Croatian](#)
- [Czech](#)
- [Danish](#)
- [Dutch](#)
- [Elmer Fudd](#)
- [English](#)
- [Esperanto](#)
- [Estonian](#)
- [Faroese](#)
- [Filipino](#)
- [Finnish](#)
- [French](#)
- [Frisian](#)
- [Galician](#)
- [Georgian](#)
- [German](#)
- [Greek](#)
- [Guarani](#)
- [Gujarati](#)
- [Hacker](#)
- [Hebrew](#)
- [Hindi](#)
- [Hungarian](#)
- [Icelandic](#)
- [Indonesian](#)
- [Interlingua](#)
- [Irish](#)
- [Italian](#)
- [Japanese](#)
- [Javanese](#)
- [Kannada](#)
- [Kazakh](#)
- [Klingon](#)
- [Korean](#)
- [Kurdish](#)
- [Kyrgyz](#)
- [Laothian](#)
- [Latin](#)
- [Latvian](#)
- [Lingala](#)
- [Lithuanian](#)
- [Macedonian](#)
- [Malay](#)
- [Malayalam](#)
- [Maltese](#)
- [Marathi](#)
- [Mongolian](#)
- [Nepali](#)
- [Norwegian](#)
- [Norwegian \(Nynorsk\)](#)
- [Occitan](#)
- [Oriya](#)
- [Pashto](#)
- [Persian](#)
- [Pig Latin](#)
- [Polish](#)
- [Portuguese \(Brazil\)](#)
- [Portuguese \(Portugal\)](#)
- [Punjabi](#)
- [Quechua](#)
- [Romanian](#)
- [Romansh](#)
- [Russian](#)
- [Scots Gaelic](#)
- [Serbian](#)
- [Serbo-Croatian](#)
- [Sesotho](#)
- [Shona](#)
- [Sindhi](#)
- [Sinhalese](#)
- [Slovak](#)
- [Slovenian](#)
- [Somali](#)
- [Spanish](#)
- [Sundanese](#)
- [Swahili](#)
- [Swedish](#)
- [Tajik](#)
- [Tamil](#)
- [Tatar](#)
- [Telugu](#)
- [Thai](#)
- [Tigrinya](#)
- [Tonga](#)
- [Turkish](#)
- [Turkmen](#)
- [Twi](#)
- [Uighur](#)
- [Ukrainian](#)
- [Urdu](#)
- [Uzbek](#)
- [Vietnamese](#)
- [Welsh](#)
- [Xhosa](#)
- [Yiddish](#)
- [Yoruba](#)
- [Zulu](#)

Search in Arabic Media

paul.strassmann@gmail.com | [Search History](#) | [My A](#)

 **Web** [Images](#) [Groups](#) [News](#) [Froogle](#) [LocalNew!](#) [more »](#)

☐ Search the Web ☒ Search Arabic pages

Web Results 1 - 6 of about 7 Arabic pages for **Paul Strassmann**.

[Iranian Information Center of Industries & Mines - \[](#)
3- **strassmann, paul a.** " information technology: benchmurking (management) "/total
quality management computerworld, jul 2002, vol. 36 issue 27, p35, 2bp ...
www.mim.gov.ir/Article/9-20-11.asp - 116k - [Cached](#) - [Similar pages](#) - [Remove result](#)

[\[PDF\] اسفندلایف تعماج](#)
File Format: PDF/Adobe Acrobat - [View as HTML](#)
Strassman, **Paul**. (1996). Interview, Knowledge Executive Report,. <http://www.Strassmann.Com/pub/Knowledge-Report.html>. 42.Sveiby, K. (1997). ...
www.philadelphia.edu.jo/arabic/adfin/research/46.pdf - [Supplemental Result](#) - [Similar pages](#) - [Remove result](#)

[MSA Intranet](#)
3- **Strassmann, Paul A.** " Information Technology: Benchmurking (Management) "/Total
Quality Management Computerworld, Jul 2002, Vol. 36 Issue 27, P35, 2BP ...
217.218.251.96/industry/it-sanat11.htm - 34k - [Supplemental Result](#) - [Cached](#) - [Similar pages](#) - [Remove result](#)


Video Searches

Google Video BETA


strassmann Search Video Preferences

Grid - [List](#) Results 1 - 2 of about 2 for strassmann (0.04 seconds)

[these videos back-to-back](#) ^{New!}



[Information Management and Organizational Entropy](#)
George Mason University
47 min 12 sec - Apr 23, 2005



[New Responsibilities of the Department of Defense CIO-Prototype for Other CIOs?](#)
George Mason University
45 min 20 sec - Oct 27, 2005

Google Base - Connecting Diverse Sources

paul.strassmann@gmail.com | [Search History](#) | [My Account](#) | [Sign out](#)

Google Base BETA

Search Base Search the Web Preferences

Search in events and activities, location, event date

Posted Items

events and activities [clear](#) location within 45 miles of new york and 11/30/2005 [clear](#)

Refine your search: [price \(7\)](#) [devon \(1\)](#) [dog \(1\)](#) [affiliate program \(1\)](#)


A [The Break Mission @ Tribeca Rock Club Tonight!](#) - Tribeca Rock Club

 event date range: nov 17, 2005 9:00pm location: 16 warren st., new york, ... [boston band](#) 0.1 mi
Nov 17 - [Report bad item](#)

B [Jazz Night @ New York Baha'i Center](#) - T Terrill

 event date range: nov 29, 2005 8:00pm location: 53 east 11th street, new ... [new york](#) [jazz](#) 1.5 mi
Nov 16 - [Report bad item](#)

C [NYC Turkey Ball 2005 Hosted by Devon Aoki at go-go](#) - JoonBug Ticket Sales

 event date range: nov 23, 2005 10:00pm location: 17 west 19th st new york... [nyc](#) [devon](#) 1.9 mi
Nov 17 - [Report bad item](#)

D [Saul Zanolari, Art](#) - SAUL ZANOLARI

event date range: nov 16, 2005 location: 531 west 25th street ne... [events and activities](#) 2.4 mi
Nov 16 - [Report bad item](#)

E [EARN EXTRA CASH \\$\\$\\$ HAVE FUN THIS HOLIDAY SEASON WITH TIMES SQUARE ...](#) - [Girls Night Out](#)

 event date range: nov 19, 2005 7:30pm - dec... location: 135 w.41st st new york, n... [job](#) 3.0 mi
Nov 21 - [Report bad item](#)

Locate events within 45 miles of New York in November, 2005

Map Satellite Hybrid

Imagery ©2005 State of New Jersey - Terms of Use

Semantic Parsing

- Tools parse millions of documents;
- Automated learning for related information.
 - Query: **“Bay Area Cooking Classes”**
 - Finds: ***“San Francisco College Classes”***;
“The Magic of Thai Cuisine”

Google Principle #3

Shared data models

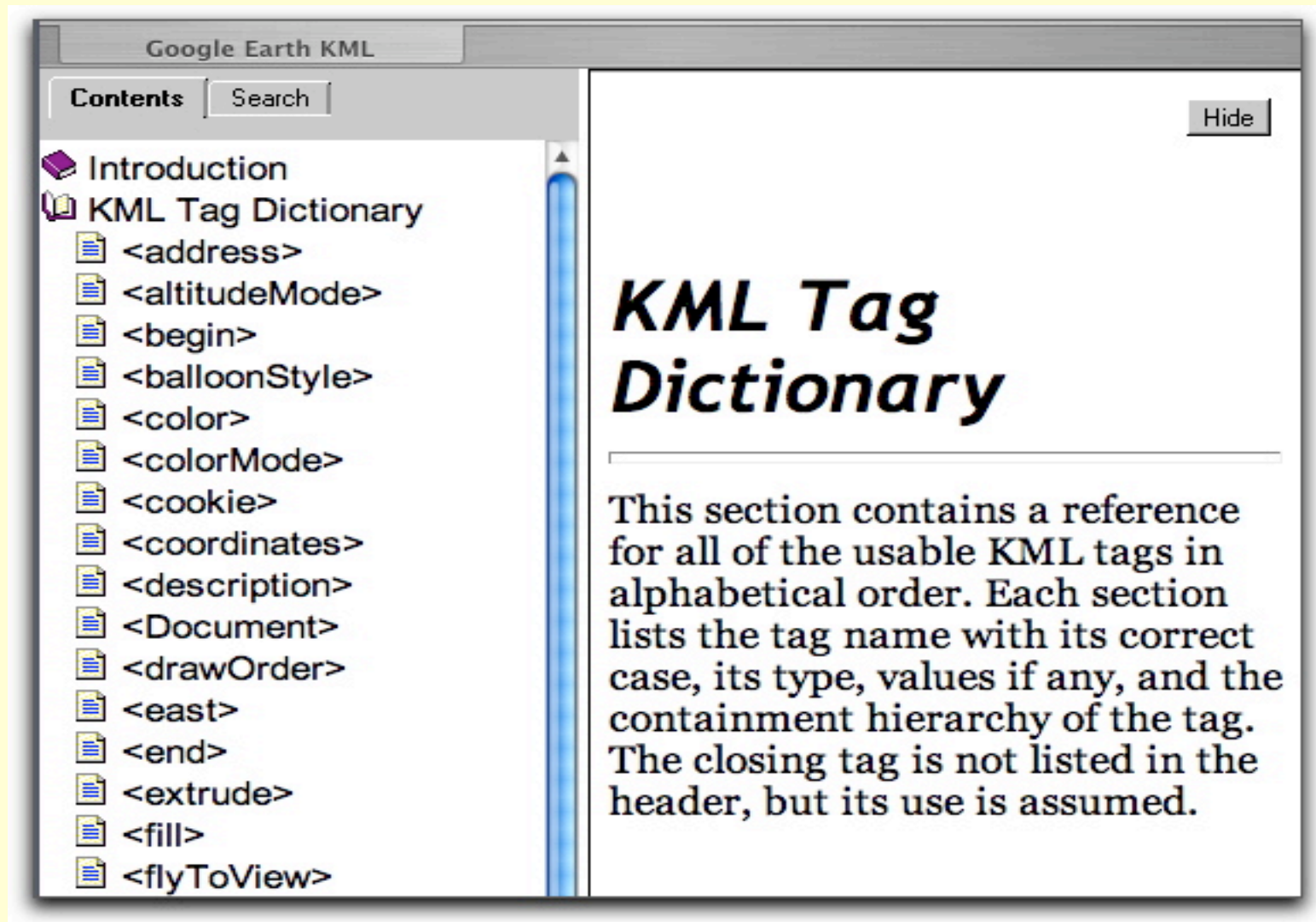
Data Engineering

- Standard file management: The Google File System (GFS);
- Standard job scheduling: The Global Work Queue (GWQ);
- Standard network management: The Google MapReduce system.

Google File System (GFS)

- Replicated Masters manage MetaData directories;
- Data transfers directly at the machine level within 2,000+ clusters;
- File broken into 64 MB chunks for 2000+ MB/second read/write load;
- All file chunks at least triplicate for safety.

Data Dictionary for Interoperability



Application Interfaces

A screenshot of the Google Web APIs (beta) page. The page has a yellow header bar with the Google logo on the left and the title "Google Web APIs (beta)" on the right. Below the header, there is a left sidebar with navigation links: "Home", "About Google", "Google Web APIs", "Overview" (highlighted in yellow), "Download", "Create Account", "Getting Help". The main content area on the right has the heading "Develop Your Own Applications Using Google" and a paragraph describing the service: "With the Google Web APIs service, software developers can query billions of web pages directly from their own computer programs. Google uses the SOAP and WSDL standards so a developer can program in his or her favorite environment - such as Java, Perl, or Visual Studio .NET."

Google™

Google Web APIs (beta)

[Home](#)

[About Google](#)

Google Web APIs

• **Overview**

[Download](#)

[Create Account](#)

[Getting Help](#)

Develop Your Own Applications Using Google

With the Google Web APIs service, software developers can query billions of web pages directly from their own computer programs. Google uses the SOAP and WSDL standards so a developer can program in his or her favorite environment - such as Java, Perl, or Visual Studio .NET.

Google Principle #4

Upgrading & Innovation

Deliver On-Line Services

Google Services



[Alerts](#)

Receive news and search results via email



[Answers](#)

Ask a question, set a price, get an answer



[Blog Search](#)

Find blogs on your favorite topics



[Book Search](#)

Search the full text of books



[Catalogs](#)

Search and browse mail-order catalogs



[Directory](#)

Browse the web by topic



[Froogle](#)

Shop smarter with Google



[Groups](#)

Create mailing lists and discussion groups



[Images](#)

Search for images on the web



[Labs](#)

Try out new Google products



[Local](#)

Find local businesses and services



[Maps](#)

View maps and get directions



[Mobile](#)

Use Google on your mobile phone



[News](#)

Search thousands of news stories



[Scholar](#)

Search scholarly papers



[SMS](#)

Use text messaging for quick info



[Special Searches](#)

Search within specific topics



[University Search](#)

Search a specific school's website



[Web Search](#)


Search over billions of web pages



[Web Search Features](#)

Do more with search

Shopping Services

[Web](#) [Images](#) [Groups](#) [News](#) **Froogle** [more »](#)

[Advanced Froogle Search](#)
[Preferences](#)

Froogle Results 1 - 10 of about 18 confirmed / 6,2

View

> **List view**
[Grid view](#)

Sort By

> **Best match**
[Price: low to high](#)
[Price: high to low](#)

Price Range


\$ to \$

Group By


> **Store**
[Show All Products](#)

Search within


> **All Categories**
[Electronics](#)
[Communications](#)
[Cell Phone Accessories](#)
[Accessories](#)
[Connectors & Cables](#)
[Computers](#)
[Components](#)




[Samsung SCH-A530 Serial/USB Cable Converter](#)
\$25.07
... port. This converter cable connects your serial cable to the serial end of the converter cable to allow you to plug into a **USB** port. ...
[[More from Your Wireless Source](#)]



[Samsung A530 Cellular Phone USB Data Cable](#)
\$24.99
High Speed **USB** data cable for your **Samsung A530** cellular phone. Our cellular phone Data Cable enables you to use your phone as a ...
[RpiWireless.com](#)



[Samsung SCH-A530 DataPilot Software and USB data cable](#)
\$55.00
... cell phone as a wireless modem with your **usb** data cable ... Features Include:PhoneBook Manager: Compatible with **Samsung A310**, **Samsung A530**, **Samsung A620**, **Samsung** ...
[[More from MyCellPhoneGear.com](#)]



[Verizon Mobile Office USB Data Cable Kit Samsung A530](#)
\$17.99
New Page 2 Your One Stop For Quality Service and Unbeatable Prices Original Verizon Mobile Office **USB** Data Cable Kit For **Samsung A530** Now Includes Phone Book ...
[Vendio](#)

Environment for Rapid Innovation



Labs.google.com, Google's technology playground.

Google labs showcases a few of our favorite ideas that aren't quite ready for prime time. Your feedback can help us improve them. Please play with these prototypes and send your comments directly to the Googlers who developed them.

New! [Google Reader](#)

Use Google's web-based feed reader to keep up with what's important to you

10/7/05 - [Give us feedback](#) - [Discuss with others](#)

New! [Google Video](#)

Search TV programs and videos

9/27/05 - [Give us feedback](#) - [Discuss with others](#)

● [Google Extensions for Firefox](#)

Add powerful new tools to your Mozilla Firefox browser

7/7/05 - [Give us feedback](#) - [Discuss with others](#)

● [Google Web Accelerator](#)

Save time online by loading web pages faster

5/4/05 - [Give us feedback](#) - [Discuss with others](#)

● [Google Ride Finder](#)

Find a taxi, limousine or shuttle using real time position of vehicles

3/30/05 - [Give us feedback](#) - [Discuss with others](#)

● [Googleサジェスト日本語版](#) (Google Suggest in Japanese)

検索窓に入力中に、検索用語の候補が表示され、矢印キーで選択することができます。

3/8/05 - [ご意見](#) - [ディスカッション](#)

● [Google Suggest](#)

As you type your search, Google offers keyword suggestions in real time

12/9/04 - [Give us feedback](#) - [Discuss with others](#)

● [Site-Flavored Google Search Box](#) Improved!

Get a search box that customizes results based on your website

6/17/04 - [Give us feedback](#) - [Discuss with others](#)

● [Froogle Mobile US](#) | [Froogle Mobile UK](#) Improved!

Search for products from your mobile phone using Froogle

2/24/04 - [Give us feedback](#) - [Discuss with others](#)

Graduates of Labs

● [Personalized Search](#)

Get the search results most relevant to you

● [Personalize Your Homepage](#)

See information you care about on your Google homepage

● [Google Maps](#)

View maps, get driving directions, and search for local businesses and services.

● [Google Scholar](#)

Search through journal articles, abstracts and other scholarly literature

● [Google SMS \(US\)](#) | [Google SMS \(UK\)](#)

Get precise answers to specialized queries from your mobile phone or device

● [Google Desktop 2](#)

Find all your information, whether it's on the web or stored on your computer, from one convenient location

● [Google Groups 2](#)

Create and join searchable discussion groups and mailing lists

● [Google Deskbar](#)

Search using Google without opening your browser

● [Web Alerts](#)

Find out about new web pages on a topic of interest

● [Search by Location](#)

Restrict your search to a particular geographic area

● [Google Glossary](#)

Find definitions for words, phrases and acronyms

● [Google News Alerts](#)

Specify a topic and receive email updates when news breaks

A New Application Launched in 15 Minutes

About Me



[View my profile](#)

[Visit my site](#)

archives

02/01/2005 - 02/28/2005

03/01/2005 - 03/31/2005

04/01/2005 - 04/30/2005

06/01/2005 - 06/30/2005

10/01/2005 - 10/31/2005

Commentaries

Comments and observations by Paul Strassmann

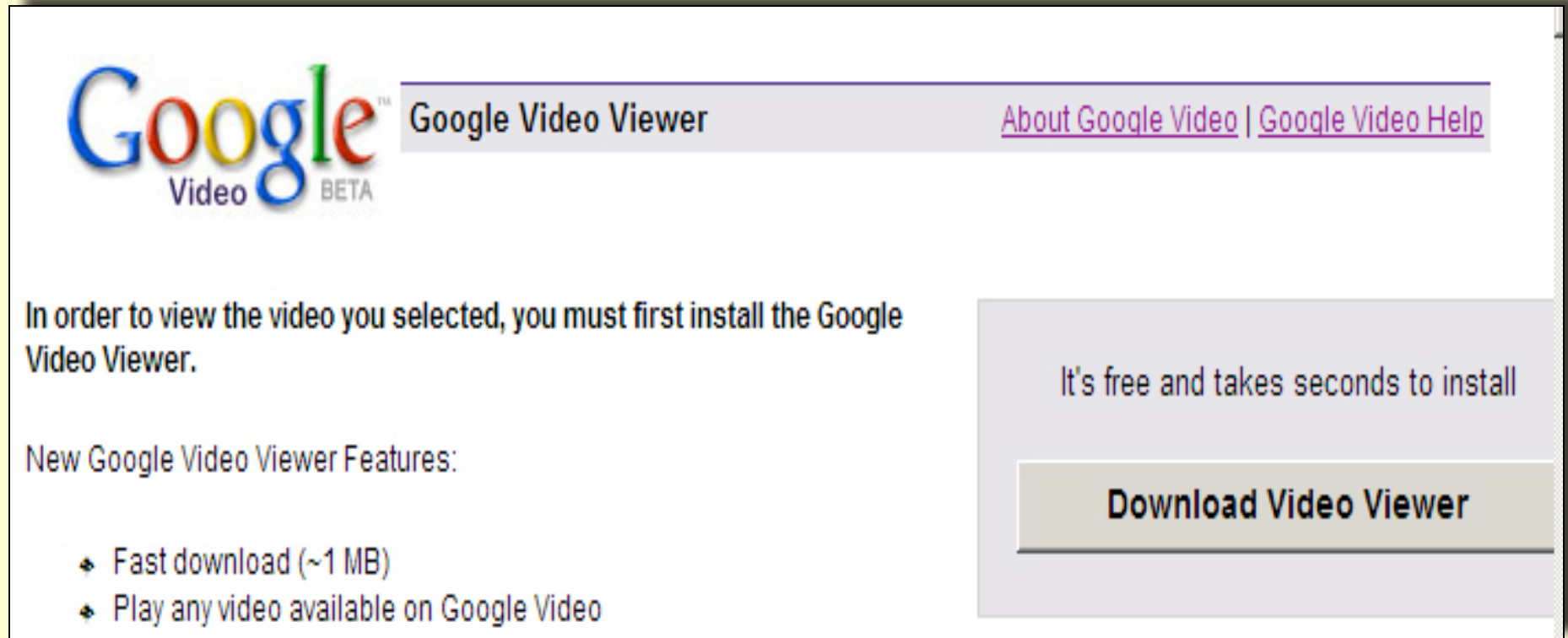
Friday, October 14, 2005

Are Federal and Corporate CIO Positions Comparable?

No, these positions are not comparable.

1. The Federal CIO position responsibilities are much more extensive than any corporate CIO roles I know of.
2. The oversight over the work of the Federal CIO is carried out by many more organizations than any corporate CIO is exposed to.
3. The sheer quantity of rules, regulations and laws guiding the conduct of the office of a Federal CIO cannot be even imagined by a corporate CIO.

Occupy the Desktop



The screenshot shows the Google Video Viewer BETA installation page. At the top left is the Google Video BETA logo. To its right is a header bar with 'Google Video Viewer' and links for 'About Google Video' and 'Google Video Help'. The main text states that the Google Video Viewer must be installed to view selected videos. Below this, it lists 'New Google Video Viewer Features:' followed by two bullet points: 'Fast download (~1 MB)' and 'Play any video available on Google Video'. On the right side, there is a grey box containing the text 'It's free and takes seconds to install' and a large 'Download Video Viewer' button.

Google Video BETA

Google Video Viewer

[About Google Video](#) | [Google Video Help](#)

In order to view the video you selected, you must first install the Google Video Viewer.


New Google Video Viewer Features:

- ❖ Fast download (~1 MB)
- ❖ Play any video available on Google Video

It's free and takes seconds to install

Download Video Viewer

Multimedia Services



Video Upload Program

[Help](#)

Your work deserves to be seen.

You've made a great video. Now who will watch it?

Whether you produce hundreds of titles a year or just a few, you can give your videos the recognition and visibility they deserve by promoting them on Google - for free. Signing up for the Google Video Upload Program will connect your work with users who are most likely to want to view them.

Sign in to Google Video Upload Program
with your

Google Account

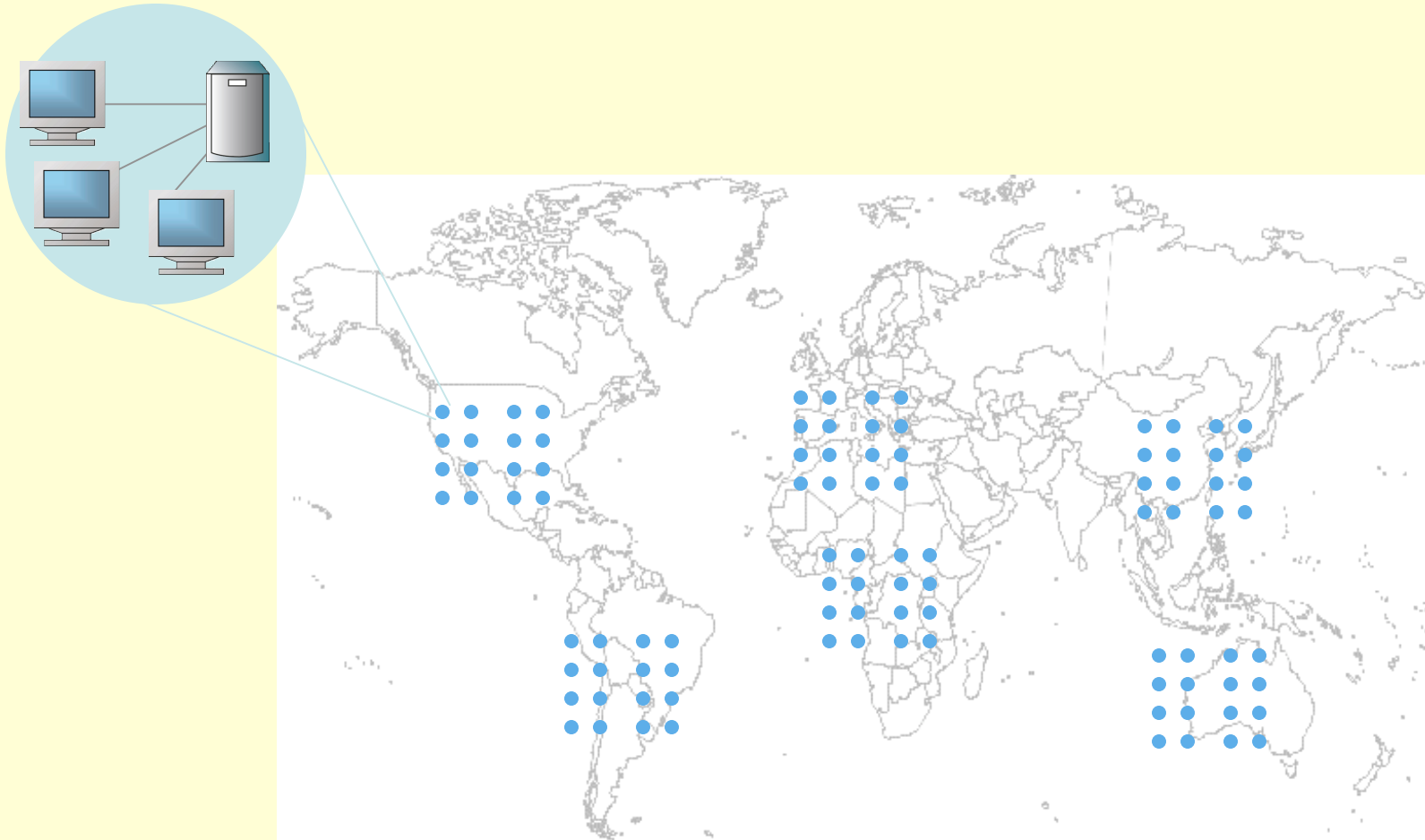
Email: **paul.strassmann@gmail.com**

Password:

Workgroup vs. Network Architectures

Comparison Summaries

Workgroup Computing Today: Millions of Local Applications+Local Data



Work-Groups Vulnerable Today

The 2005 SANS Top 20
The Most Critical Internet Security Vulnerabilities
See www.sans.org/top20/ for details

Top Vulnerabilities in Windows Systems

- W1. Windows Services
- W2. Internet Explorer
- W3. Windows Libraries
- W4. Windows Office and Outlook Express
- W5. File Sharing Applications
- W6. Windows Configuration Weaknesses

Top Vulnerabilities in Cross-Platform Applications

- C1. Backup Software
- C2. Anti-virus Software
- C3. PHP-based Applications
- C4. Database Software
- C5. DNS Software
- C6. Media Players
- C7. Instant Messaging Applications
- C8. Web Browsers
- C9. Other Cross-platform Applications

Top Vulnerabilities in UNIX Systems

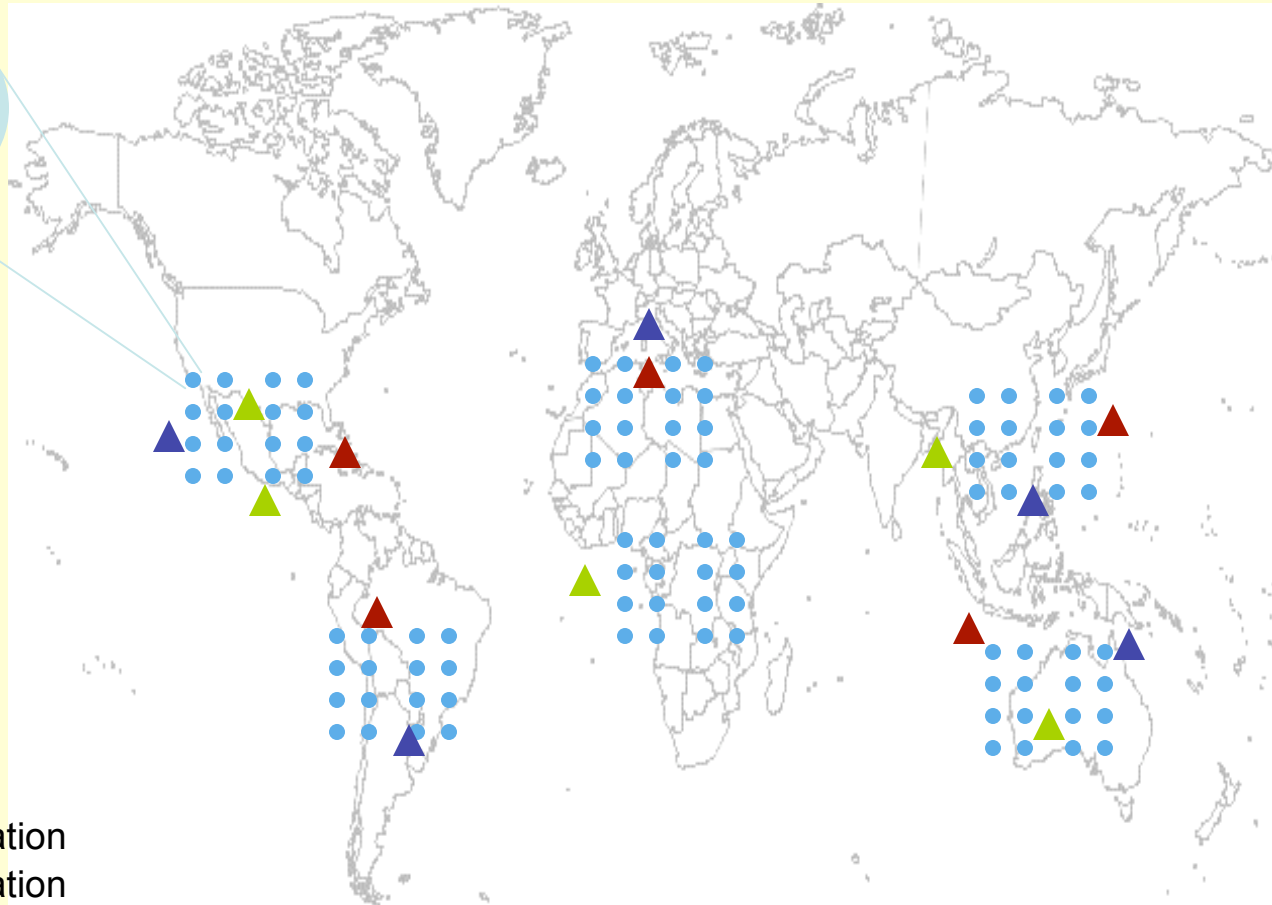
- U1. UNIX Configuration Weaknesses
- U2. Mac OS X

Top Vulnerabilities in Networking Products

- N1. Cisco IOS-based Products
- N2. Cisco non-IOS Products
- N3. Cisco Devices Configuration Weaknesses

New Internet: Billions of Browsers, Secure Shared Applications+Data

Browsers



▲ ▲ ▲ ▲ Application
▲ ▲ ▲ ▲ Application
▲ ▲ ▲ ▲ Application

Workgroup vs. Network Architectures (1)

Workgroup Centric

Strategy: Capture Desktop

Customer's labor and capital

User-specific infrastructures

Systems controls by user

Operating system dependency

License Software

Data read from files

Network Centric

Strategy: Occupy Internet

Labor and capital in network

Infrastructure is universal

Network controls in network

Open source browsers

Pay for Use

Data assembled in context

Workgroup vs. Network Architectures (2)

Workgroup Centric

Strategy: Capture Desktop

Customer's labor and capital

User-specific infrastructures

Systems controls by user

Operating system dependency

License Software

Data read from files

Network Centric

Strategy: Occupy Internet

Labor and capital in network

Infrastructure is universal

Network controls in network

Open source browsers

Pay for Use

Data assembled in context

Workgroup vs. Network Architectures (3)

Workgroup Centric

Strategy: Capture Desktop

Customer's labor and capital

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Operating system dependency

License Software

Data read from files

Network Centric

Strategy: Occupy Internet

Labor and capital in network

Infrastructure is universal

Network controls in network

Open source browsers

Pay for Use

Data assembled in context

Workgroup vs. Network Architectures (4)

Workgroup Centric

Strategy: Capture Desktop
Customer's labor and capital
User-specific infrastructures
Systems controls by user
Operating system dependency
License Software
Data read from files

Network Centric

Strategy: Occupy Internet
Labor and capital in network
Infrastructure is universal
Network controls in network
Open source browsers
Pay for Use
Data assembled in context

Workgroup vs. Network Architectures (5)

Workgroup Centric

Strategy: Capture Desktop
Customer's labor and capital
User-specific infrastructures
Systems controls by user
Operating system dependent
License Software
Data read from files

Network Centric

Strategy: Occupy Internet
Labor and capital in network
Infrastructure is universal
Network controls in network
Open source browsers
Pay for Use
Data assembled in context

Workgroup vs. Network Architectures (6)

Workgroup Centric

Strategy: Capture Desktop
Customer's labor and capital
User-specific infrastructures
Systems controls by user
Operating system dependent

License Software

Data read from files

Network Centric

Strategy: Occupy Internet
Labor and capital in network
Infrastructure is universal
Network controls in network
Open source browsers

Pay for Use

Data assembled in context

Workgroup vs. Network Architectures (7)

Workgroup Centric

Strategy: Capture Desktop
Customer's labor and capital
User-specific infrastructures
Systems controls by user
Operating system dependent
License Software

Data read from files

Network Centric

Strategy: Occupy Internet
Labor and capital in network
Infrastructure is universal
Network controls in network
Open source browsers
Pay for Use

Data assembled in context

The Future

Technology

- All electronic devices on Internet.
- Data, voice, video, sensor inputs accessible.
- Phone, TV and print media displaced.

Services

- Systems respond to questions.
- Information is displayed in context.
- Applications for decision-making.

Relevance for National Security Systems

- Workgroups to Network-Centric services.
- Migrate through displacement.
- Invest savings in innovation.