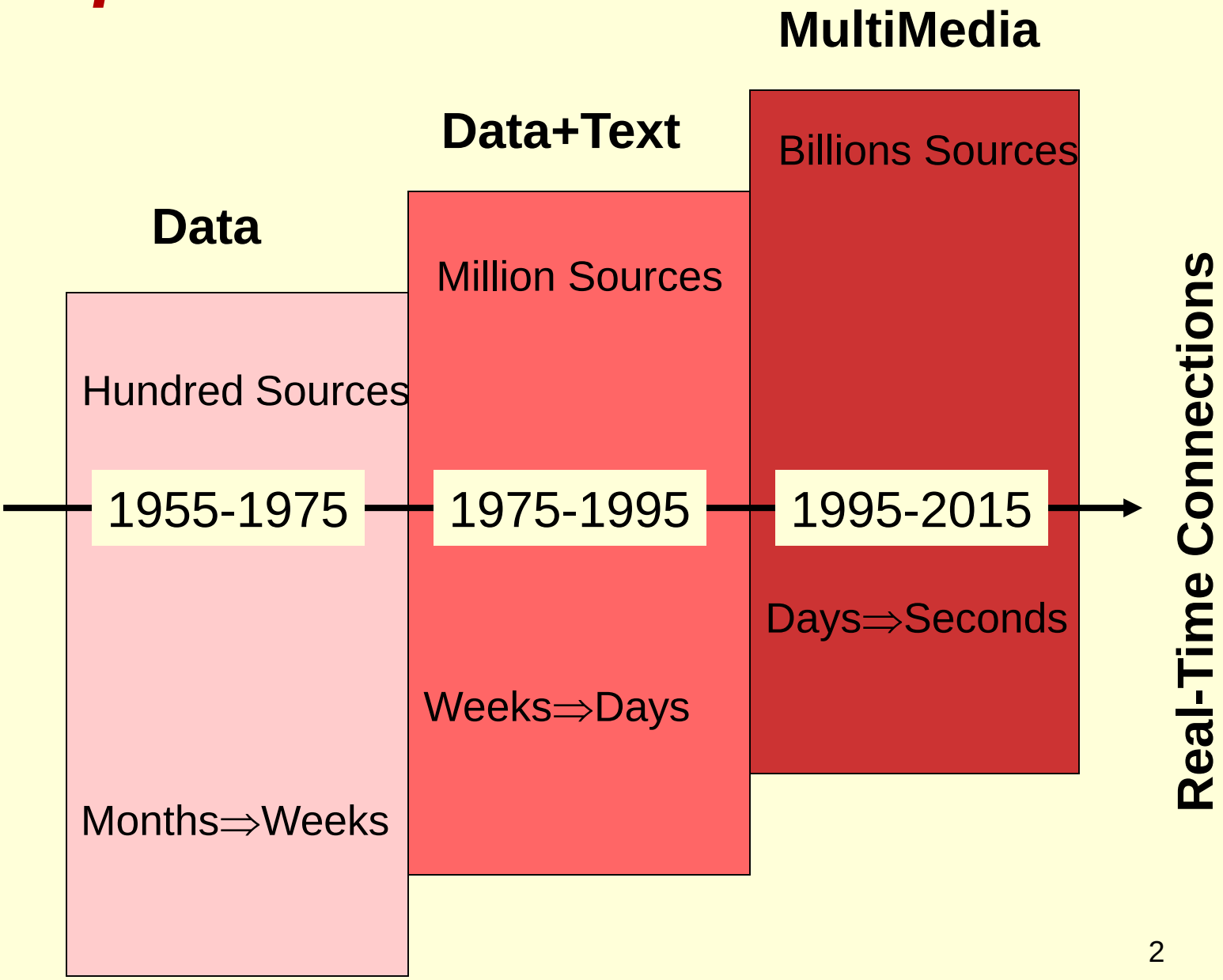
The Next I.T. Tsunami

Paul A. Strassmann

Perspective



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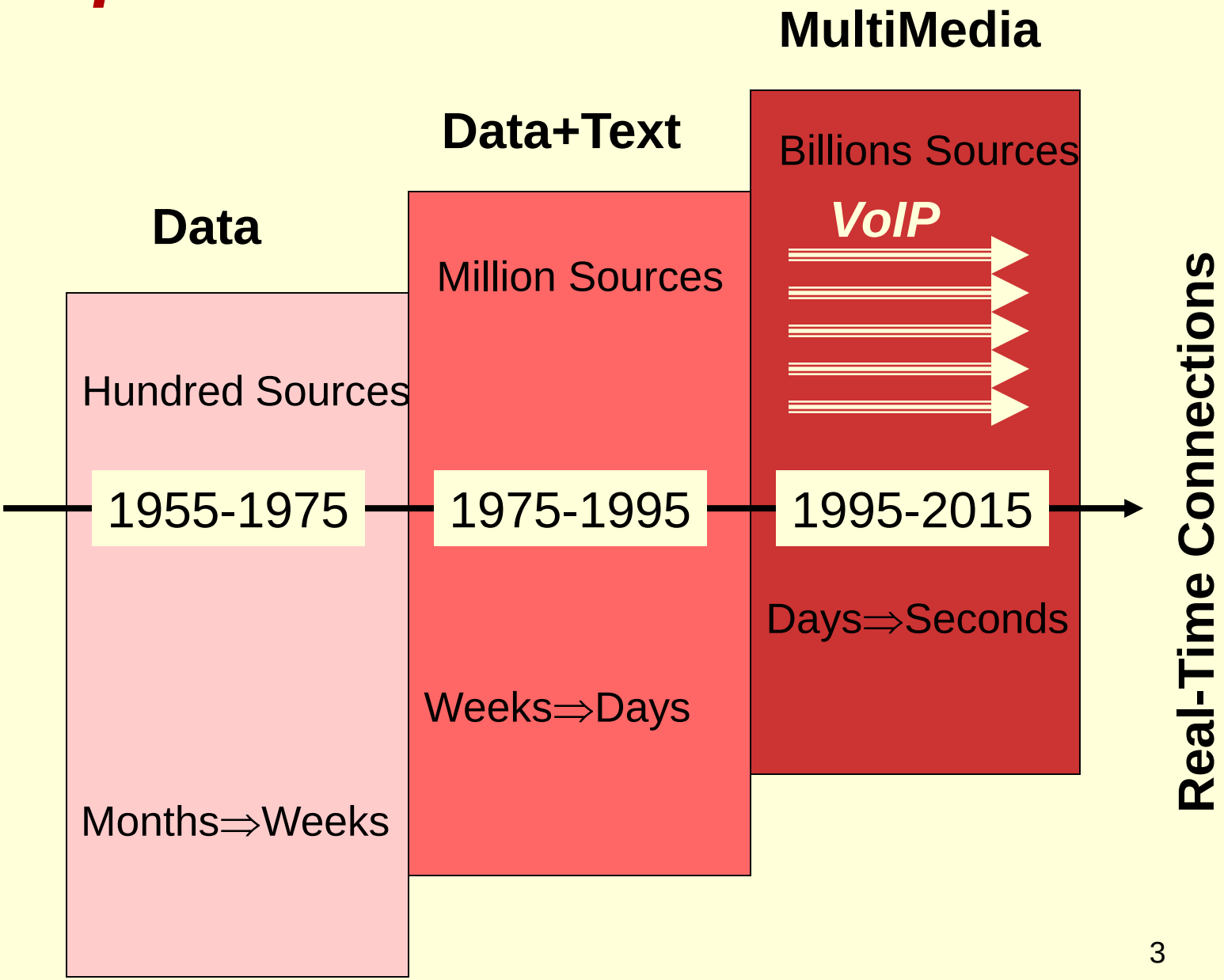
Perspective



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Today's Presentation

- Organization of multi-media communication.
- Internet services.

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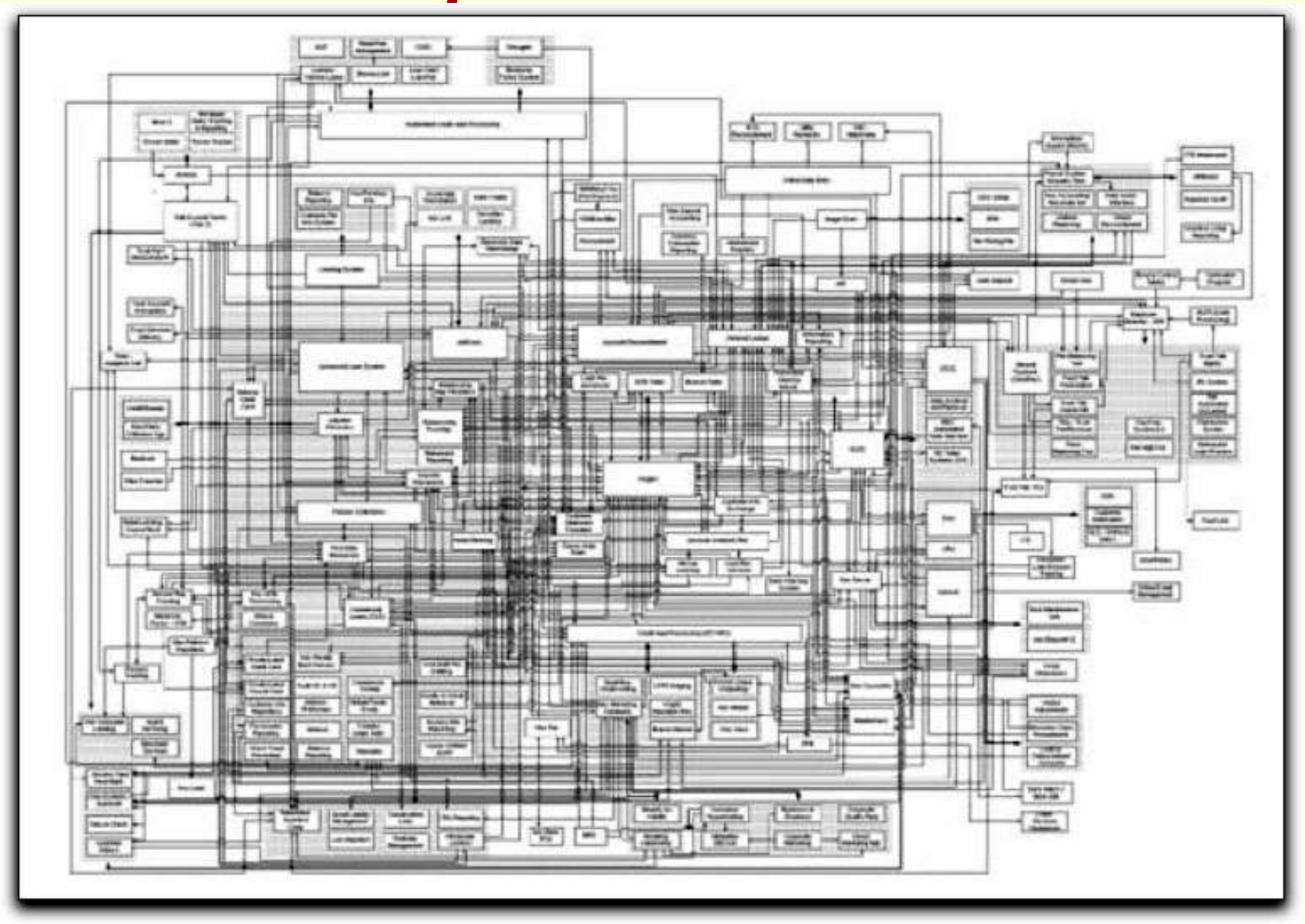
A View of Corporate Networks



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The Challenge

- Infrastructure costs = >50% of total spending;
- Networks insecure;
- Integration costs = >50% of application costs;
- Network downtime = >20 hrs/year;
- Desktop costs = Excessive;
- Time to innovation = Excessive.

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Metrics for the Future

- **Integrated data, voice and video services:**

- Six Sigma+ Reliability (<5 min downtime/yr);
- Workstation Speed (200 Billion ops/sec);
- Workstation Connectivity (>1 Gigabyte/sec);
- Systems Reconfiguration (<1 min delay);
- Access to petabytes of data (<0.25 sec);
- Customizing an Application (<1 hr implementation);
- Strong authentication for access.

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Example of Next Generation Design

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The Google Infrastructure

- >200,000 commodity Linux servers;
- Storage capacity >5 petabytes;
- Indexed >8 billion web pages;
- Capital and operating costs at fraction of large scale commercial servers;
- Traffic growth 20-30%/month.

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Dimensions of a Google Cluster

- 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

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Architecture for Reliability

- Replication (3x +) for redundancy;
- Replication for proximity and response;
- Fault tolerant software for cheap hardware.
- Policy: Reliability through software architecture, not hardware.

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Query Serving Infrastructure

- Processing a query may engage 1000+ servers;
- Index Servers manage distributed files;
- Document Servers access distributed data;
- Response time = <0.25 seconds anywhere.

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Systems Engineering Principles

- Overwhelm problems with computational power;
- Impose standard file management;
- Manage through standard job scheduling;
- Apply simplified data processing discipline.

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Google: The Network is the System

- Coordinates servers in real-time;
- Automates distribution of workload;
- Assures fault tolerance;
- Performs systems-wide cluster scheduling;
- Delivers status and performance monitoring.

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Intelligence Built into Services

- Tools examine millions of documents in real time;
- Automated learning for logical processing
  - Query: “Bay Area Cooking Classes”
  - Matches: “San Francisco College Classes”; “The Magic of Thai Cuisine”

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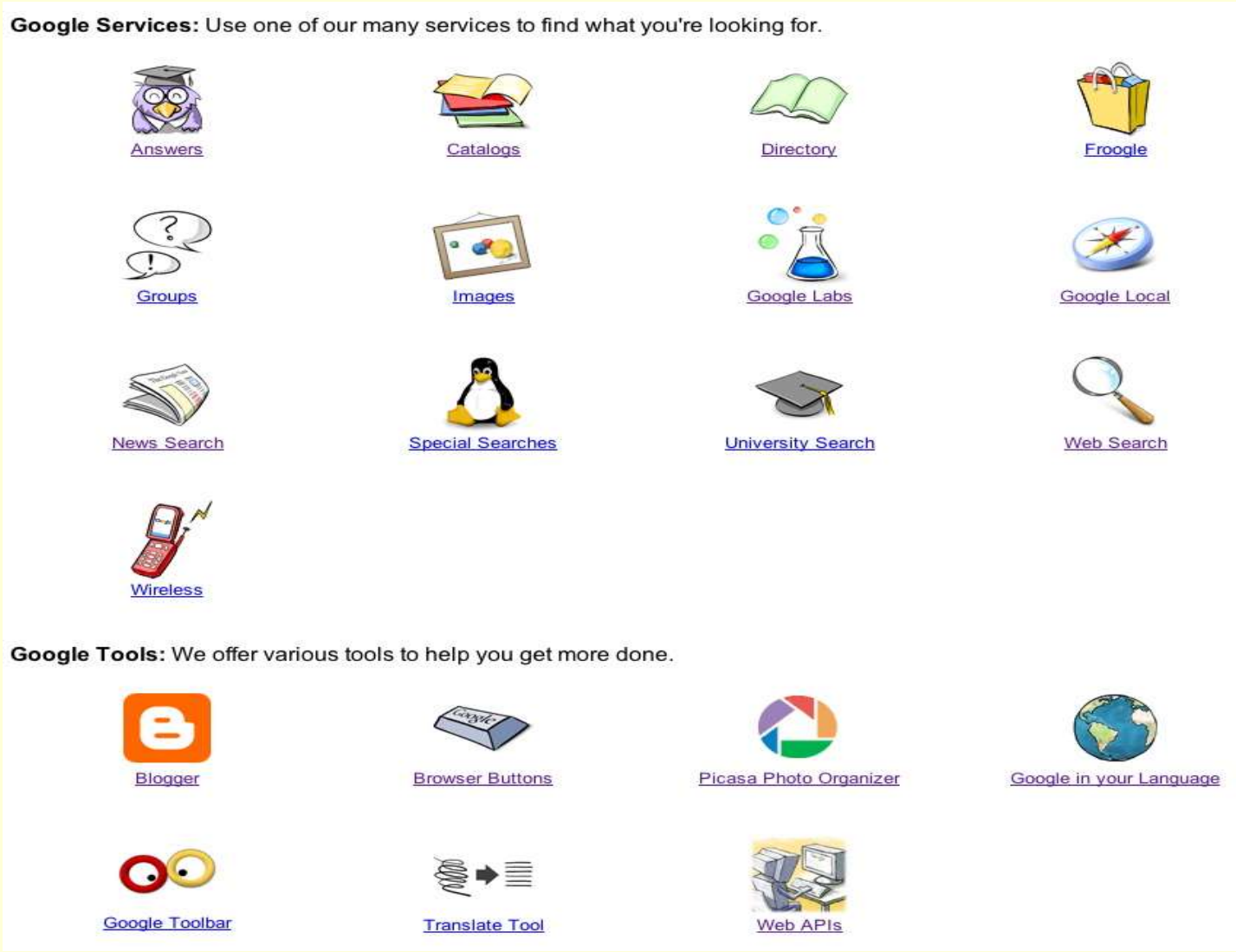
Rapid Additions to Robust Infrastructure



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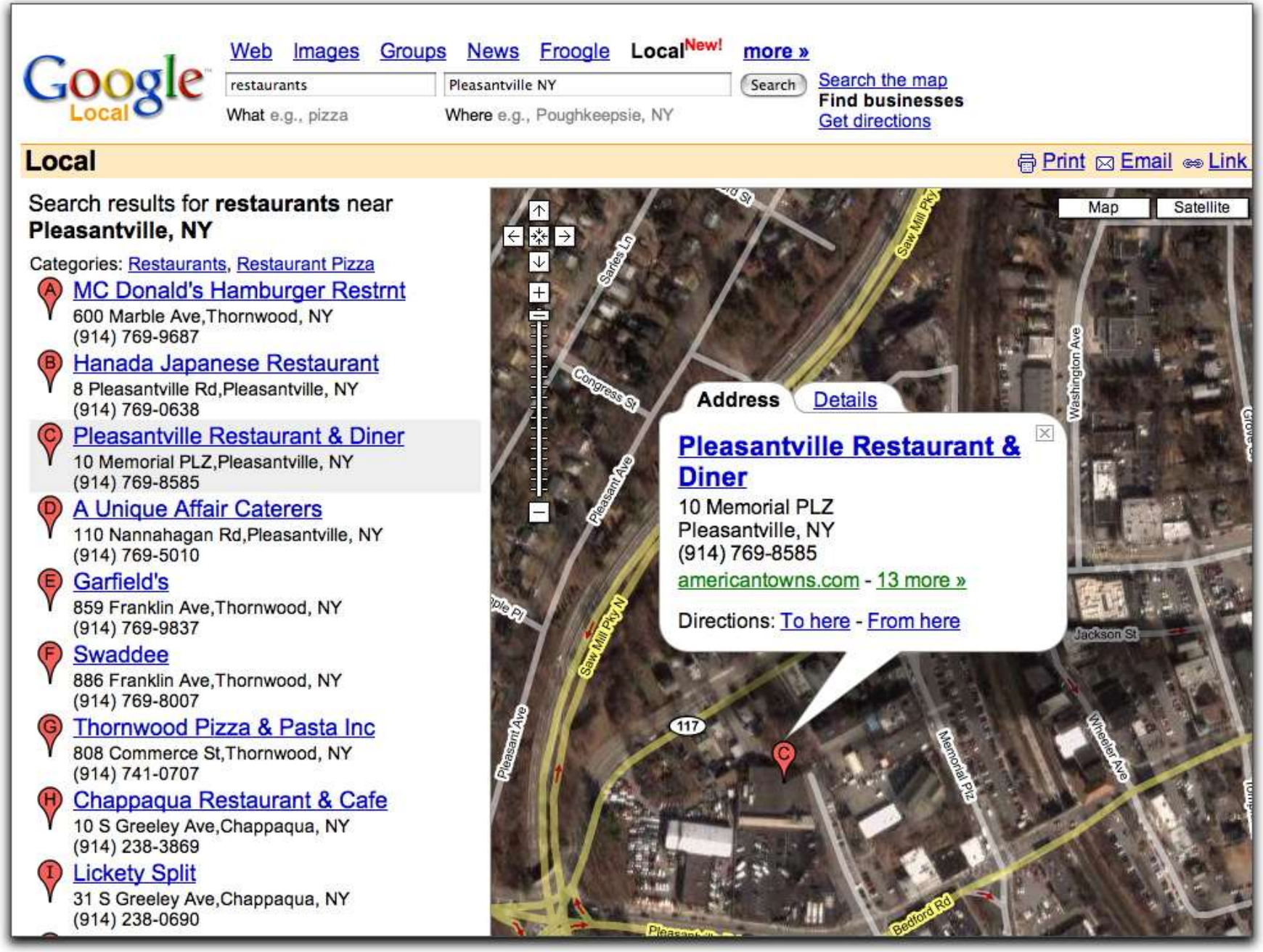

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Future: Rich Internet Applications

- “Thin-clients” deliver Internet services.
- Browsers display graphic interfaces.
- Standard browsers, not plug-ins.
- Packaged applications available on Internet.
- Delivery of data, voice and video.
- Replaces phones, TV and print media.

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Summary

- Computer-centric solutions will be replaced by network-centric services.
- A Google-like architectures open a way for significant reductions in the costs of Internet services.
- We know what will happen, just do not know how to get there.

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