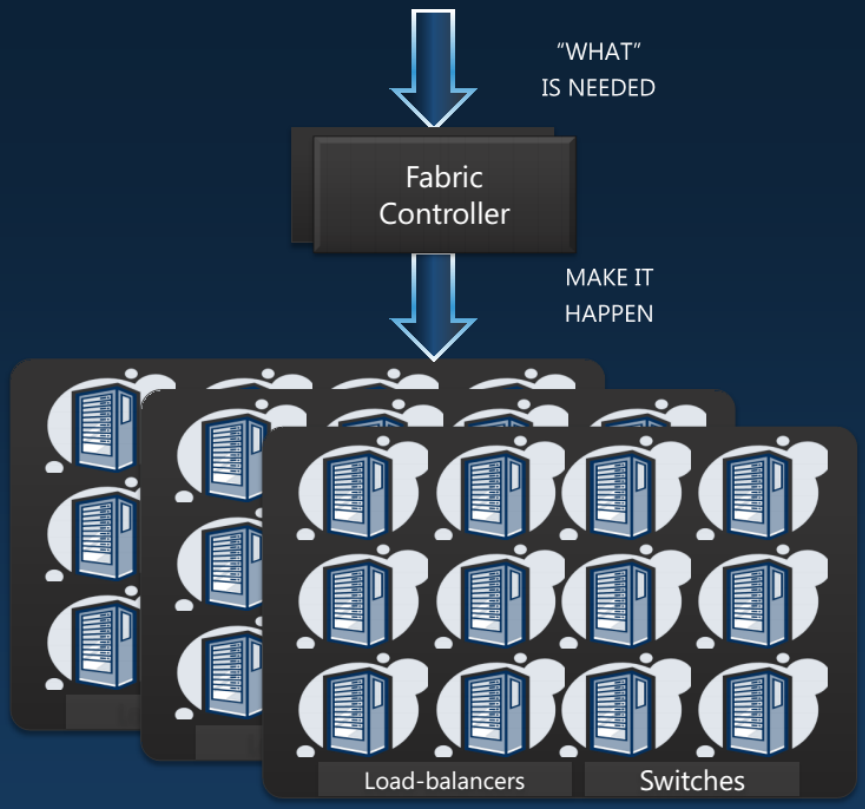
Computing At Scale: Windows Azure

- Redundancy at multiple levels
- Virtualized compute and network

- Model-driven automation
  - Logical application graphs mapped over physical topology

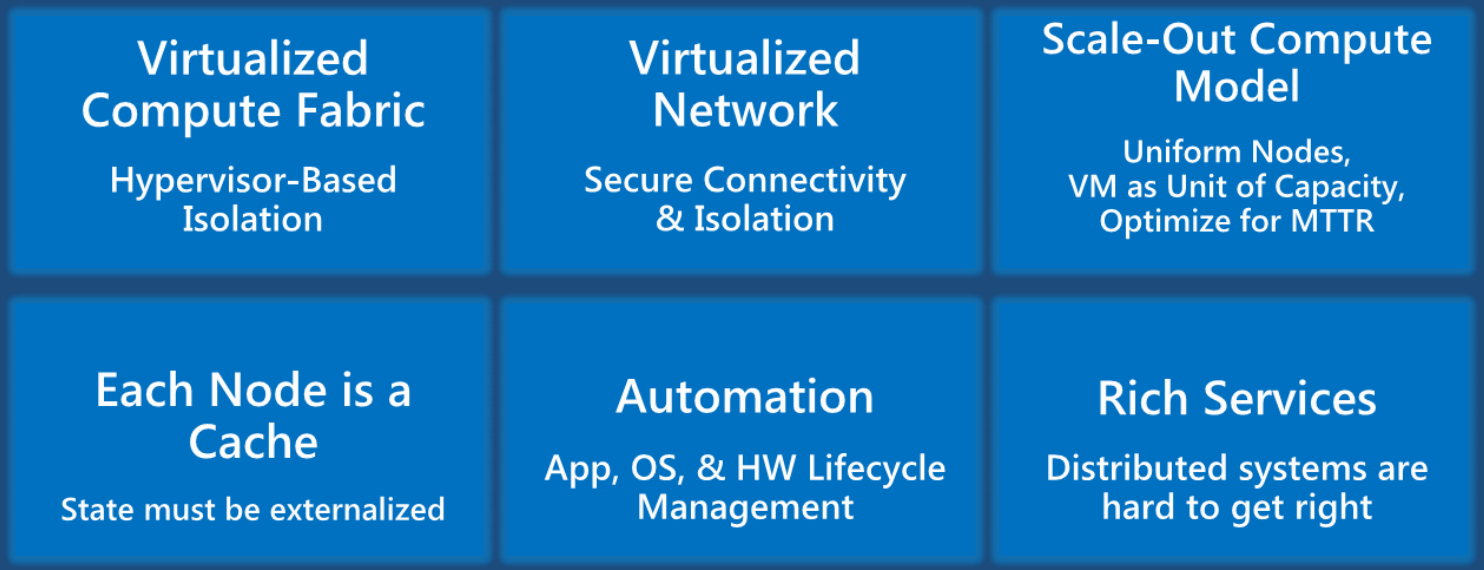
- Development and Management tools
  - REST APIs, multiple language and tool support
  - Web and enterprise management tools

- Rich services - built as Azure apps
  - Storage, SQL Azure, etc.
  - Secure cloud federation services



http://research.microsoft.com/en-us/um/redmond/events/cloudfutures2012/tuesday/Keynote_OpportunitiesAndChallenges_Yousef_Khalidi.pdf

Architectural Principles



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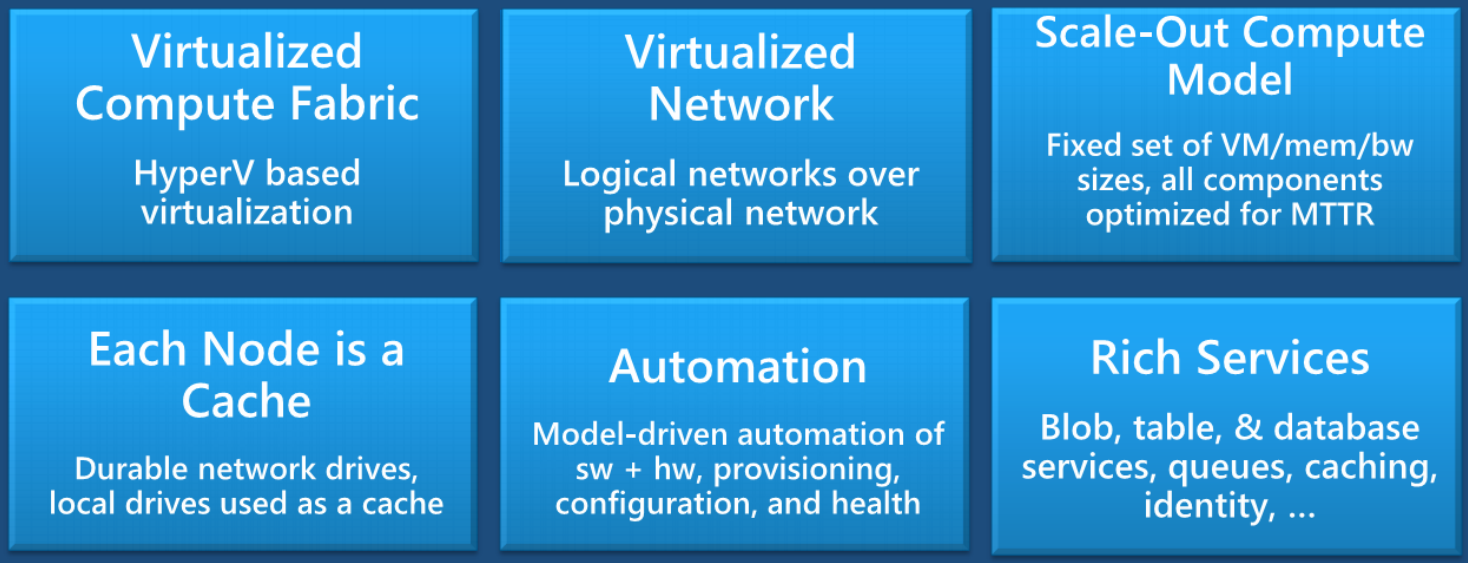
Applying Architectural Principles in Azure



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The Challenge of Data Centers & Apps

- The impact on the environment
  - In 2006 data centers used 61 *Tera*watt-hours of power
    - 1.5 to 3% of US electrical energy consumption today
  - Great advances are underway in power reduction
- With 100K+ servers and apps that must run 24x7 constant failure must be an axiom of hardware and software design.
  - Huge implication for the application design model.
  - How can hardware be designed to degrade gracefully?
- Two dimensions of parallelism
  - Scaling apps from 1 to 1,000,000 simultaneous users
  - Some apps require massive parallelism to satisfy a single request in less than a second.

http://research.microsoft.com/en-us/people/barga/sc09_cloudcomp_tutorial.pdf

Microsoft

The Microsoft Cloud is Built on Data Centers

~100 Globally Distributed Data Centers

Range in size from “edge” facilities to megascale (100K to 1M servers)

Quincy, WA

eneration 4 DCs

Data Centers Clouds & Economies of Scale I

Range in size from "edge" facilities to megascale.

Economies of scale

Approximate costs for a small size center (1K servers) and a larger, 50K server center.

2 Google warehouses of computers on the banks of the Columbia River, in The Dalles, Oregon

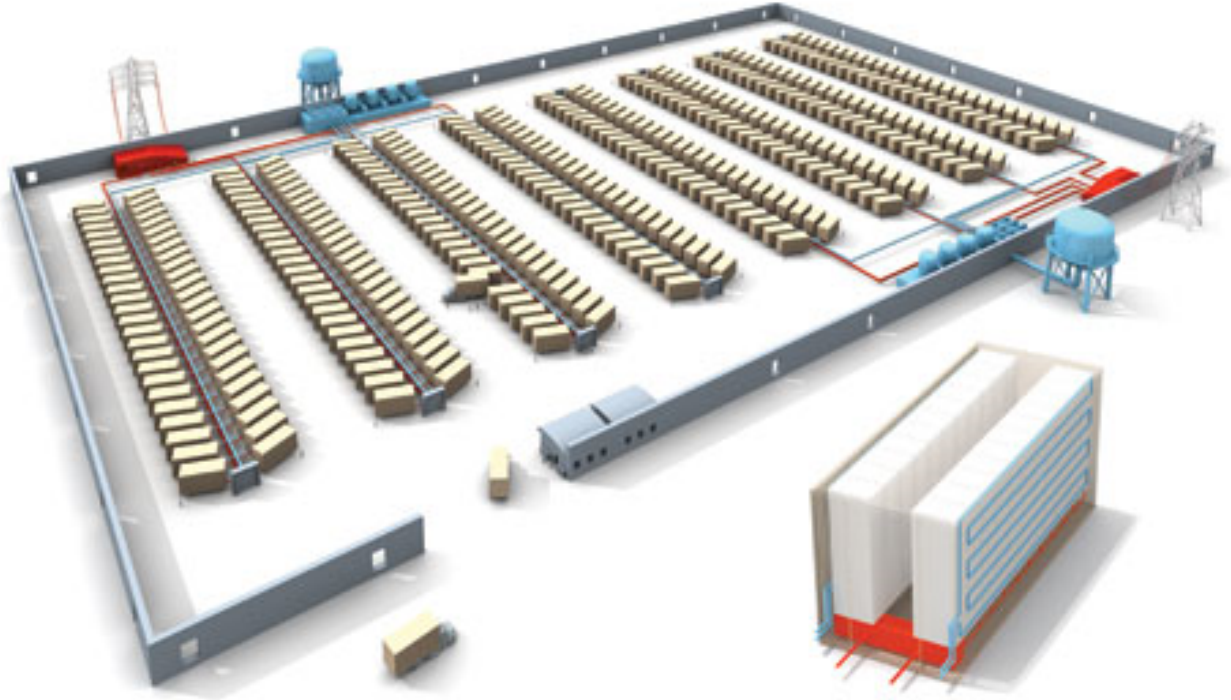
Such centers use 20MW-200MW each with 150 watts per CPU

Save money from large size, positioning with cheap power and access with Internet

http://research.microsoft.com/en-us/people/barga/sc09_cloudcomp_tutorial.pdf

Data Centers, Clouds & Economies of Scale II

- Builds giant data centers with 100,000's of computers;
  ~ 200-1000 to a shipping container with Internet access
- "Microsoft will cram between 150 and 220 shipping containers filled with data center gear into a new 500,000 square foot Chicago facility. This move marks the most significant, public use of the shipping container systems popularized by the likes of Sun Microsystems and Rackable Systems to date."



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