Google Datacenter
Datacenter Organization

Single server:
- 8-24 cores
- DRAM: 16-64GB @ 100ns
- Disk: 2 TB @10ms

Rack:
- 50 machines
- DRAM: 800-3200GB @ 300 µs
- Disk: 100TB @ 10ms

Row/cluster:
- 30+ racks
- DRAM: 24-96TB @ 500 µs
- Disk: 3 PB @ 10ms
Sun Containers
Sun Containers, cont'd
Google Containers
Microsoft Containers

COOLING: High efficiency water-based cooling system—less energy-intensive than traditional chillers—circulates cold water through the container to remove heat, eliminating the need for air-conditioned rooms.

STRUCTURE: A 24,000-square-meter facility houses 4,000 containers. Delivered by trucks, the containers connect to a spine infrastructure that feeds network connectivity, power, and water. The data center has one conventional air-conditioned room.

POWER: Two power substations feed a total of 1000 megawatts to the data center, with 300 MW used for computing equipment and 700 MW for cooling and electrical losses. A large generator provides backup power.

Each 65-foot container houses 2,900 servers, about 30 times as many as a conventional data center. A typical container is 65 feet long, 8 feet wide, and 20 feet high. Each container contains a cooling system integrated into the data center.

Today's most advanced data centers house tens of thousands of servers. What would it take to house 1 million?
Microsoft Containers, cont'd
Failures are Frequent

Typical first year for a new cluster (Jeff Dean, Google):

- ~0.5 overheating (power down most machines in <5 mins, ~1-2 days to recover)
- ~1 PDU failure (~500-1000 machines suddenly disappear, ~6 hours to come back)
- ~1 rack-move (plenty of warning, ~500-1000 machines powered down, ~6 hours)
- ~1 network rewiring (rolling ~5% of machines down over 2-day span)
- ~20 rack failures (40-80 machines instantly disappear, 1-6 hours to get back)
- ~5 racks go wonky (40-80 machines see 50% packet loss)
- ~8 network maintenances (4 might cause ~30-minute random connectivity losses)
- ~12 router reloads (takes out DNS and external vips for a couple minutes)
- ~3 router failures (have to immediately pull traffic for an hour)
- ~dozens of minor 30-second blips for DNS
- ~1000 individual machine failures
- ~thousands of hard drive failures
- Slow disks, bad memory, misconfigured machines, flaky machines, etc.
- Long distance links: wild dogs, sharks, dead horses, drunken hunters, etc.
How Many Datacenters?

- 1-10 datacenter servers/human?
- 100,000 servers/datacenter

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<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>World</th>
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<tbody>
<tr>
<td>Servers</td>
<td>0.3-3B</td>
<td>7-70B</td>
</tr>
<tr>
<td>Datacenters</td>
<td>3000-30,000</td>
<td>70,000-700,000</td>
</tr>
</tbody>
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- 80-90% of general-purpose computing will soon be in datacenters?