A practical review of data center standards and an exploration of auditing and certification.

Presented by Matt Flowerday
mflowerday@capitoline.org
Independent Design
No building
No product
Just the right design

Reduce running costs
Increase capacity
Minimise failure
Find hotspots with thermal imaging
What Tier/Class of Data Centre do you have?

The only Data Centre training presented by Chartered Engineers who are also practising data centre consultants.

Data Centre Design
Data Centre Operations Management
BICSI & CIBSE certified

DESIGN   AUDIT   TRAINING
Data Centers a brief History
The PC arrived
Servers Followed

LAN

PC Clients

Servers
Then came the Server Room
Followed by Chaos!
Cool the room
In 2003

400W

1,600W
Blade Servers

400W

25kW
Our original design

1.6kW
Gets hotter!

16kW
...and hotter !!!

25kW
So we build a modern data centre
Computational Fluid Dynamics

Sophisticated CFD programmes can model air flow

e.g. TileFlow©

www.tileflow.com/
www.flomerics.com/flovent/
3D visualisation
And the Data Centre market continues to grow
Modern Data Centre issues

Cooling

Power
The reason is we start with...

N+1 Electrical Design
But then we increase the load
N+1 Cooling Design
Becomes ‘N’ Design
One unit fails
Other things to think about
Virtualisation

Email  File  Print  Apps
Power over Ethernet
Thin client
Multi disciplined and complex design
Data Centre Standards

- TIA 942
- BICSI 002
- EN 50600 series
- EN 50173-5
- ISO/IEC 24764
Data Centre Cabling Standards

- TIA 942
- BICSI 002
- EN 50600 series
- EN 50173-5
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Data Centre Standards

- TIA 942
- BICSI 002
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- ISO/IEC 24764
TIA 942

• Started development in 2002
• An attempt to combine all data centre disciplines
• Input from IT, ASHRAE, architects & users
• Ratified in April 2005 and updated in 2010
• Developed Tier strategy for DC’s from Tier 1 to Tier 4
• A lot of telecommunications but also
  – Temp
  – Humidity
  – Floor loadings
  – Colour of the walls
  – Etc......

• Efficiency not specifically mentioned but
  – Hot aisle/cold aisle
  – Seal raised floor etc.
Data Centre Standards

- TIA 942
- BICSI 002
- EN 50600 series
- EN 50173-5
- ISO/IEC 24764
• Released in 2010
• Designed as a “How to do” best practices manual
• In excess of 500 pages
• Now released as ANSI-BICSI-002
Data Centre Standards

- TIA 942
- BICSI 002
- EN 50600 series
- EN 50173-5
- ISO/IEC 24764
Data Centre Standards

- TIA 942
- BICSI 002
- EN 50600
- EN 50173-5
- ISO/IEC 24764
EN50600

- In development
- Classifying data centre infrastructure in terms of
• In development
• Classifying data centre infrastructure in terms of **Availability**
EN50600

• In development
• Classifying data centre infrastructure in terms of Availability, Security
• In development
• Classifying data centre infrastructure in terms of **Availability, Security** and **Energy Efficiency**
• But won’t specify
  – Temp, Humidity
  – Hot aisle/cold aisle
  – PUE
  – etc.
Tier/Class rating

The UpTime Institute

=

TIA 942

=

BICSI 002

=

EN50600
TUI Tiers

• Tier 1. Enough items to do the job

• Tier 2. Redundant items

• Tier 3. Concurrently maintainable.
  – Any item or path can be taken down for maintenance and the system will still operate

• Tier 4. Fault tolerant
  – As Tier 3 but will automatically cope with failures without human intervention
<table>
<thead>
<tr>
<th></th>
<th>TIER 1</th>
<th>TIER 2</th>
<th>TIER 3</th>
<th>TIER 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uninterruptible Power Supply System-UPS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPS-Redundancy</td>
<td>N</td>
<td>N+1</td>
<td>N+1</td>
<td>2N</td>
</tr>
<tr>
<td>UPS-Topology</td>
<td>Single Module or Parallel Non-Redundant Modules</td>
<td>Parallel Redundant Modules or Distributed Redundant Single or Parallel Modules with static bypass</td>
<td>Parallel Redundant Modules or Distributed Redundant Modules or Block Redundant System</td>
<td>Parallel Redundant Modules or Distributed Redundant Modules or Block Redundant System</td>
</tr>
<tr>
<td>Automatic Bypass</td>
<td>None</td>
<td>Yes with non dedicated feeder to automatic bypass</td>
<td>Yes, with dedicated feeder to automatic bypass</td>
<td>Yes, with dedicated feeder to automatic bypass</td>
</tr>
<tr>
<td>UPS-Maintenance Bypass Arrangement</td>
<td>By-pass power taken from same utility feeds and UPS modules None</td>
<td>By-pass power taken from same utility feeds and UPS modules Non dedicated maintenance bypass feeder to UPS output switchboard</td>
<td>By-pass power taken from same utility feeds and UPS modules Dedicated maintenance bypass feeder serving UPS output switchboard</td>
<td>By-pass power taken from a reserve UPS system that is powered from a different bus as is used for the UPS system Dedicated maintenance bypass feeder serving UPS output switchboard</td>
</tr>
<tr>
<td>System/Class</td>
<td>Class F0</td>
<td>Class F1</td>
<td>Class F2</td>
<td>Class F3</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>----------</td>
<td>----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>UPS redundancy</td>
<td>N or &lt;N</td>
<td>N</td>
<td>A minimum of N+1</td>
<td>A minimum of N+1</td>
</tr>
</tbody>
</table>
### EN 50600-1 Availability

<table>
<thead>
<tr>
<th></th>
<th>Availability Class 1</th>
<th>Availability Class 2</th>
<th>Availability Class 3</th>
<th>Availability Class 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of overall set of facilities and infrastructures</td>
<td>low</td>
<td>medium</td>
<td>High</td>
<td>Very high</td>
</tr>
<tr>
<td>Example for the facility/building (see EN 50600-2-1)</td>
<td>ffs</td>
<td>ffs</td>
<td>ffs</td>
<td>ffs</td>
</tr>
<tr>
<td>Example for power distribution (see EN 50600-2-2)</td>
<td>Single-path (no determined requirements)</td>
<td>Single-path (resilience provided by redundancy of components)</td>
<td>Multi-path (resilience provided by redundancy of systems)</td>
<td>Multi-path (fault tolerant even during maintenance)</td>
</tr>
<tr>
<td>Example for environmental control (see EN 50600-2-3)</td>
<td>N/A</td>
<td>Single-path (no determined requirements)</td>
<td>Single-path (resilience provided by redundancy of components)</td>
<td>Multi-path (resilience provided by redundancy of systems)</td>
</tr>
<tr>
<td>Example for telecommunication cabling (see EN 50600-2-4)</td>
<td>N/A</td>
<td>Single-path</td>
<td>Multi-path</td>
<td>Multi-path (with additional requirements ffs)</td>
</tr>
<tr>
<td>Example for security systems (see EN 50600-2-5)</td>
<td>ffs</td>
<td>ffs</td>
<td>ffs</td>
<td>ffs</td>
</tr>
</tbody>
</table>
Standards for Data Centre Operations

- ISO 9000 - Quality System
- ISO14000 - Environmental Management System
- ISO 27001 - Information Security
- PCI – Payment Card Industry security standard
- SAS70 & ISAE 3402 or SSAE16 (USA) - Assurance controls
- AMS-IX - Data Centre business continuity standard
- TUI Tier Standard: Operational Sustainability
- EN50600-2-6 Management and Operational Information
Telecoms Versus IT Data Centers
IT Data Center
Telecom Data Center

ETSI TR 102 489 V1.2.1 (2010-02)
Figure 6.3.2.4b: Option B Free Blow along the aisles
Telecom top to bottom airflow
AC - DC

Voltage or current

Direct current

Alternating current

Time
48 V DC distribution

- Mains ac power supplies are inefficient
- A DC system is more efficient
- This can reduce cooling, but........
- If 48 V unit is in same cabinet it will in turn dissipate heat
- If supplied externally then large 48 V dc supply has to be built
- Current goes up to compensate for the same power
- Power lost in cables goes up
- Supply cable must be very big to compensate
China Media Digest 0903 (week7)
By Wei HE • February 15, 2009

TVCC of CCTV on fire
The northern building of the new CCTV complex was caught fire on Feb. 9, at around 8:00pm. The fire spread quickly and soon the entire structure was in flames. The 44-storey building, about 200 meters from the iconic CCTV tower, houses the Television Culture Center (TVCC), the luxury Mandarin Oriental Hotel and an electronic data processing center.
Why do data centres fail?

Updated #2: Internode blames power failure for outage
Stormy weather was to blame for the power failure at one of the ISP's datacentres

Spandoe Lui 21 September, 2009 17:17:00
Tags: Internode, Data Center

A storm has caused an outage at internode's Adelaide datacentre, which affected services in South Australia.

According to notes provided on the ISP's suppo website, the ADL6 datacentre facility encountered a mains failure at 2.37pm Australian Central Standard Time (ACST) on Monday September 21. UPS power was used after issues with emergency power generators, which kicked in automatically.

“Despite being regularly tested, one of the backup generators did not synchronise and was not able to contribute to power demand during the mains failure,” Internode managing director Simon Hackett, said.
84 major data centre failures in 36 months, and that’s just the ones made public.

If we presume this is at best half of all failures then a data centre goes down somewhere every 2 weeks.

And that’s excluding individual equipment failures.

Average downtime 14.5 hours per major incident:
- From 20 minutes to 8 days.
Reported data centre failures*

*Publically reported catastrophic failures

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Failure mechanisms

<table>
<thead>
<tr>
<th>Failure mode</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power failures</td>
<td>23</td>
</tr>
<tr>
<td>Fire</td>
<td>7</td>
</tr>
<tr>
<td>Storm &amp; flood</td>
<td>9</td>
</tr>
<tr>
<td>Other external issues</td>
<td>3</td>
</tr>
<tr>
<td>Malicious attack, DDoS or theft</td>
<td>8</td>
</tr>
<tr>
<td>HVAC</td>
<td>4</td>
</tr>
<tr>
<td>Major IT problem</td>
<td>18</td>
</tr>
<tr>
<td>Unspecified</td>
<td>12</td>
</tr>
</tbody>
</table>

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The cost of failure

Bar Chart 3a
Average cost for partial & complete outage

Source: Emerson/Ponemon research Feb 2011
Almost every failure could be avoided with...

- Better design
- More thought about location
- Proper maintenance plans
- Testing of all systems, not just components
- Adequate fire suppression methods
- Monitoring
- Business processes

FACT: 1 in 4 businesses never re-open their doors after a disaster
The cost of downtime goes beyond dollars lost

- 93 percent of companies that suffer a significant data loss are out of business within five years
  - U.S. Bureau of Labor
- 43 percent of U.S. businesses never reopen after a disaster, and 29 percent (more) close within two years.
  - University of Wisconsin
- “Two out of five companies that experience a catastrophe or an extended system outage never resume operations, and of those that do, one-third go out of business within two years”
  - GartnerGroup
• “More than 60% of businesses in the U.S. do not have a basic plan to mediate the effects of a disaster should they occur.”
  – Gartner Group

• “90% of European enterprises with global revenues in excess of €100M have no formal business continuity plans in place.”
  – International Data Corporation
Auditing

• Not all audits are the same
• Different types of audit
• Reasons for auditing
• The auditor
• How to make the most of the audit
Data centre auditing

• Many data centres are audited each year in the UK, Ireland, Netherlands and the Middle East

• For reasons different reasons;
  - Amsterdam Internet Exchange and Cisco EMEA

• No two customers have the same expectation from a data centre audit
What are the motives to obtain a DC audit?

• Their customers require it
• Need to understand ‘Tier’ rating
• Know they have problems but need an external consultant to confirm that to free up funding
• Have current and severe operational problems and need to start the overhaul/replacement process
• Need ISMS audits such as ISO 27000
• Need to know their green/CO₂/PUE position
• Want compliance with H&S and other legislation
About 50 separate standards that could be applied to a data centre plus many national requirements
Data centre Auditing

• What does the customer want to achieve?
• Use the right audit package to answer the customer’s questions/requirements
• Select from the range of appropriate standards available. There is no one standard that fits all requirements
• An audit includes business processes not just physical attributes
The Capitolline view of Data Centre Design and Auditing

- Building Regulations
- Information Security
- Business Continuity & Operating Practices
- Energy Efficiency
- Data Centre Design and Resilience
- Health & Safety at Work

Asymmetric approach depending upon customer requirements

AMSIX
Amsterdam Internet Exchange

Bicsi
www.Capitoline.eu
Certification of co-location data centers
A major central London data centre owned by Level 3 overheated in Sunday's sunshine, (May 31\textsuperscript{st} 2009) taking down major websites including the popular music service Last.fm.

Temperatures at the facility in Braham Street in the City topped 50°C at 7pm, after one of five chillers failed in the afternoon heat. According to data recorded at City Airport, the outside temperature peaked yesterday at about 23°C.

The other chillers were unable to bear the extra strain and the temperature rose uncontrollably. Servers shut down to cool and were gradually brought back online after about four hours.

Level 3 said today that engineers were still working to repair the faulty chiller, but added that the other four were now able to maintain a working temperature. It said it had informed customers of the problems.”
Tier 3?
Tier 3?
Do all of these racks have the same cooling?

| UPS 1 | CRAC 1 | UPS 2 | CRAC 1 | PDU 1 | CRAC 1 | PDU 2 | CRAC 1 |
Tier 3 concurrent maintainability?
Add Equipment and the Breaker Trips
Maintaining CRAC – Power trips
No vented tile
Hot Rack
The Fan has failed!
What’s wrong?
Poor airflow through tiles
Lost air through cable holes
Lost air through floor
Low Ceiling
Poor airflow in hot air return
Thermal Gain
Thermal gain through cable holes
Becomes visible
Electrical Health and Safety
H&S trip hazard
Dangerous wiring
Cardboard boxes
Un-sealed holes
Powder fire extinguishers
Rubbish under the floor
Cabling under floor
Cabling in racks
Vesda wrong way up
Hot aircon pipes near cables

57°C
Hot pipes under the vented tiles
Cables blocking airflow
Cables between Racks
Floor unstable
Floor won’t lay flat
No earth
Dirty/dusty
Fans and blowers
Wasted Air No Equipment
Wrong sized cable routes
Auditing

• Not all audits are the same
Choose your Auditor carefully

• Qualified
• Experienced
• Knowledgeable
• Independent
What are the motives to obtain a DC audit?

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For many different reasons:
- Amsterdam Internet Exchange and Cisco EMEA and IT integrators around the world.

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The Capitoline
view of Data
Centre Design
and Auditing

- Building Regulations
- Asymmetric approach depending upon customer requirements
- Business continuity & operating practices
- Information security
- Energy Efficiency
- Data Centre design and resilience
- Health & safety at work

www.Capitoline.eu
Certification of co-location data centers
If all else fails!

THAT SHOULD DO THE TRICK