Content

- The organisation
- The project
- Storage infrastructure, physical and logical
- Problem conditions and indicators
- Health status levels
- Instant and historical status reports
- Conclusions
- Future work
- Questions
The organisation

- KLM IS delivers ICT-services to KLM’s business processes
  - Electronic booking, online check-in, …
    - Primarily database and web applications
- Different platforms (UNIX, Linux, Windows) are managed by their own departments
- A central Fibre Channel Storage Area Network (SAN) with connected storage systems is managed by the SAN department
Each department monitors its own systems to support their own daily operations. Therefore the SAN department does not see storage related problems experienced by hosts. A better understanding of the storage infrastructure’s health is desired.
Problem definition

How can an alarm system be created that monitors the long term as well as immediate health of a Fibre Channel fabric?

- What indicators are relevant for the health of the Fibre Channel fabric, and where can they be found?
- What are the important interrelations between such indicators, and how can they be quantified?
- What kind of health status levels can be defined, and by which indicators and thresholds should they be reached?
Storage infrastructure (physical)
**Storage infrastructure (logical, 1)**

- One or more **hosts** can share one or more **HBAs**, and each **HBA** can have one or more **host ports** connected to a **switch port**. Such a connection is a **host link**.

- One or more **hosts** share one or more **LUNs**.

- A **fabric** consists of one or more interconnected **switches** and includes all connected **host ports** and **storage ports** as well.

- A **switch** has one or more **switch blades**, which each contain one or more **switch ports**.

- An **ISL** is a link that connects a **switch port** to a **switch** port from another **switch**, both **switches** are by definition in the same **fabric**.

- A **storage subsystem** contains one or more **LUNs** which can be made available via one or more **storage ports** that are connected to a **switch port**. Such a connection is a **storage link**.
Storage infrastructure (logical, 2)
Problem conditions

- Hardware failure
- Capacity shortage
  - Reduced redundancy of load balanced components poses an extra risk
  - Can be caused by hardware failure
Problem indicators

- DCB error
- Path failure
- Mirror out of sync
- Frame discard
- Over-utilisation
- Hardware failure
- Port latency
An established problem can be related to other components
- A failed storage port on the fabric can be related to a number of affected hosts
From some problem indicators, more specific relations can be found:
- A DCB error points to a storage port.
- A relation between DCB errors and frame discards on a storage port can be confirmed or denied.
Health Status Levels (1)

- No problems
- Problems with no impact
- Limited impact
- Severe impact

Per fabric, as well as in total
# Health Status Levels (2)

<table>
<thead>
<tr>
<th>Fabric 1</th>
<th>No problems</th>
<th>No impact</th>
<th>Limited impact</th>
<th>Severe impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>No problems</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>No impact</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Limited impact</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Severe impact</td>
<td>8</td>
<td>16</td>
<td>32</td>
<td>64</td>
</tr>
</tbody>
</table>
Instant Health Status
Average Health Status

Average Health Status Fabric 0 (four-hourly)

Average Health Status Fabric 1 (four-hourly)

Average Combined Health Status (four-hourly)
Conclusions

- A relational model of components relevant for the storage infrastructure has been developed
- Hardware failures, as well as (increased risks of) capacity shortages are indicators that affect the health status of the storage infrastructure
- Health status levels are determined by their impact, and the separate fabric statuses are being combined
- Over longer time periods an average health status, and the amount of activity is presented
What's next?

- Implementation
- Evaluation
- Extra indicators and relations to enhance the system
Questions