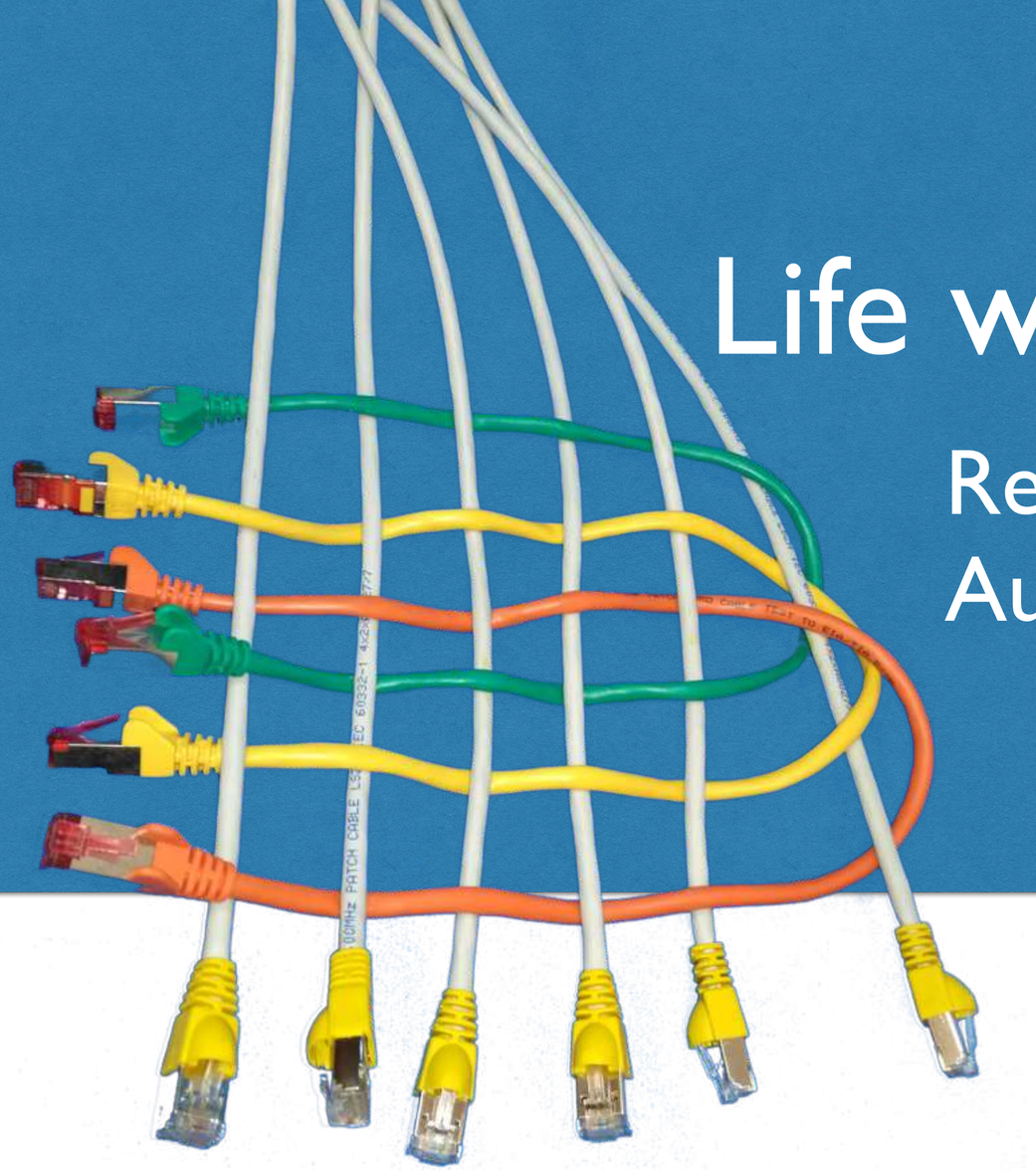

Life without a Safety Net?

Redundancy in Ethernet based Audio Networks

Marc Schettke

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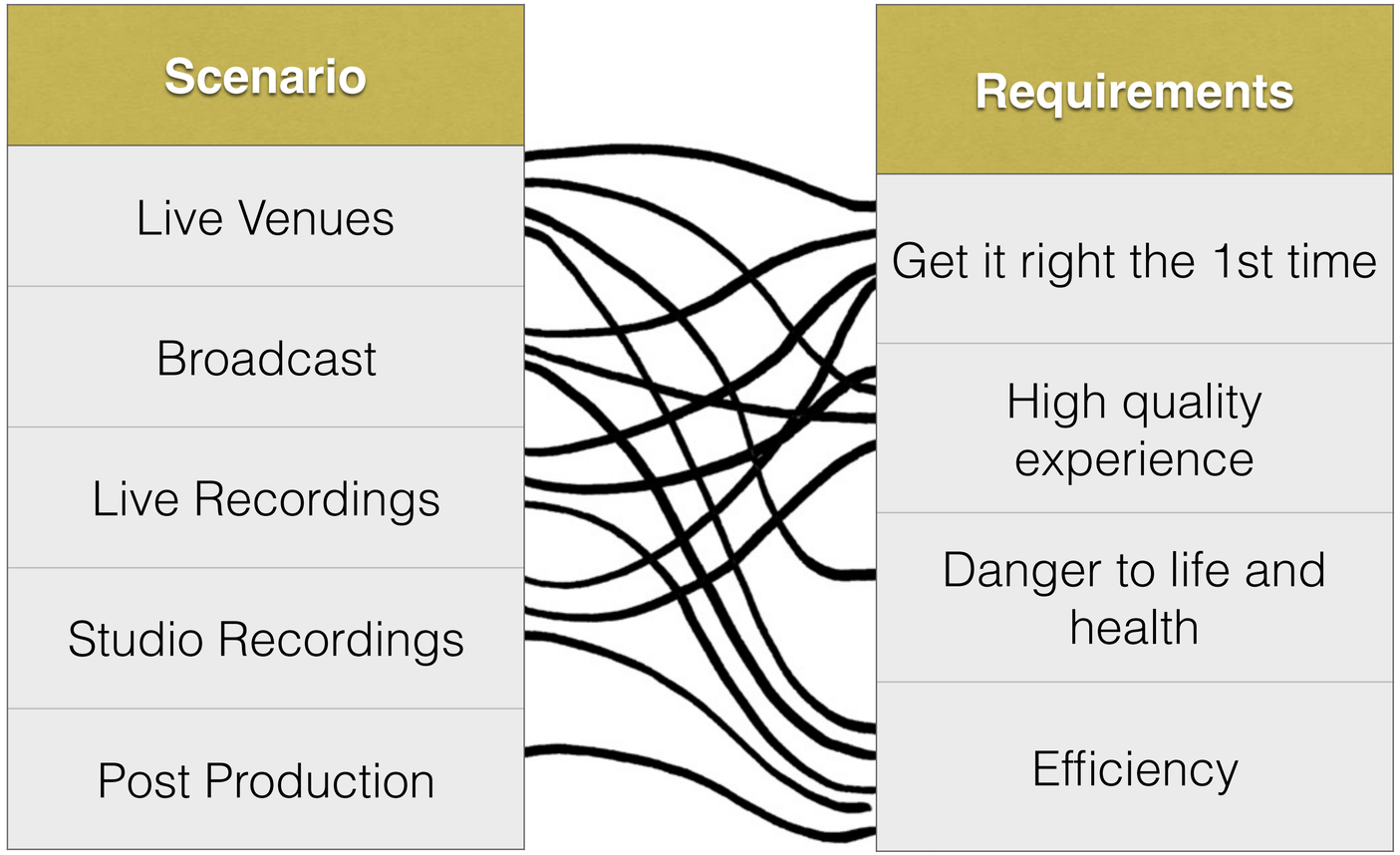
29. Tonmeistertagung • VDT International Convention • 17. - 20. November 2016 • Cologne, Germany

Agenda

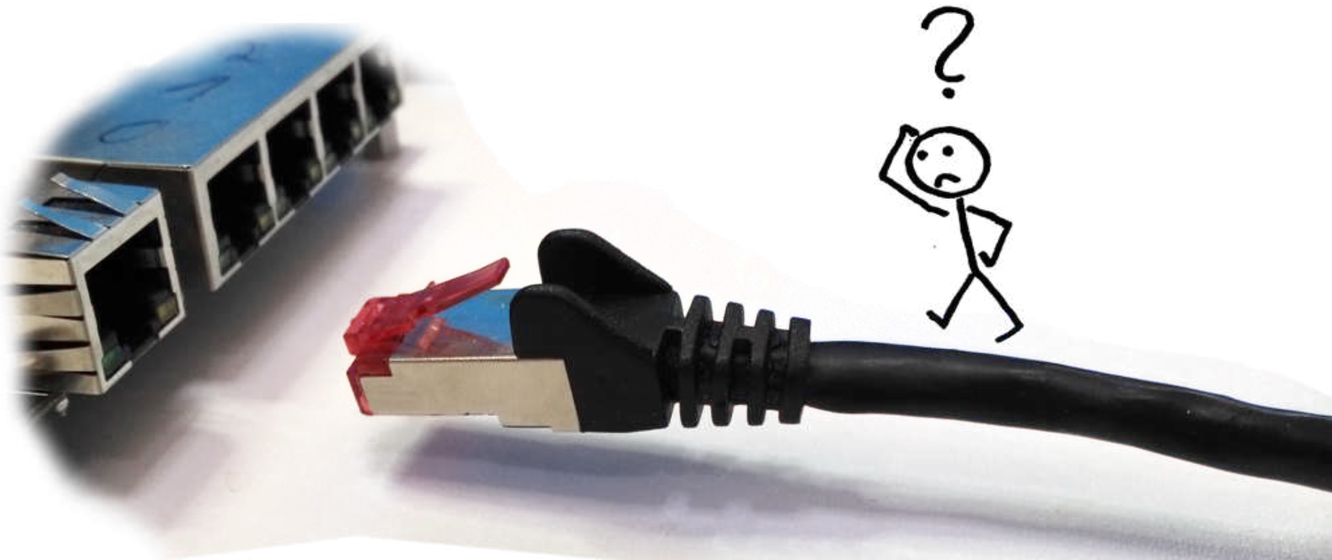
- Why redundancy matters
- Scope of this talk
- Existing standards and solutions
- Cost/Benefit Considerations
- Interoperability
- Summary/Conclusion

Redundancy matters



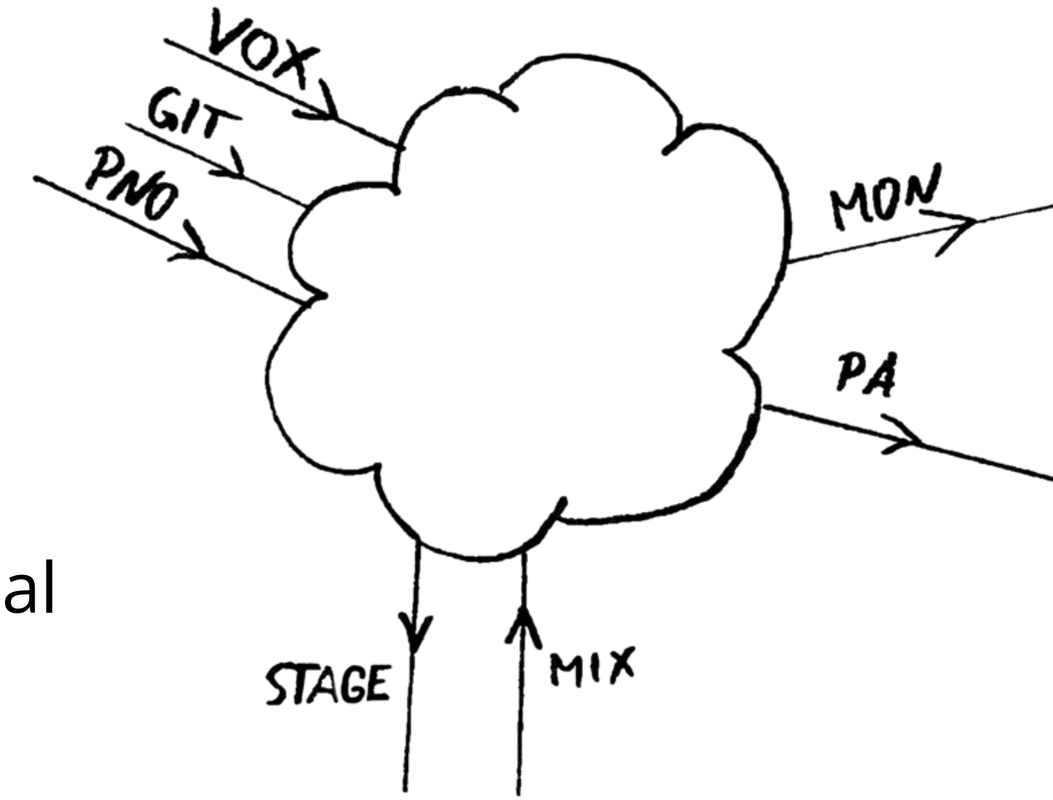
Redundancy matters

- Cables
- Devices
  - Loss of power
  - Hardware defect
  - Firmware Bugs
- Humans
  - Misconfiguration
  - „Can I unplug thi…“



Redundancy matters

- Less hardware = increased importance of each device/cable
- Networks obfuscates topology („the cloud“)
- Engineered networks require human resources & IT knowledge
- Synchronisation differs from traditional clocking



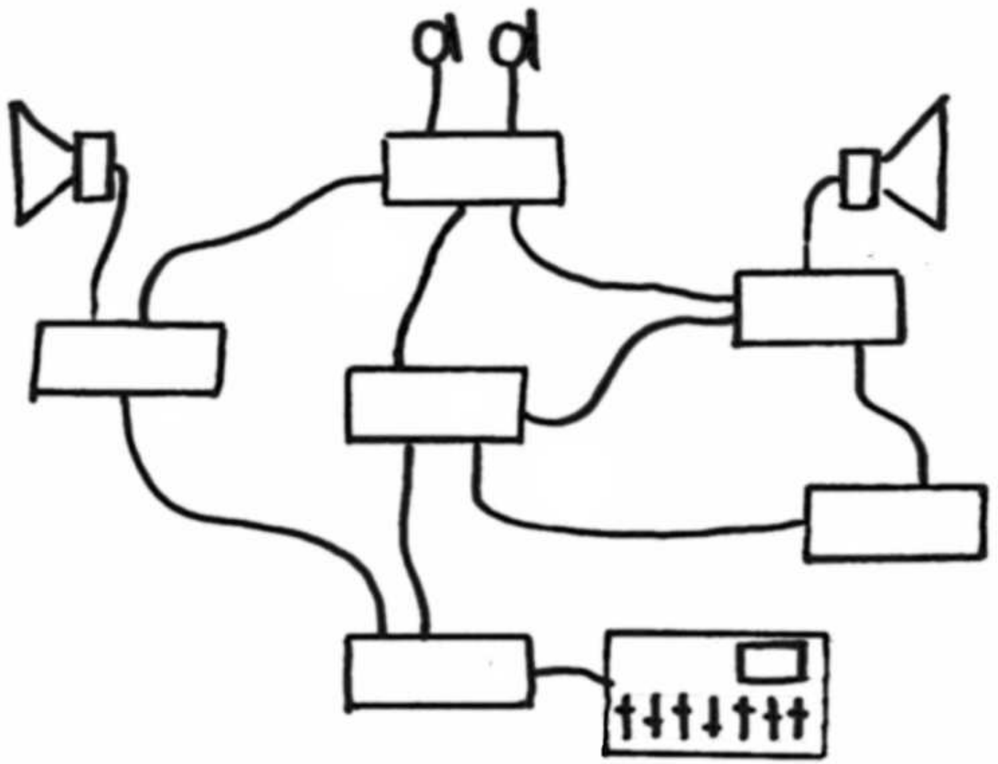
Scope

- Full Redundancy
- Network-related redundancy
- Automatic failover
- Local Area Networks
- Only Dante/Ravenna/AES67/AVB/TSN

Methods & Technology

Dynamic Redundancy

- Spanning Tree Protocol (today: RSTP/MSTP)
- physical mesh -> logical tree
- not glitchfree/hitless/seamless
- Recovery time hard to predict
- Single point of failure at devices



Methods & Technology

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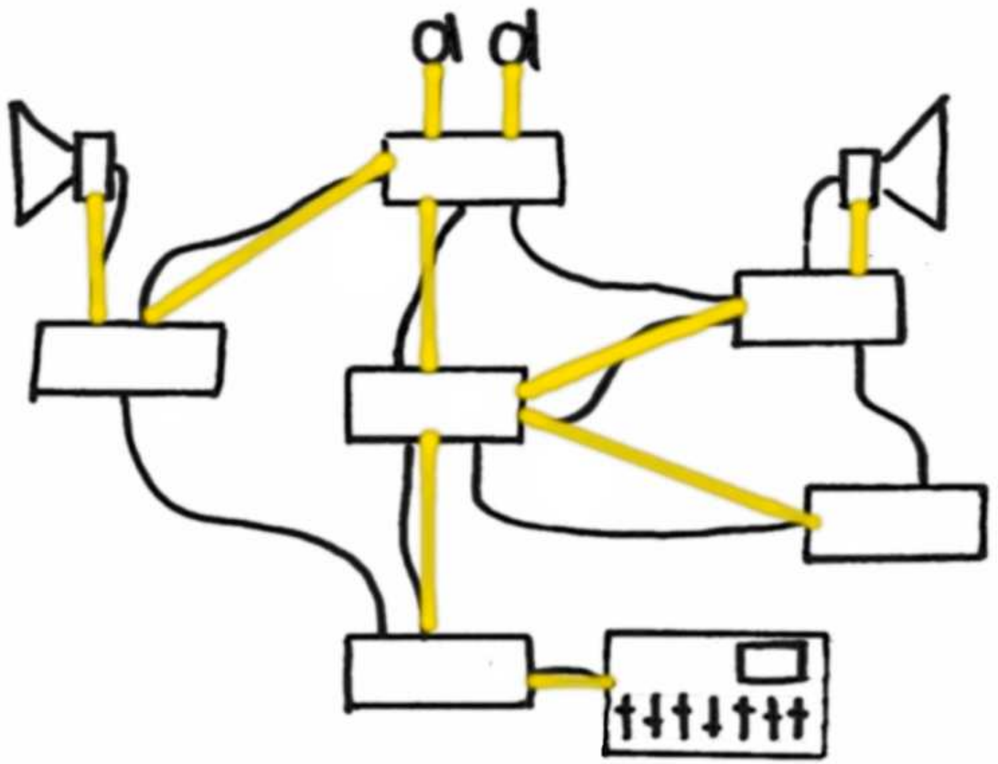

Methods & Technology

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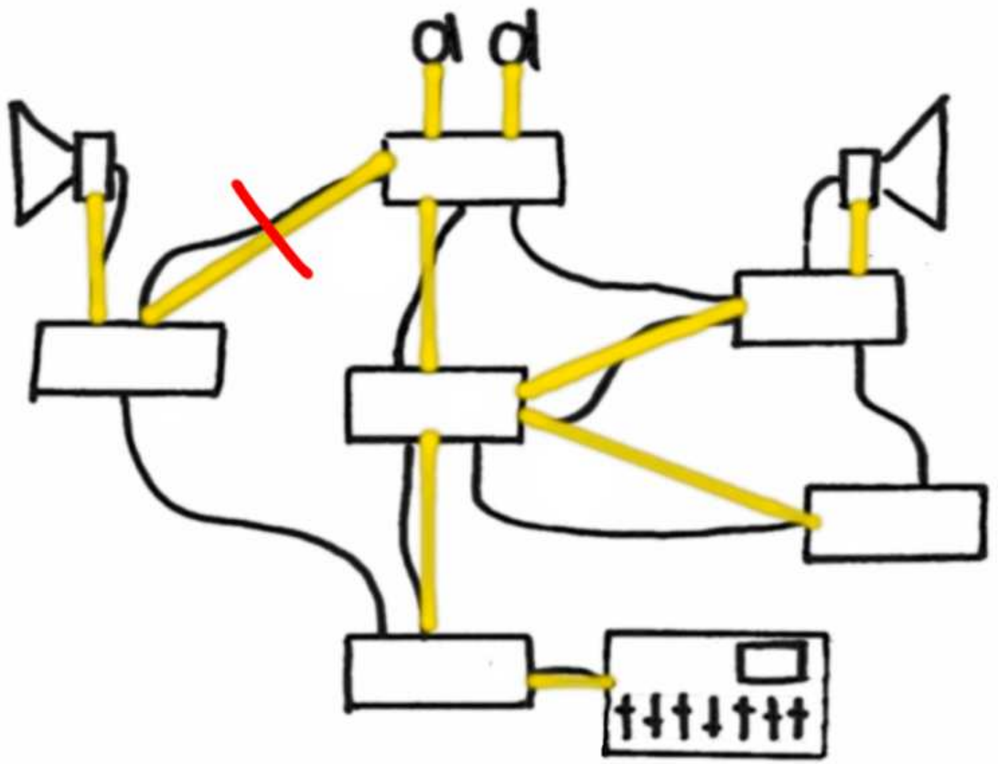

Methods & Technology

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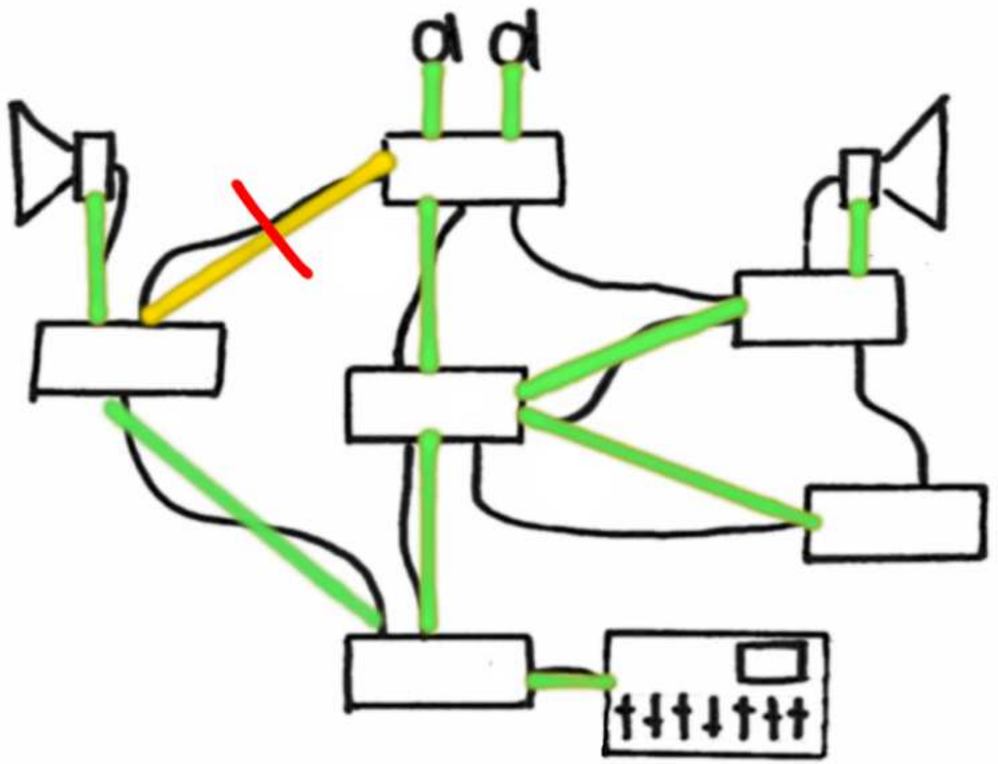


Methods & Technology

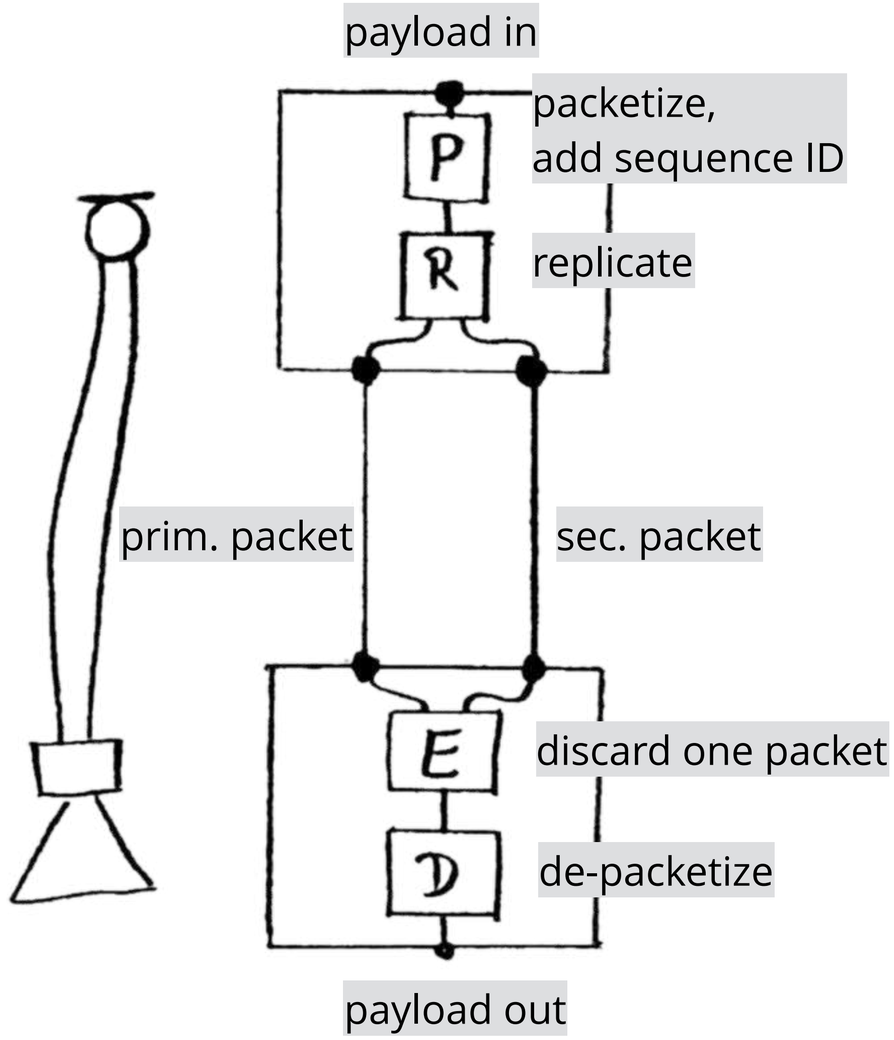
Link Aggregation

- Link Aggregation Group (LAG) / Trunk
- Cable redundancy for important backbones
- Shorter recovery times than STP (more „deterministic“)

Methods & Technology

Static Redundancy

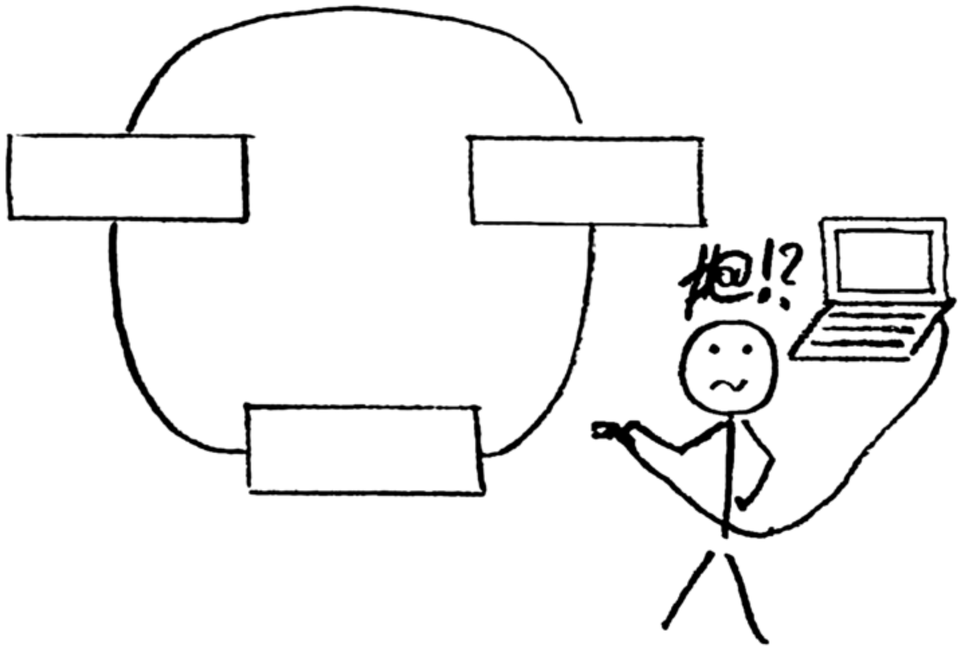
- Double attached nodes (DANs)
- Redundancy handling in endpoints
- Basic Operation:
  - Provide sequence information (ID)
  - TX: Replicate packet
  - RX: Eliminate duplicated packet
- Industrial Ethernet: IEC 62439-3



Methods & Technology

Static Redundancy: Ring

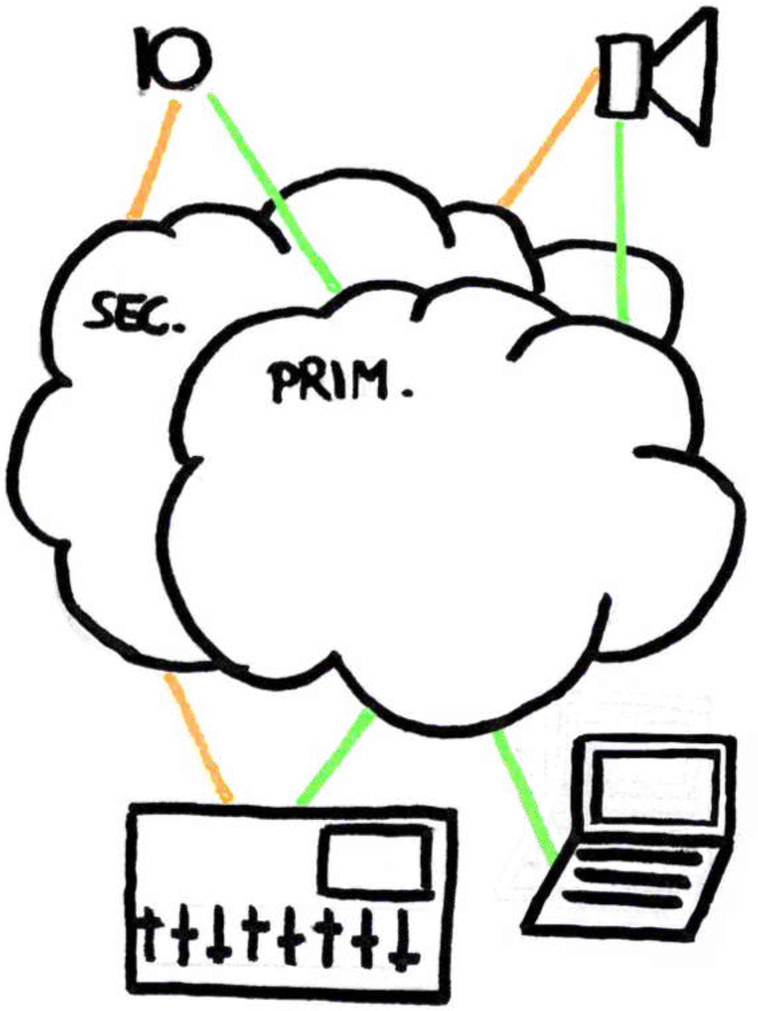
- Reduced cabling and no switches
- One ring often impractical
- No Single Attached Nodes (SAN)
- Industrial Ethernet: HSR
- AVID AVB



Methods & Technology

Static Redundancy: Redundant Star

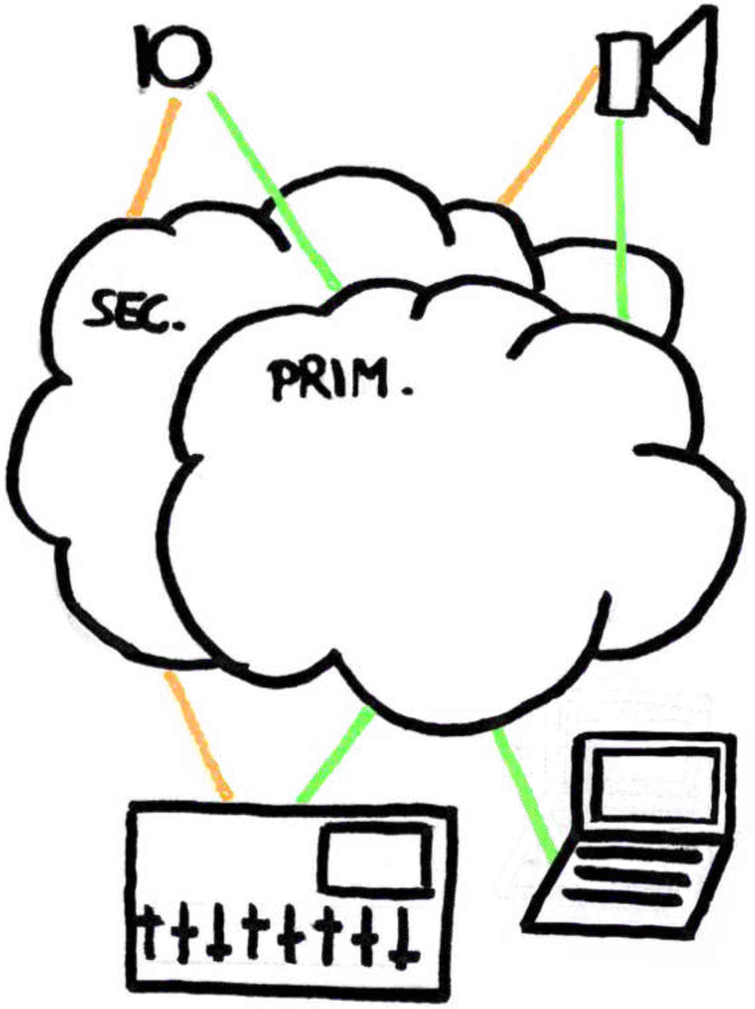
- Two independent LANs
- Automation Networks: PRP
- SMPTE 2022-7, IETF RFC 7198
- IETF DetNet
- Dante, Ravenna



Methods & Technology

Static Redundancy: Redundant Star

- Single attached nodes can't use second network
- Control and non-audio traffic may not be redundant



Methods & Technology

Clocking

- Pandora's box
- Time-aware infrastructure?
- External clock input?
- PRP: Same grandmaster on both networks?
- $t_{rec\_network}$!= t_{rec_ptp} != $t_{rec\_media\_clock}$
  - Media clock derived from PTP clock

Methods & Technology

Monitoring

- Dynamic Redundancy
  - Information usually available (i.e. SNMP)
  - Not used by solutions
- Static Redundancy
  - Notification in user interface
  - Information in log files

Cost-Benefit

- Cost for hardware: **Devices & Infrastructure**
- „**Hidden cost**“:
  - System integrator (initial setup)
  - IT expert (changing setups, troubleshooting)
  - Future proofness
- **Convergence** with other network services (Light, Video, Control)

Cost-Benefit

Dynamic Redundancy

- „Special switches“ required (which are pretty standard)
- Recovery time depending on management*
- Scales well:
  - LAG (backbones)
  - RSTP „ring“
  - RSTP multiple redundant paths
- Convergence possible

* Redundancy optimization for networked audio systems; D. Kowalski, P. Kozlowski; Proc. 132nd AES Convention

Cost-Benefit

Static Redundancy

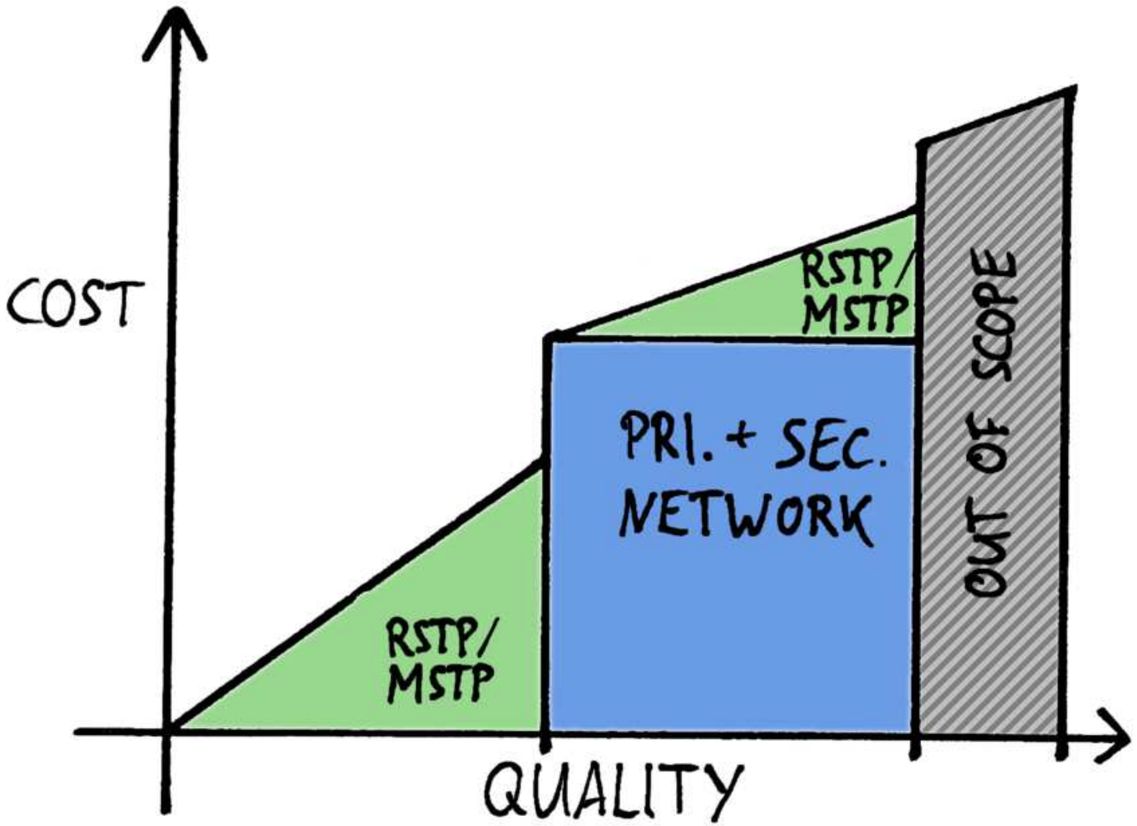
- all-or-nothing: Ring or 2 LANs
- Duplicated management cost
- Increased complexity
- Convergence possible but interconnections require careful configuration
- But: still less expensive than analog or complex digital redundancy!

Cost-Benefit

- Static redundancy preferred
- RSTP/MSTP can be applied easily (even „on top“)

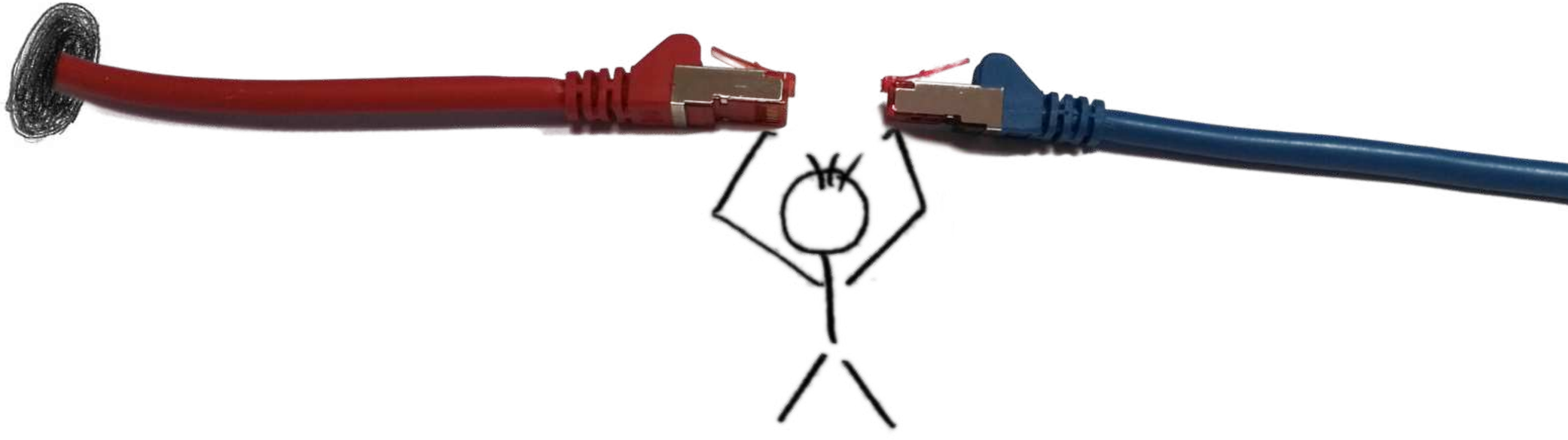
Scenario
Live Venues
Broadcast
Live Recordings
Studio Recordings
Post Production

Requirements
Get it right the 1st time
High quality experience
Danger to life and health
Efficiency



Interoperability

- Solutions: Dante, Ravenna
- Protocols: AES-67, AVB/TSN



Interoperability

Special case: Dynamic Redundancy

- Failover done at infrastructure level
- Supported by all solutions and protocols

Interoperability

Solutions

- Dante
  - Devices interoperable if second network port exists
- Ravenna
  - Devices interoperable if second network port exists AND is already enabled

Interoperability

AES67

- „[redundancy is] outside the scope of AES67.“*
- „[…] can be added on top […]“*
- Responsibility of Media Networking Alliance?

* http://medianetworkingalliance.com/faq-aes67/

Interoperability

AVB/TSN

- Not specified in AVB
- Time sensitive networking (TSN, „AVB gen. 2“)
  - 802.1AS-REV: Redundant PTP grandmaster
  - 802.1CB: „Frame replication and Elimination for Reliability“ (FRER)
  - 802.1Qcc: Centrally-managed network
  - Auto-configuration available
  - Zero congestion loss

Interoperability

AVB/TSN

- Too good to be true?
  - Work in progress
  - Slow adoption predictable
  - Too heavy for our industry?

Summary/Conclusion

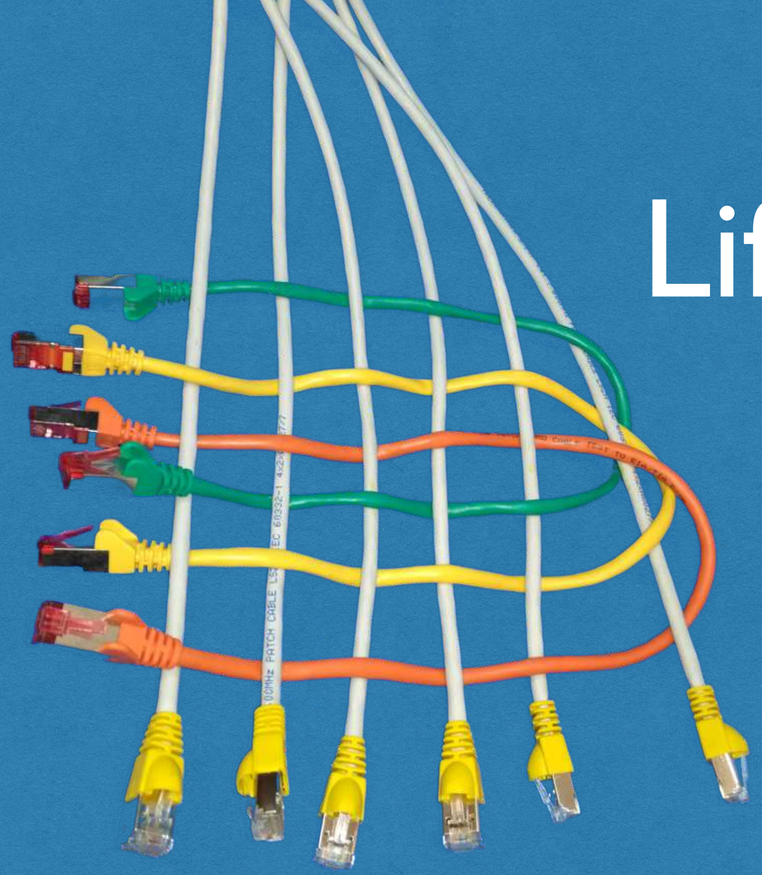
- Different layers:
  - Network (not glitchfree without new switches)
  - Application (Dante, Ravenna)
  - System (not „one size fits all“)

Summary/Conclusion

- An ideal solution…
  - scales with size and requirements
  - is interoperable within a standard set
  - doesn’t add complexity for the user
- In reality…
  - this is only true with dynamic redundancy
  - neither AES67 nor AVB offer static redundancy

Summary/Conclusion

- Standards available for industrial ethernet
- TSN (AVB gen. 2) could be a solution
- Unlikely to supersede AES67 compatible solutions
- A new AES standard based on IEC 62439-3 or IETF RFC 7198 might help



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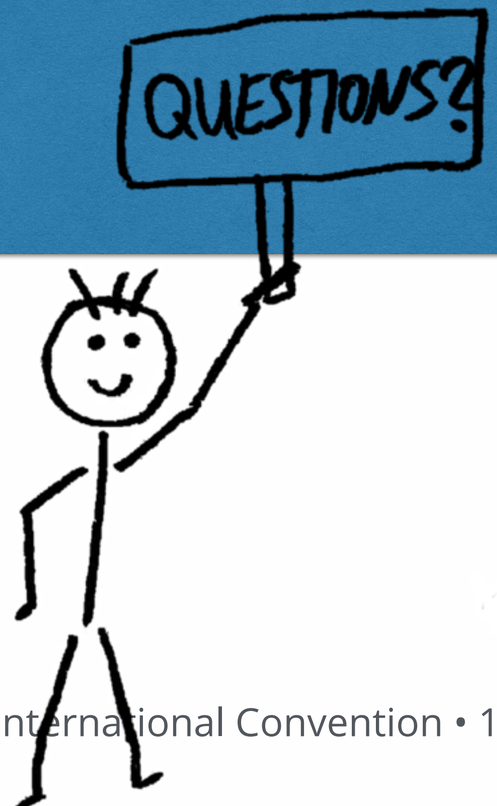

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