

Top Technical Challenges over the Next Ten Years

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The Permanent Challenge



Dependability is and will remain a key challenge due to:

- Ever-increasing systems complexity
- Ever-growing number of attacks and threats, novice users and third-party or open-source software, COTS
- Growing connectivity and interoperability
- Dynamicity (frequent configurations, reconfigurations, updates, upgrades and patches, ad hoc extensions)
- Systems proliferation to applications in all domains of human activity



Status Quo - Approaches

- Robust development
- Rigorous analysis
- Testing, testing, testing,...
- Fault injection

→ **do not scale well up to industrial complexity levels**

Promising Direction: Empirical Modeling (learning from systems biology)

Systematic fault injection based on a given fault model, taxonomy or ontology

Runtime monitoring and failure prediction

Dynamic models capable of reconfiguration at runtime

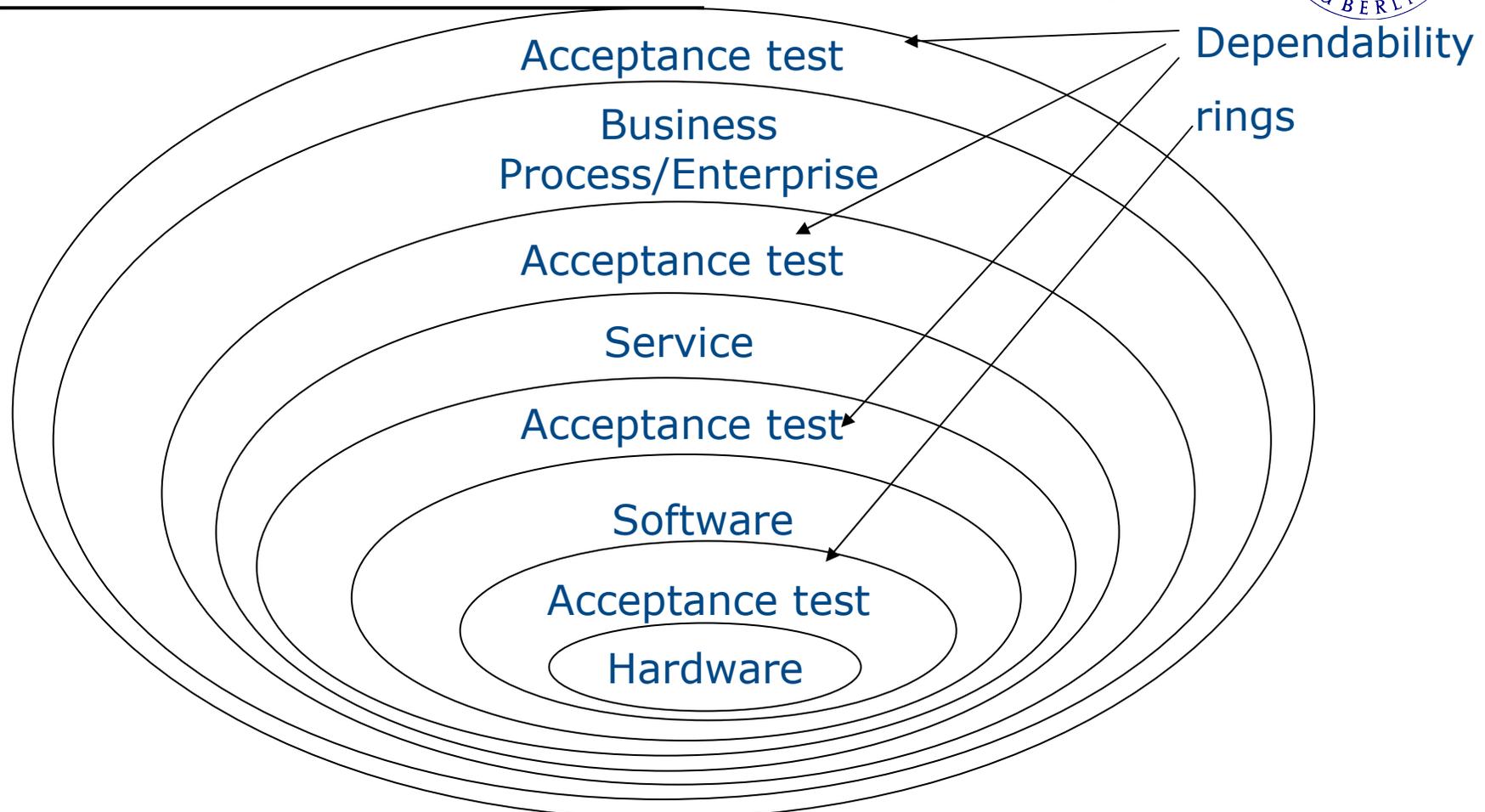
The Challenge of Taming



- Complexity
- Uncertainty
- Time



Translucency of Dependability Rings



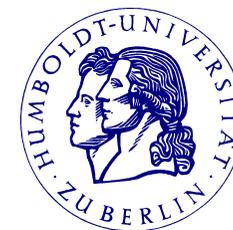
Each dependability ring should provide measures and mechanisms for dependability/resilience/security (measurement, monitoring, detection, location, prediction, avoidance, testability and recovery)

Proactive Fault Management (1)



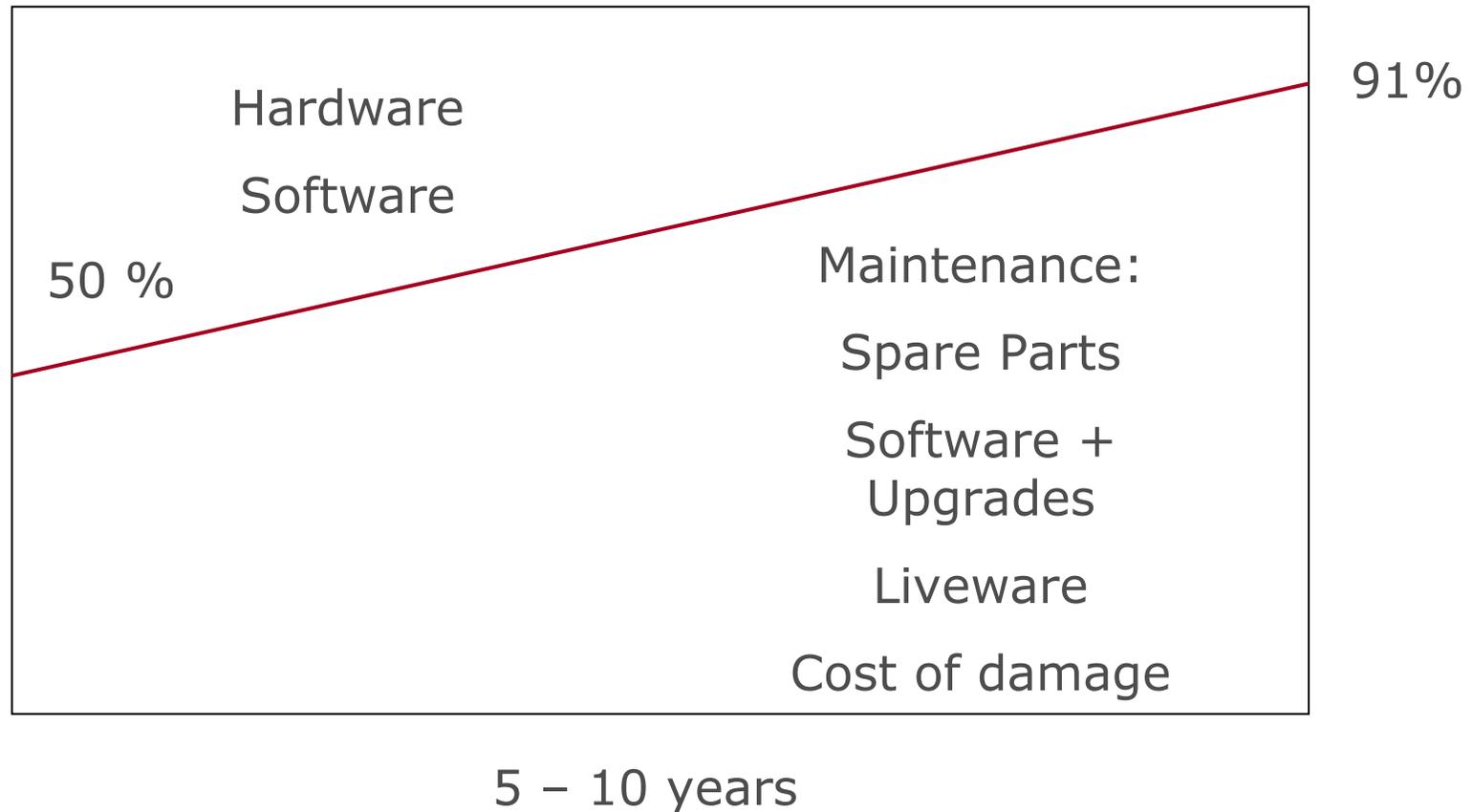
- **Runtime dependability assessment and evaluation**
- **Runtime monitoring** for online failure prediction and avoidance
- **Prediction methods** to anticipate resource exhaustion, security breaches or other critical situations
- **Predictive diagnosis** and fault location as well as root-cause analysis

Proactive Fault Management (2)



- **Downtime minimization techniques** such as prediction-driven restarts, rejuvenation, adaptive checkpointing, or other prediction-driven enhancements of traditional repair methods
- **Downtime avoidance mechanisms** such as preventive failover, state-clean up, proactive reconfiguration, failure-prevention driven load balancing
- **Benchmarking, domain-specific case-studies**, applications, experiments, experience reports
- **Proactive maintenance techniques** such as monitoring-based replacement, configuration and management of computer systems and components

Proactive Maintenance





Summary

- The permanent challenge
- Empirical modeling
- Taming (complexity, uncertainty and time)
- Translucency
- Proactive fault management