

Component 8 Installation and Maintenance of Health IT Systems

Unit 9a Creating Fault-Tolerant Systems, Backups, and Decommissioning

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What We'll Cover

- What is fault tolerance?
- Why are redundancy and fault tolerance Important?
- Three levels of fault tolerance
- Six rules of fault tolerance in a system
- Getting technical: creating fault tolerance
- Backup strategies

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· Tips on decommissioning data & hardware

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Redundancy and Fault Tolerance

- Dependence on EHRs is increasing exponentially.
- EHR systems require redundant, or "failover", resources and fault tolerance to ensure uptime and data integrity.
- "Failure" vs "fault": fault is the cause of a failure of the system to comply with its specifications / precise requirements.
- Ask vendor how fault tolerance is designed/coded into the EHR application.

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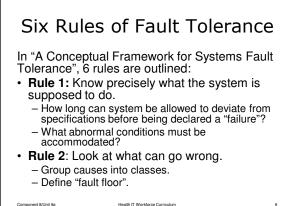
Redundancy and Fault Tolerance (cont'd)

- Forrester Consulting report (2010) on server failure during prior two years:
 - ³/₄ experienced downtime.
 - Only 1% of server outages were resolved within five minutes.
 - 68% had impact on clinical activities.
 - 50+% affected administrative processes.

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Six Rules of Fault Tolerance (cont'd)

- Rule 3: Study your application & determine appropriate fault containment regions & earliest feasible time to deal with potential faults.
 - Fault tolerance generally means more resources (time & space)
- Rule 4: Completely understand application requirements & use them to make appropriate time/space trade-offs.
 - Consider costs, & classify faults by likelihood. Health IT Workforce Curriculum Version 2.0 Spring 2011

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Six Rules of Fault Tolerance (cont'd)

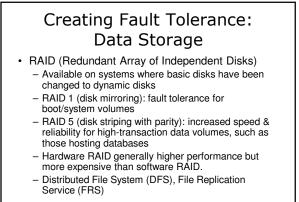
- Rule 5: Concentrate on credible faults first.
 - Ignore less likely faults unless they require little additional cost. Mitigate the most likely faults first.
- Rule 6: Determine application failure margins.
 - Balance the degree of fault tolerance needed with the cost of implementation.

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Creating Fault Tolerance: Hardware

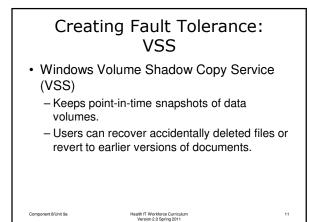
- · Features: hot-add memory, hot-swappable hard drives, hot-plug PCI-X slots (add/remove PCI expansion cards), redundant power supplies & cooling fans
- Choose fault-tolerant servers over clustered servers (less reliable & more difficult to maintain).
- Measure ROI (return on investment) against costs of downtime: safety, lost productivity, financial, litigation, disruption.
- Mirror critical systems & disperse throughout the network. Consider hot spare servers.

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Creating Fault Tolerance: Virtualization

- Server virtualization: multiple virtual operating systems run on single physical machine yet remain logically distinct.
- Advantages: single environment & license; protection; redundancy (no single point of failure); flexible in storage type; basic system management skills needed; supports applications without modification; simple; less expensive
- Consider combining with duplicate hardware hosting.
- Limitations: some programs don't run well in virtual environment, e.g. frequent memory access.

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Creating Fault Tolerance: System-Wide

- Distributed architecture: maintains access to application despite network interruption.
- Uninterruptible Power Supply (UPS) & backup power in key areas, e.g. server rooms, wiring closets
- Redundancy & fault tolerance in network infrastructure switches, routers, & WAN links: provides secondary network connections between sites.

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Creating Fault Tolerance: System-Wide (cont'd)

- Windows networks: consider Network Load Balancing (NLB).
 - Scales application to run on up to 32 separate servers, increases availability.
 - Provides fault tolerance through failover support for applications and services running on IP networks.

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Summary

- A *failure* is defined as deviating from compliance with the system *specification*. When delivering a service to the user
- A *fault* is the adjudged cause of a failure.
- Systems that have fault tolerance/ redundancy built into their hardware and/ or software to minimize downtime, even during a failure.

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