



# RAS and Five Nines

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# RAS

- RAS acronym for Reliability, Availability and Serviceability
- Reliability: the probability that the product or service operates as expected when needed
- Availability: the probability that the product or service will operate when needed
- Serviceability: the ability to service a product or support a service and make them available when needed



## RAS cont.

- Reliability is measured by Mean Time Between Failure: MTBF
- Serviceability is a measure of Mean Time To Repair: MTTR
- Availability is measured by the ratio:  $MTBF/(MTBF+MTTR)$
- High Reliability, Availability and Serviceability are absolute requirements for survival in today's e-business economy



# Five Nines

- Five Nines is defined as 99.999% product or service availability
- This means the  $MTBF = 10^5 \bullet MTTR$
- 2 hour MTTR requires the product or service MTBF to be 200,000 hours or better to achieve 99.999% availability
- A common goal in mission critical applications today is to achieve 99.999% availability or less than 5.3 minutes of downtime per year

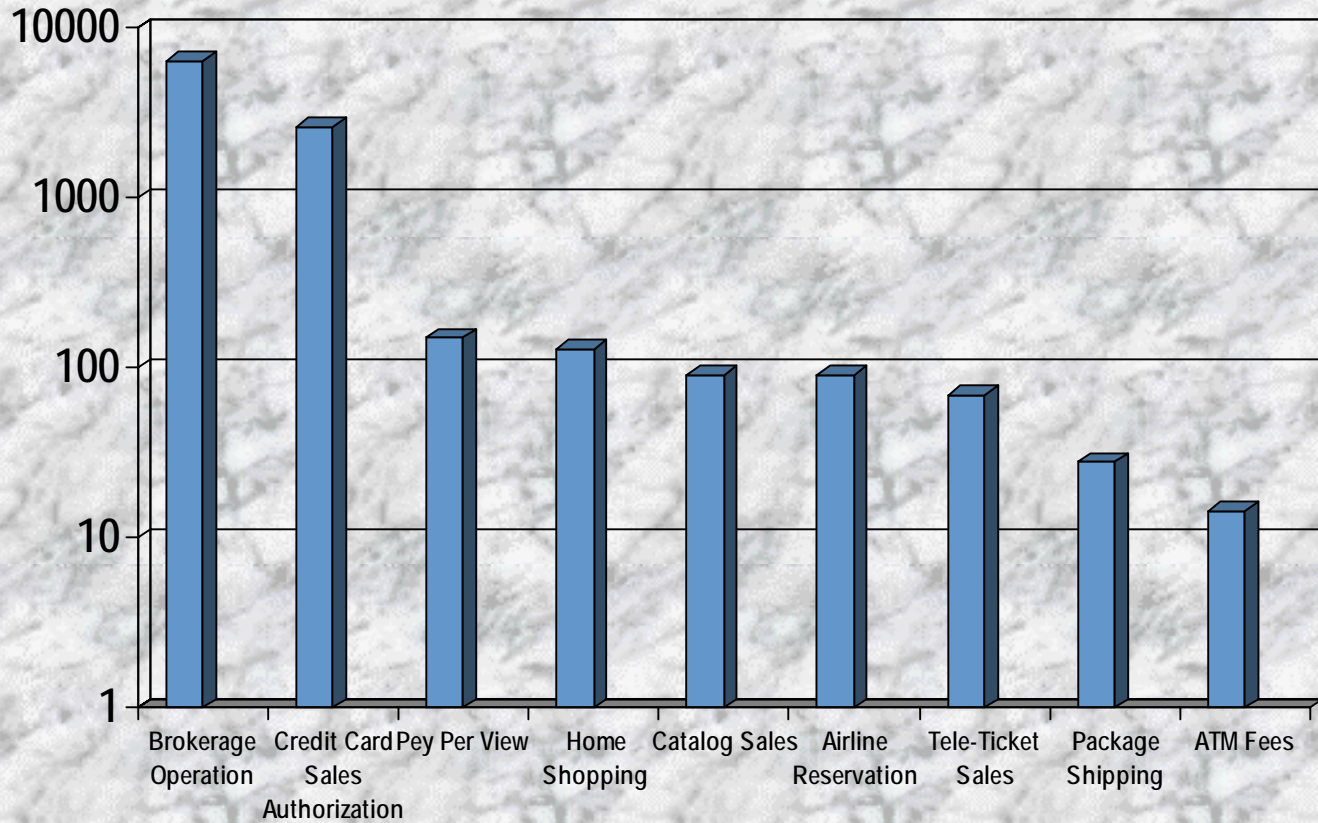


# Cost of Product/Service Unavailability

Hourly Cost of Downtime by Industry	
Industry	Hourly Cost
Brokerage Operation	\$6,450,000
Credit Card Sales Authorization	\$2,600,000
Pay Per View	\$ 150,000
Home Shopping	\$ 113,000
Catalog Sales	\$ 90,000
Airline Reservation	\$ 90,000
Tele-Ticket Sales	\$ 69,000
Packaged Shipping	\$ 28,000
ATM Fees	\$ 14,500



# Cost of Product/Service Unavailability





# Five Nines, What Does It Take?

- Five Nines requires implementation of a RAS program through planning, design, implementation and operation that yields high MTBF, low MTTR and minimizes operational errors
- High MTBF is achieved through
  - Formal methodology for the product development process
  - Design quality into the product
  - Project management and cross-functional teams
  - Customer involvement, clearly defined requirements
  - Tools for simulation, version control and testing



# Five Nines, What Does It Take? cont.

- Low MTTR is achieved through
  - Product designed for supportability
  - Superior support processes
  - Intelligent integration of support tools to optimize the support processes
  - Clear and complete documentation
  - First class training programs





# The RAS Program

- A meaningful RAS program must consider
  - Hardware availability
  - Software availability
  - Power/Environmental reliability
  - System test and validation
  - Overall system availability
  - User interactions
  - Product support and support processes



# Hardware Availability

- Hardware will fail
- Calculate hardware MTBF using industry standards such as MIL-HDBK-217F
- Increase MTBF through good design principles and careful component selection
- No single points of failure and easy to replace hot swappable components to lower MTTR



# Software Availability

- No industry standard for measuring software reliability
- Remove faults in the design process by code inspection, design reviews and module testing
- Include system self monitoring, reporting and execution tracing.
- Include inline code updates to minimize MTTR



# Power/Environment Reliability

- Affects the overall reliability of product/services
- Some averages
  - Average outages per year is 15
  - 90% of outages less than five minutes
  - 99% of outages less than 1 hour
  - Total cumulative outage duration per year is approximately 100 minutes
- Include redundant power in the product that can be connected to independent power sources



# System Test and Validation

- Requirement validation
- Stress testing
- Operational testing simulating multiple operational environments
- Abnormal sequence testing
- Fault injection testing



# Overall System Availability

- Redundancy substantially increases *MTBF*

$$MTBF_R \approx \frac{MTBF_S^2}{2 \bullet MTTR} \quad MTBF_S \gg MTTR$$

- System availability is the product of the availability of the individual components
- Software monitors all components for operational integrity and switches to operational components when failures are detected.
- Hot swappable hardware and inline software updates with low restart times
- Dual power with independent connections and UPS



# User Interaction

- Identify user errors that may impact availability
  - Gartner estimates that 40% of all product and service unavailability is due to user error and poor support and support processes
    - Analyze operational scenarios, expertise, staffing, support and support processes for gaps
- Some initiatives to minimize errors
  - Operator training
  - Easy to operate user interfaces
  - Provide clear and complete documentation
  - Develop online knowledge base for access by users



# Product Support and Support Processes

- Identify support processes, design, implement and document with clearly specified responsibilities
- The processes must cover areas such as
  - Customer relationship services
  - Technical support services
  - Configuration management
  - Root cause failure analysis and database
  - Logistics
- Integrate tools to optimize support processes and capture customer feedback





# In Summary

- Product availability approaching Five Nines can be achieved by:
  - A comprehensive RAS program
  - A commitment and participation from all groups of the organization throughout all phases of the product life cycle
    - Planning
    - Design
    - Introduction
    - Operation
    - Decommission
  - Total quality orientation to customers and suppliers



# In Summary

- TFS can help you
  - Assess the state of your RAS program
  - Plan your RAS program
  - Implement your RAS program
  - Execute your RAS program