



Availability Analysis of CTBTO's Network of Systems

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Reliability and Failure Analysis Lab

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Overview

- ▶ Availability Analysis of CTBTO's network of sensors that detect seismic activity.
 - Multiple Technologies
 - Auxiliary Seismic
 - Primary Seismic
 - Infrasound
 - Radionuclide
 - Hydroacoustic
 - Geographically Dispersed network
 - Specific Operational Requirement



Why Should this be done?

- ▶ Ensure that you meet specifications
- ▶ Shows potential and current capability
- ▶ Minimize Operational and Support Costs
- ▶ Modeled Design Alternatives

Global View

- ▶ Systems are all around the globe
- ▶ Geographical locations
 - World Wide
 - United States





Issues

- ▶ Geographically Dispersed
- ▶ Different Station Operators
- ▶ Different Technology Managers
- ▶ Different Equipment

Process

- ▶ Understand the purpose of the system.
 - What is the purpose of the systems?
 - Big Picture Overview
 - How does it work?
 - Breakdown into subsystems
 - What is the process?
 - Different steps/processes in each subsystem.

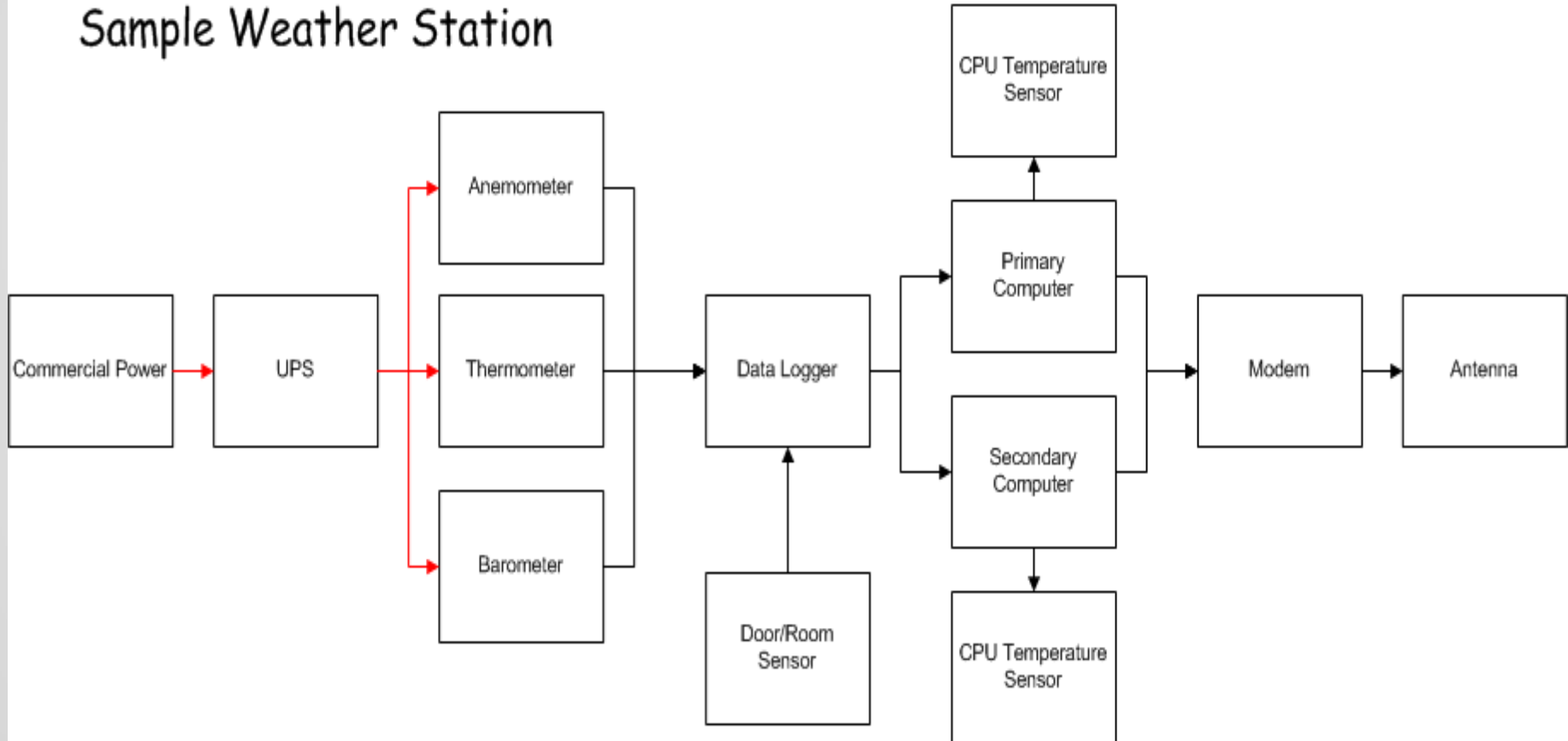


Schematic

- ▶ Obtain/Develop a schematic diagram for each system.
 - Visual tool
 - Aids in understanding the system
 - Develops a part list

Schematic Diagram

Sample Weather Station



MTBF

Mean Time Between Failure

- ▶ MTBM – Mean Time Between Maintenance
- ▶ MTBDE – Mean Time Between Downing Event
- ▶ Historical Data
- ▶ Manufacturer Data

MTTR

Mean Time To Replace/Repair/Restore

- ▶ Physically Replace the LRU
 - Restore – Recharge a UPS/Battery Pack
 - Repair – Reset a Modem
 - Replace – Put a new part in
- ▶ Troubleshooting Time
 - Fault Detection
 - Fault Isolation



ALDT



Administrative and Logistics Downtime

- ▶ Shipping Time
- ▶ Traveling to a remote location
- ▶ Administrative Tasks
- ▶ Going through Customs
- ▶ Repair personal to site
- ▶ Other Factors



Spares

- ▶ On Site or at a Depot.
- ▶ Shipping from Depot.
- ▶ Ordering Part.
- ▶ Restock Spares.
- ▶ New Model.
 - Different Properties
 - MTTR
 - MTBF



Critical Items

- ▶ If this part failed what happens?
 - Degraded Mode
 - System Failure
 - Nothing
- ▶ Aids in developing the RBD

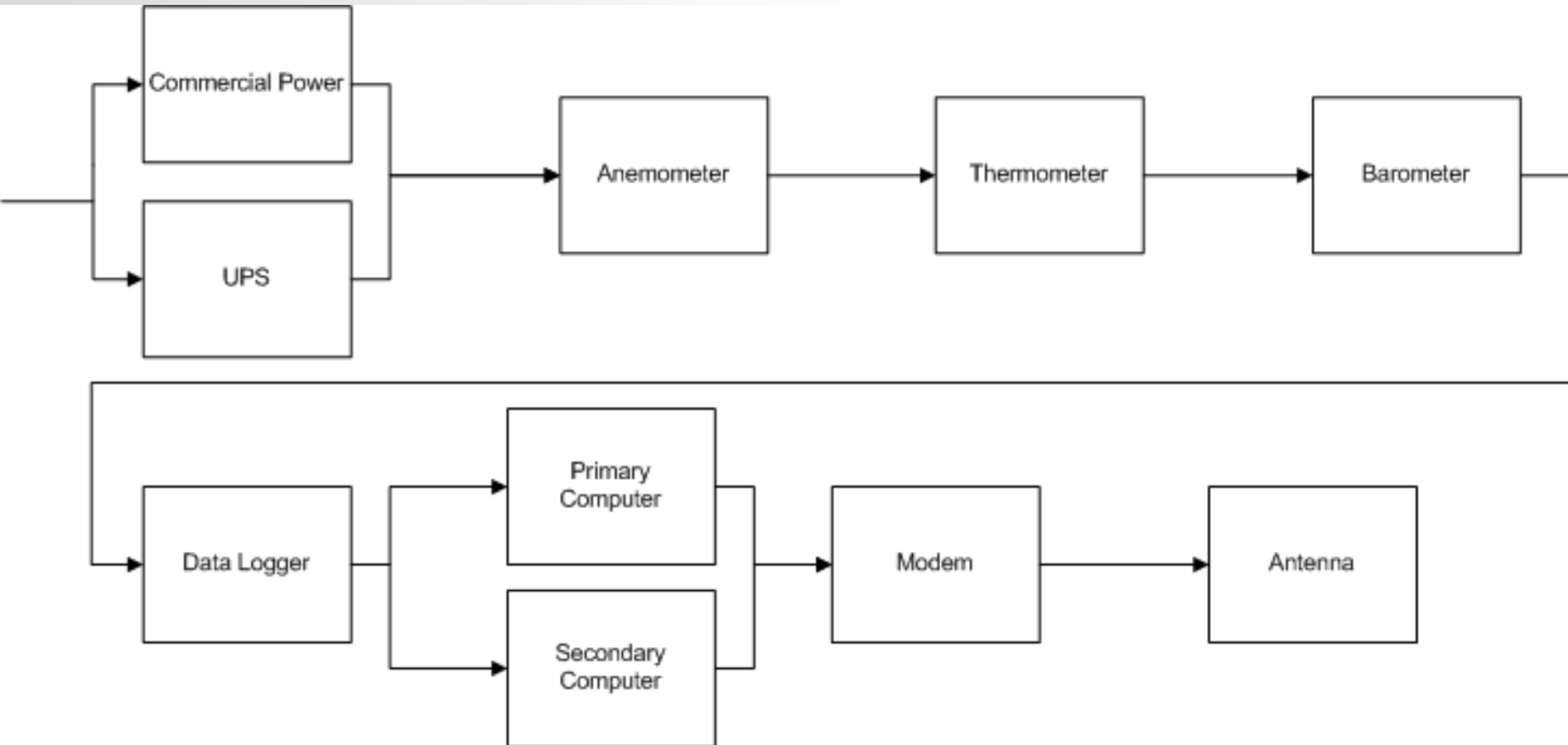


Reliability Block Diagram



- ▶ Visual representation of Critical Items List.
- ▶ Shows single points of failures.
- ▶ Shows Redundancies
- ▶ Easier to recognize problem areas

Weather Station: Sample Reliability Block Diagram





Analysis

- ▶ Excel
- ▶ Mathcad
- ▶ Minitab
- ▶ Relx Software
 - An Aid in our Analysis



Analysis

- ▶ Use our tools and expertise to obtain
 - Inherent Availability – A_i
 - Maximum possible Availability
 - Operational Availability – A_o
 - Current Availability
 - Includes Logistics
 - Number of Failures for system/part



Benefits

- ▶ Optimized Sparing Strategies
- ▶ Evaluate Design Modifications
- ▶ Opportunities for Research and Development
- ▶ Shows if you can meet specifications
- ▶ Potential and current capability
- ▶ Minimize Operational and Support Costs
- ▶ Modeled Design Alternatives

Conclusion

- ▶ The goal is to determine the overall availability for CTBTO's network of systems.
 - Schematic
 - Parts List
 - MTTR, MTBF, Logistics, Critical Items
 - RBD
 - Given Criteria/Specification from Customer
 - Overall A_i and A_o



Future

- ▶ This process can be used on different types of systems
 - Weather Stations
 - Power Plants
 - Nuclear Plants
 - Airplanes
 - Wind Turbine
 - Solar Energy



Questions?

