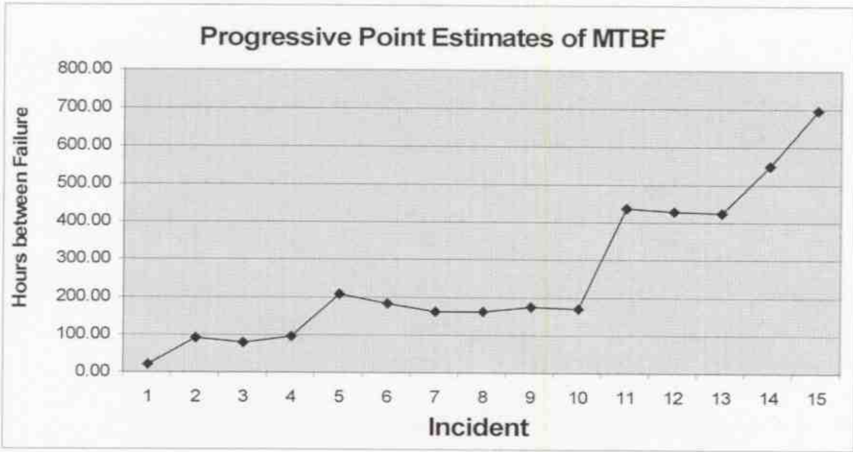


Figure 4-1. Progressive Point Estimates of MTBF

Based on the fact that the MTBF (or the failure rate) of the various subsystems has not reached a steady state, the frequency of the outages will generally be reduced even without major upgrades to the system. However, this statement is not true when assessing the system's MTTR trends. For the short run, the most urgent need is to improve the maintainability, such as having an adequate and better-trained support staff. A required strategy is to amend all identified weak points in the system and infrastructure, particularly, the single points of failure identified in Section 3. This will improve the overall system availability by:

- Reducing the vulnerability to system-wide failure and consequently increase the uptime.
- Providing automatic switchover to the backup and thus effectively reduce the downtime.

The HEC incident report shows that 6 out of 15 system failures since the system went live involved human or procedural errors, and they account for 78% (32.08 hours / 35.73 hours) of the total unexpected outage downtime. The outage history indicates that, not only did the maintenance staff from Northrop Grumman and HP make mistakes; they also seemed to complicate the problems further resulting in a very slow recovery of the system. Some problems leading to human errors may have been intrinsically difficult. Nevertheless, improvements in the skill level of the maintenance staff may help to increase the MTTR and, thus, improve the availability of the system.

4.3 Workload and Performance Assessment

The MITRE team observed the operations of the CAD system during several on-site visits and interviewed management staff, call takers, and call dispatchers to discuss system performance. During these discussions, concerns were raised about the performance of the system during busy time periods and when upgrades were made to the system. In order to attempt to determine whether the workload of the system impacted system and performance, call volume statistics and data were gathered. This data identified call volume statistics handled by the various departments for the period of January 2004 to December 2004. A secondary analysis was to try to determine if the demand level pointed out a probable cause for some of the system outages that occurred at HEC.

System performance can be affected by the amount of demand using the system. There are three major types of demands that require system resources and may contribute to component wear out and cause degradation in system performance. These three types are:

(1) 911 (including 10-digit calls) call volume statistics.

(2) Call takers and dispatchers use of the CAD systems.

(3) Police and Fire/EMS units and stations that have to respond to the dispatching assignments and make information queries.

Among those three types of demands, only the call volume statistics has data available for each hour during the assessment period. A more useful demand data will be the staffing level records (how many call takers and dispatchers are connecting to the system at each hour), which corresponds to the second type of demands. A series of charts of call volume data are presented in Appendix D. As an example, Figure 4-2 shows the chart for November 2003 (prior to the acceptance). The purpose of the analysis is to determine whether there is any correlation between call volume and outage occurrences. Each chart covers a one month interval within the assessment period. The call volume value includes all calls for Fire, EMS, and Police events. Each data point is the call volume for the corresponding hour. Each triangle on the chart indicates the start time of one of the seventeen outages since the system went live.

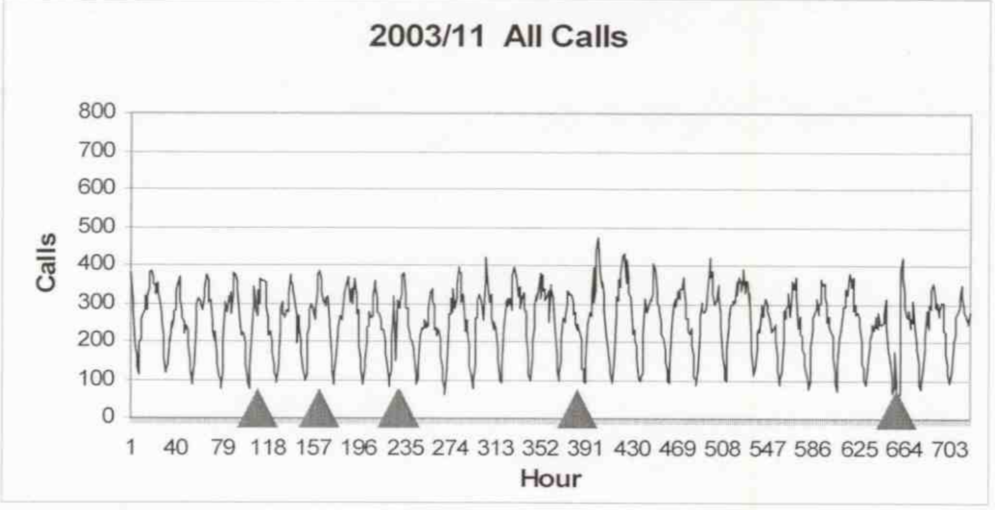


Figure 4-2. Call Volume Statistics and Outages

The analysis of the data from the charts concludes that none of the outages correlate with a spike or surge of the total 911 call volume. Using separated department-wise[7] call volume data, there is still no evidence of correlation between system outages and the volume of either Police calls or Fire/EMS calls. Although a careful analyst may sometimes look further into the fluctuation and variation of the raw data to extract hidden patterns, observations obtained from the plain call volume data deemed further analyses unnecessary. MITRE concludes that the call volume data by itself, does not show impact on the outages.

The MITRE team attempted to gather performance statistical data at various levels to make a clear determination or root cause analysis of system performance.

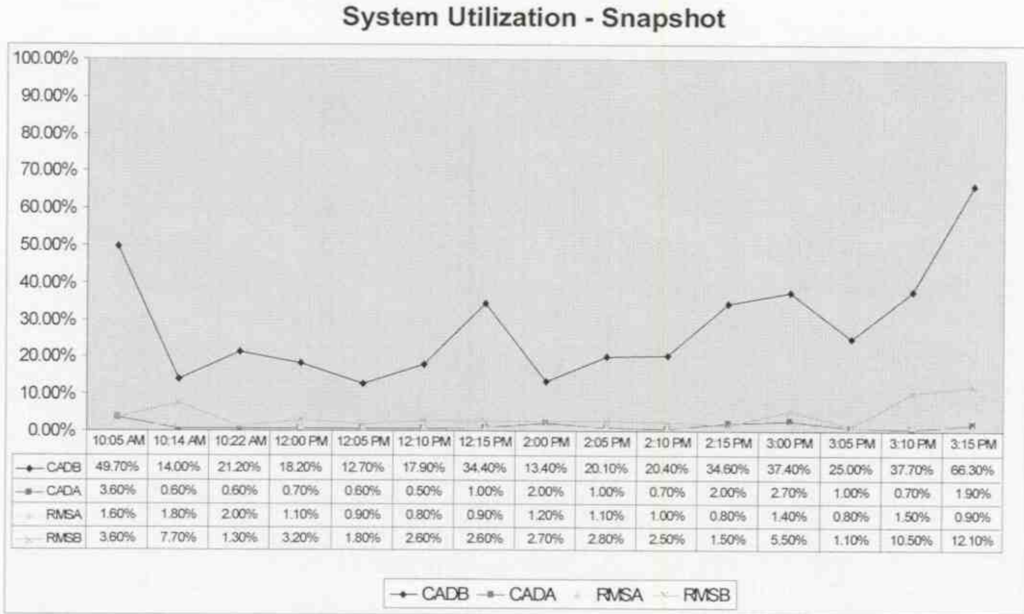
Figure 4-3 identifies our approach to the end-to-end performance analysis effort. By taking this approach, the team planned to gather performance data at each layer of the subsystems, and then correlate the data to make an accurate assessment of potential system performance issues.

The HP Systems Insight Manager was not adequate for the performance analysis because it was not completely configured. The team was able to use UNIX level command scripts to gather performance data on the CAD and RMS servers in order to conduct a performance analysis for these two subsystems. Figure 4-4 summarizes CPU utilization for a specific snapshot period.

[7]Individual charts for Police calls and Fire/EMS calls are not included in this report, but they have been inspected and led to the same conclusion.

Performance Analysis Scope	Performance Analysis Toolkit	Results
Application Layer (CAD, RMS)	• Transaction Response Tool	Tool turned off; Monthly data from Altaris Command Stats
Database Layer	• Oracle Enterprise Manager	Tool not available; Data from DB Data Status Reports
Hardware / Operating System Layer	• Unix Perf; Tools • HP System Insight Manager	New intall of Insight Mgr; Used Unix tools to snapshot perf.
Network Management Layer	• OPNET NetDoctor	Perf. Data captured and analyzed
Telecom Infrastructure	• Network Sniffer	Perf. Data captured and analyzed

Figure 4-3. Performance Analysis Layers



	10:05 AM	10:14 AM	10:22 AM	12:00 PM	12:05 PM	12:10 PM	12:15 PM	2:00 PM	2:05 PM	2:10 PM	2:15 PM	3:00 PM	3:05 PM	3:10 PM	3:15 PM
CADB	49.70%	14.00%	21.20%	18.20%	12.70%	17.90%	34.40%	13.40%	20.10%	20.40%	34.60%	37.40%	25.00%	37.70%	66.30%
CADA	3.60%	0.60%	0.60%	0.70%	0.60%	0.50%	1.00%	2.00%	1.00%	0.70%	2.00%	2.70%	1.00%	0.70%	1.90%
RMSA	1.60%	1.80%	2.00%	1.10%	0.90%	0.80%	0.90%	1.20%	1.10%	1.00%	0.80%	1.40%	0.80%	1.50%	0.90%
RMSB	3.60%	7.70%	1.30%	3.20%	1.80%	2.60%	2.60%	2.70%	2.80%	2.50%	1.50%	5.50%	1.10%	10.50%	12.10%

Figure 4-4. System Utilization – Snapshot

As evidenced in the above Figure, for this specific snapshot, the CADB systems' (primary production environment) CPU utilization increased to over 48% in the early morning (approximately 10:00 am), returned to an average range between 13%-34% for the mid-day period, then increased to over 66% utilization towards the latter part of the day (approximately 3:15 pm). Unfortunately, because no other performance data is available for either the Application Layer or the Database Layer during this period, we are unable to perform any root cause of the increases in the CPU utilization.

Northrop Grumman provided summarized data corresponding to the command response time statistics in task category "Check response time of CAD commands," see Section 4.6. For each of the 464 commands, the data shows the total number of invocations in each month and the number of elapsed seconds averaged over each month. Many commands were not used in every month. About 80% of commands were infrequently used. (Less than 7200 invocations per month. If there were averagely 10 CAD users per hour, this would imply that such a command was used averagely less than 1 time per user.) Table 4-9 compares the January 2005 measurement results with the CAD response time requirements for the acceptance test defined in Attachment 27 Section J (Acceptance Test Plan for Altaris CAD Implementation). Northrop Grumman provided measurement results for 18 out of 27 command types. For each of these 18 command types, the response time averaged over the entire month compared very well with the corresponding threshold value. However, the two sets of numbers do not represent the same time scale. The requirements defined for the acceptance testing were meant for evaluating a peak load hour of at least 433 events (Page B-6 of Test Plan), while the Jan 2005 results were averaged out over the entire month of January 2005 and did not correspond to a particular hour with peak load condition. The comparison results are shown here only for indicating that, on a monthly average basis, the CAD response time average performance fared very well in January 2005.

MITRE recommends the entire performance analysis toolkit referenced above be activated and an extended performance data capturing period be established in order for the appropriate level of performance data correlation and root cause analysis be conducted.

The process for the creation, delivery, verification of the Geofile has a major impact on the performance of the public safety system. During interviews with HEC, Northrop Grumman, call takers and dispatchers, the Geofile accuracy was a major discussion item. The team was unable to determine if the concerns were technical or training issues. For example, it was noted during the interviews with call taker and dispatcher personnel that location information sometimes has to be keyed in different ways before the system recognized the street address and provided the proper system and agency recommendation. These concerns were also discussed with the Graphical Information System (GEO) Team lead. Based on the discussions, the MITRE team believes that these issues could be caused by a number of reasons, many of which cannot be solved through technology solutions. Many of the issues require improvements in processes and communications to be assessed. The process improvements include the use of written documentation to record and forward the problems to the Graphical Information System Team. Next, the recommendations in Section 5 for improved processes should also help to identify and resolve these issues.

4.4 Scope of Services and Performance

MITRE analyzed the performance of the system to determine where performance may not meet requirements in the Northrop Grumman scope of services. Three areas of noncompliance and possible noncompliance with the scope of services were identified.

First, the CAD and RMS did not meet the required monthly 99.9% availability. The Scope of Service requirement number 14.1.2 requires Northrop Grumman to maintain the required system availability of 99.9% for the CAD upgrade and RMS systems. The requirement states that the City shall record the system downtime on a monthly basis. If the system availability is not met, Northrop Grumman is required to submit a report that documents the event and to detail a plan of action to prevent a recurrence in the future. As identified in Section 4.2, the CAD system has not met the monthly requirements of 99.9% availability.

Second, the system performance and monitoring is not being provided. The Scope of Service requirement number 3.3.17 requests CAD reporting statistics, including transaction response times, be provided for any time/data range required. Northrop Grumman has several tools that are

Table 4-9. Measurement Results

Command Type		Response Time Requirement	Jan 2005 Result (monthly average seconds)
Call-Taker Commands			
Event Entry Form Call-up		1-second or less	-
Location Verification		1-second or less	.26
Access Geo Location Information		1-second or less	.07
Access Location Information		1-second or less	.30
Access Location History		1-second or less	.08
Add Event		3-seconds or less	.35
Dispatch Commands			
Display Event		1-second or less	.25
Unit Suggestion – by Geographic District		2-seconds or less	.26
Dispatch Single Unit		1-second or less	.22
Assist – Single Unit		1-second or less	.63
On-Scene – Single Unit		1-second or less	.20
Change Location – Single Unit		1-second or less	.11
Change Unit Status		1-second or less	.20
Clear Unit and Close Event		3-seconds or less	.15
Mapping Commands			
Center on Location		4-seconds or less	-
Center on Unit		4-seconds or less	-
Pan Left – Predefined Increment		4-seconds or less	-
Pan Right – Predefined Increment		4-seconds or less	-
Zoom-In – Predefined Increment		4-seconds or less	-
Zoom-Out – Predefined Increment		4-seconds or less	-
CAD Inquires – Local Database			
Event History – Single Event Number		2-seconds or less	.12
Unit History – Single Unit		2-seconds or less	.26
Unit Summary – Single Area		3-seconds or less	-
Recent Event History – Last 20 Events		2-seconds or less	.24
Event Query – by Key Field		2-seconds or less	-
Administrative Messages			
Send Message		2-seconds or less	.11
Retrieve Message		2-seconds or less	.17

gathering and collecting this data. However, this information has either not been properly requested or is not being properly provided to the HEC.

Third, the team was unable to determine whether the transaction performance requirements applied to the operational system and whether they were being met. The Scope of Service requirement number 15.10.3 identified requirements for the response time for a list of user command types. This section applies to the acceptance test period and the team could not determine if the requirements were applied after system acceptance. Northrop Grumman performed and successfully passed a modified version of these requirements in[8] the Response Time/Load Test in a simulated environment before the acceptance testing in a live operation environment. Since the system acceptance, there has not been any systematic reporting of such statistics, even though users have expressed concerns about perceived slow response times on occasions.

4.5 Reliability

4.5.1 End of Life

Figure 4-5 shows equipment that is near the end of its life that should be replaced. The systems that are close to or past end of life means that the systems are or will become obsolete within a year.

This figure incorporates all of the major public safety data and radio systems. While the majority of the assessment of data in this section focuses on the HEC systems, this chart emphasizes the importance of evaluating performance parameters for the whole system.

These systems can still function and meet existing operational requirements but will become difficult to maintain. Therefore, key critical components may be reaching their end of life (EOL) which increases the risk to the resiliency and reliability of the overall public safety system.

In addition to concerns with certain systems approaching their end of life, the analysis also showed that two major components used by these systems are becoming obsolete, Oracle database and network equipment.

As of December 31, 2004, Oracle discontinued its support of Oracle 8i products. Users can still get support for Oracle 8i products by signing a contract with Oracle. However, such contracts do not include any potential patches that may be needed to resolve software problems that are found. Currently, most of the user community is using Oracle 9i, with a few users moving to Oracle 10g, because of some functionality that they may need that is not

---

[8] In the PRC Response to the City of Houston Revised Scope of Services for Houston Public Safety Dispatch Consolidation, PRC identified the Acceptance Test Plan, Attachment 27, Section J as the list of the response values that would be the basis for test. Pages B-6 to B-8 of the document titled: Acceptance Test Plan for Altaris® CAD Implementation, August 2001, identify the actual operations and the corresponding test values.

found in Oracle 9i. Oracle 9i is quite stable at this time, and therefore it would be a good option to migrate to that version.

[redacted]

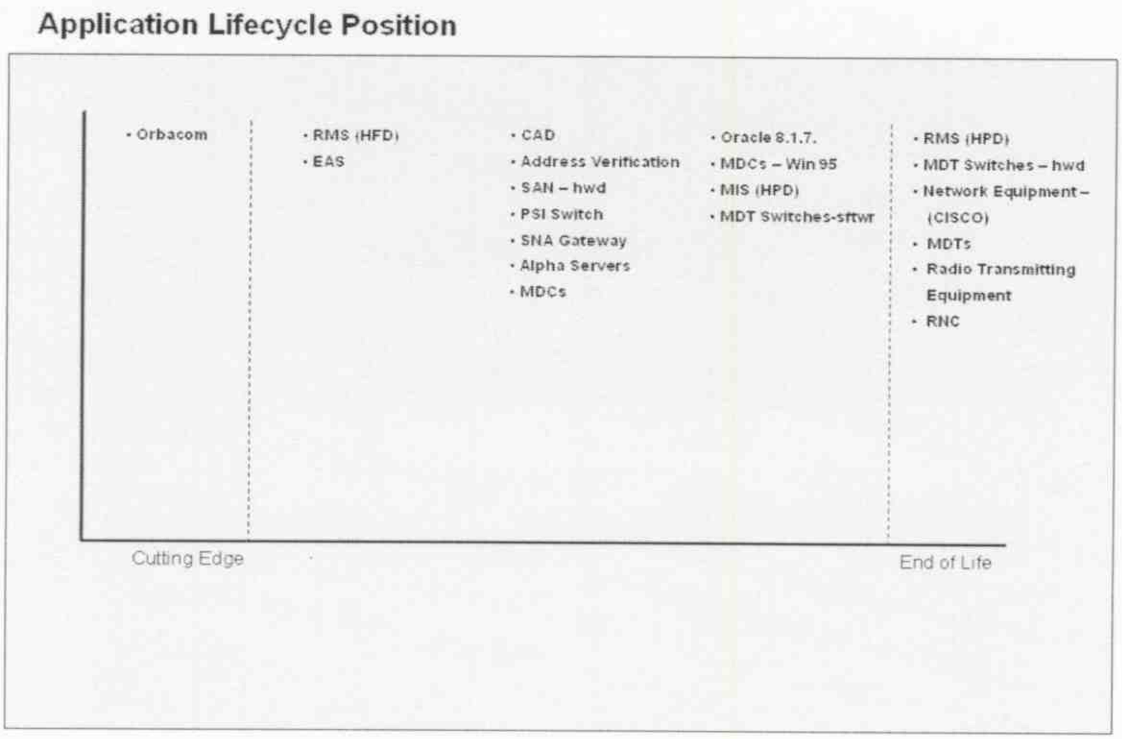


Figure 4-5. Public Safety System Life-Cycle

[redacted]

[redacted]

4.5.2 Network Configuration Analysis

MITRE conducted an analysis of the network router configuration to determine potential problems in the configuration of the network. OPNET's NetDoctor (Version 11.0) tool was used to examine the suite of routers and switches used at the HEC. The results of this analysis are provided in the report titled "Net Doctor Report", February 4, 2005. The network topology is shown in Figure 4-6. The nodes in the figure represent workstations and servers that are attached to the network devices and are used to establish traffic demand for routing analysis. While real traffic data was collected, that data was not used for this simulation since the primary goal of this