

While the CAD system is the core system used by the call takers and dispatchers, there are many other systems (applications) required to be available and functioning in an optimal manner in order to efficiently and effectively enable communications between the call takers, dispatchers, and HPD/HFD response personnel when responding to 911 emergency incidents.

Other key components comprising the City of Houston's public safety system are shown in Table 3-2:

Table 3-2. [REDACTED]

[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

The above list highlights those device components also required to be operational in order for all data to be successfully transmitted to and from the CAD system. In the event that any one of the above device components is not properly functioning, back-up procedures are activated in order for HPD/HFD emergency response personnel to continue responding to 911 emergency incidents.

[REDACTED] Table 3-3:

Table 3-3. [REDACTED]

[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

The Tables depict the various groups involved in the end-to-end delivery of the HEC IT portfolio. Figure 3-1 illustrates the complexity of the operations and support for the public safety system. Root cause analysis of a perceived system problem may require multiple organizations to become involved in order to validate and verify that their particular scope of supported component is not the root cause of the problem or issue being experienced. Finally, outages to the system may be prolonged due to differences in service levels from the various groups identified below. While some groups and organizations provide 7x24 support for their components, other groups are only responsible for delivering support during regular business hours Monday through Friday.

As is the case with the device components and subsystems, public safety system performance may become degraded or unavailable to all or portions of the public safety system users when any of the above systems are not properly functioning. While back-up/contingency processes and procedures are instantly activated in order to eliminate disruptions to 911 emergency operations, unavailability of any of these components may have a performance impact to the CAD system.

The architecture was evaluated for possible single points of failure. This analysis primarily focused on the CAD, RMS, MSS, SAN, and network and did not address the possible failure of the radio, EAS, or PBX systems. For purposes of this assessment, single point failure analysis explored the impact of the majority of users being denied access to computer resources necessary to carrying out their mission. Based on the design of the HEC infrastructure, key systems such as CAD and RMS have been redundantly maintained

[REDACTED] In addition, alternative systems to support voice via radio interface can function without the need for CAD or RMS and still permit the dispatch of resources (while somewhat less efficient than if CAD were available). Therefore, if CAD were to shut down, the ability to use Orbacom in conjunction with the call taking front end still permits the emergency dispatch function to occur. The following is a list of potential single points of failure that should be further studied and remedied:

- [REDACTED]
- Data Interfacing to MDT and RMS-HPD system from/to CAD.
- SAN Architecture.
- Integrated Database – Integrating CAD and RMS-Fire.
- [REDACTED]

3.2.1 [REDACTED]

[REDACTED]

3.2.2 RMS-HPD System From/To CAD

The next single point of failure addresses loss of services within 61 Riesner even when network services are available. While the CAD at HEC has a redundant design for both Fire/EMS and HPD, HEC only supports a redundantly configured RMS for Fire/EMS. A corresponding RMS-HPD exists at 61 Riesner that is not redundantly configured – implying a server failure (RMS-HPD) will result in down time with no failover option (as exists for the RMS-Fire/EMS at HEC).

The team was concerned that a past CAD outage resulted in problems at RMS-HPD [REDACTED] causing CAD to “hang” due to large queue backlogs that were unanswered. This problem has been resolved through upgrades to memory and processor functions.

3.2.3 Storage Area Network Architecture

The primary disk storage supporting the [REDACTED] was designed to support a high degree of redundancy from a RAID design as well as provide mirror imaging to another system (connected via a SAN) that could be used for recovery in the event of catastrophic failure of the primary RAID system. However, the implementation of the storage environment does not provide for real-time dynamic failover (it was neither specified in any requirements nor tested during acceptance). The intent of the components that are used in the design is primarily for disaster recovery.

[REDACTED]

In the event the primary RAID fails, the secondary system (which is basically a mirror image of the primary) is “resurrected” and becomes the primary system (until manually switched back to the backup role). This resurrection process is manual and can take many minutes depending on the disk configuration.

[REDACTED]

Network storage systems do exist that can provide real time dynamic failover but the current implementation does not provide that level of support.

3.2.4 Integrated Database – Integrating CAD and RMS-Fire

The database failover capability is primarily oriented at ensuring that when the primary system fails the system fails over to the backup system. This capability supports redundancy but does not adequately address other critical areas that need to be planned for to prevent database failures from causing outages. As noted in the review of the outages, one or more of the longer outages related to human error associated with the CAD/RMS databases. While disk mirroring can protect against catastrophic equipment failure, human error that erases the database is instantly “mirrored” to the backup disks. At that point, reconstruction of some type will be necessary to have an operational system. The best protection against this type of failure is to prevent it through better process management (configuration control practices). Other database improved performance measures can include:

- Database management tools exist that can create checkpoint rollbacks for certain types of transactions.
- Database replication with properly configured delays to remedy human error.

- Other database tools that can analyze the impact of a change prior to that change. Further analysis would need to be conducted to determine the best tools and techniques to mitigate this type of potential failure.

[REDACTED]

The team also noted that the current database version used in the system is Oracle 8. Oracle 8 is not fully supported by Oracle Corporation. Several security vulnerabilities have been identified with Oracle 8 and patches are not being provided to remedy these vulnerabilities. Oracle 9i can improve the reliability, security, maintainability, and performance of the system. For example, Oracle Real Application Cluster (RAC) is provided with Oracle 9i and it has distinct advantages over Oracle Parallel Server (OPS) used by Oracle 8.

RAC, introduced with Oracle 9i, is an advanced version of OPS with many additional self-tuning, management, and data warehousing features.

Oracle 9i introduced many new features to help the database administrator such as the ability to change database configuration "on the fly," enhanced availability, automatic performance and configuration tuning, and enhanced manageability. Given the nature of how past database administrator activities have led to system outages, the additional functionality reduces the risk of making a wrong decision that impacts the overall operations.

3.3 Systems Operations and Support

The public safety operations includes call takers from HEC, and dispatchers from the Houston Fire Department and the Houston Police Department. The primary roles are:

- Neutral 911 Call Taker
- HEC Call Taker (Fire/EMS)
- HFD Dispatcher
- HEC Call Taker (Police)
- HPD Dispatcher
- Supervisor HEC Call takers (Fire/EMS)
- Supervisor HEC Call takers (Police)
- Supervisor HPD Dispatch
- Supervisor HFD Dispatch

Appendix B provides a description of the call takers and dispatchers functions and how they operate the system.

