

Improve communications and technology capabilities

Firefighters and EMS personnel were hindered in their response on September 11 by multiple failures of communications systems and processes and technology limitations. We recommend that the FDNY proceed simultaneously on two tracks to answer these challenges:

- 1) Revamp the management process it uses to evaluate, acquire and deploy communications systems and protocols and technology.
- 2) Immediately address urgent needs in its technology infrastructure, processes and protocols.

1) REVAMP THE COMMUNICATIONS AND TECHNOLOGY MANAGEMENT PROCESS

Currently, the FDNY lacks an effective, well-established process to manage the progress of technology initiatives involving multiple Department bureaus. It also lacks the ability to ensure that these bureaus exchange information effectively. These shortcomings pose perhaps the largest hindrance to the Department's ability to effectively address some long-standing communications and technology problems.

The key to facilitating good working relationships across bureaus and establishing effective management controls is the creation of a cross-functional, standing Technology Steering Committee (TSC) responsible for managing all technology and communications initiatives within the Department. The TSC should also provide to the MAP group, and the Planning Oversight Committee,³³ on a quarterly basis, up-to-date information on the initiatives' progress, impact and major obstacles.

The TSC should be comprised of one senior representative from each of the following bureaus and groups: Fire Operations, EMS Operations, Technology, Communications, and Administration. It should be led by an appointee of the

³³ The TSC will be the working committee for all technology related initiatives within the Department. (See planning recommendations section).

Commissioner and the Chief of Department. In addition, a technology-specific, project management group of three people should be created to support the TSC in managing these multiple initiatives.

The TSC's responsibilities can be broken down into two broad areas:

- ¶ Leading development of a long-term FDNY Technology Plan that includes technology initiatives.
- ¶ Managing the implementation of these initiatives using a standardized process.

1.1) Lead the development of a long-term Technology Plan

The TSC should be responsible for leading development of the Department's forward-looking Technology Plan and ensuring that all specific technology initiatives included in that plan support the operational requirements of the Department. The plan should cover a 5-year period and should be submitted via the MAP Group to the Planning Oversight Committee for incorporation into the Department's overall Plan. Specific steps in developing this plan include:

- ¶ **Assess and document the needs** of the Fire Department – primarily those of Fire and EMS Operations – that would be addressed by technology initiatives. Those defining these needs and initiatives should not feel constrained by what they perceive as technologically possible. They should let the needs drive the solutions. Once this is done, the needs can be compared to current technology capabilities to determine any gaps that must be addressed.
- ¶ **Act as a centralized clearinghouse** for internally generated ideas for technology initiatives, aggregating these ideas and including appropriate ones in the Technology Plan. This should be done by proactively seeking out Department members to get their needs and suggestions.
- ¶ **Define the Department's technology strategy**, which should be aligned with the operational needs and financial constraints of the Department, and prioritize the identified technology initiatives in accordance with that strategy. Document the strategy in the formal 5-year Technology Plan.
- ¶ **Annually develop and describe in detail** those portions of the Technology Plan that should be undertaken in the coming 12 months. Determine the key milestones, deliverables, responsibilities, and budget for that one-year period.

1.2) Manage implementation of initiatives using a standardized process

The TSC will be responsible for coordinating staffing of teams, along with managing and tracking the progress of all technology initiatives in the Department. Bureaus that are involved in evaluation, acquisition and deployment of initiatives will use TSC as a mechanism to help them agree upon their specific responsibilities, milestones, deliverables and resource commitments. TSC will ensure that the responsibilities and commitments of individuals and bureaus are documented for all parties, explained to them and understood by them.

TSC should standardize the process for managing technology initiatives in the Department. This will help ensure the initiatives can be successfully developed, tracked and pushed toward completion in an efficient and thorough manner. We recommend the following process that can be used for any initiative:

- ¶ **Describe needs to be addressed in detail.** The first step in developing an initiative is identifying the specific needs it will address. TSC should ensure that those undertaking a technology initiative perform this task.
- ¶ **Evaluate potential solutions.** Once these details are developed, TSC should work with appropriate bureaus to evaluate potential technology solutions through the issuance of RFIs and RFPs. As part of this process, TSC should ensure that input from all relevant bureaus is collected, documented and unambiguously articulated in the RFIs and RFPs. For instance, TSC could have bureaus fill out structured survey forms that allow them to easily offer this input. As RFIs and RFPs are developed, TSC should make sure that appropriate criteria are developed to evaluate the proposals resulting from them, with input from all relevant bureaus.
- ¶ **Choose and test solutions.** After all responses to RFIs/RFPs are fully evaluated, TSC should be closely involved in the process of deciding which solutions should be acquired or evaluated further. TSC should also put in place a structured process for conducting tests and pilots, including test/pilot planning, development of testing protocols, documentation and rollout.
- ¶ **Train personnel.** TSC should coordinate the design and implementation of training programs and procedures to support the deployment of new technology issued to FDNY personnel. TSC should ensure that bureaus commit adequate resources for training, that they create training timetables, materials, and a quality control process for all training programs.
- ¶ **Deploy solutions.** TSC should establish and document deployment plans for newly acquired solutions after testing and training has been completed. Deployment plans should include guidelines, checklists and

feedback forms. TSC should manage the deployment and provide a mechanism for collecting feedback and refining the use of the technology.

Throughout the implementation process, the TSC should provide periodic (e.g., monthly) updates to the MAP group, the Operational Planning Unit and the Planning Oversight Committee describing technology milestones achieved, the progress of ongoing initiatives (including deliverables by each bureau and individual) and any specific roadblocks that need resolution.

In addition, the TSC should develop and maintain relationships with external parties connected to technology initiatives (e.g., National Institute of Standards and Technology and the NYC Department of Information Technology and Telecommunications). It should participate in externally sponsored technology events such as symposiums and conferences, and should reach out to other fire departments and emergency services agencies to exchange information.

2) IMMEDIATELY ADDRESS URGENT NEEDS

At the same time the Department revamps the process for deploying and managing new technologies, we believe it must address a number of current needs right away. These fall into four broad areas:

- 1) Improve communications capabilities.
- 2) Improve the Department's ability to receive and disseminate critical incident information.
- 3) Give chief officers at incident scenes better ways to manage information and track personnel.
- 4) Improve EMS Operations' ability to track patients during incidents.

2.1) Improve communications capabilities

Fire and EMS personnel have experienced a variety of significant communications problems: the portable radios used in the World Trade Center response lacked more advanced features available in the marketplace; FDNY personnel often cannot communicate reliably in high-rise buildings, subways and tunnels; and EMS personnel face excess radio traffic due, in part, to the fact that two communications channels operate on the same frequency and personnel do not adhere strictly to communications protocols. The following recommendations address these issues.

2.1.1) Complete testing of UHF portable radios. The Department purchased new UHF portable radios in 1999, but has not deployed them. An unsuccessful deployment attempt occurred in early 2001.

While the Department still must evaluate important aspects of the performance of these new radios, they do have several features that could give them significant advantages over the currently deployed VHF portable radios. They support a larger number of channels, providing an opportunity to fit Fire, EMS and interagency channels, including NYPD channels, on the same radio. Their signals usually reach further inside structures, and they can be used in conjunction with the new Police Radio System now being deployed for the subways. All these features suggest that deployment of these radios could improve the communications capabilities of the FDNY, but only if they pass rigorous testing and evaluation.

We recommend that the Department continue to accelerate the testing and evaluation of the new radios. If the radios provide improved quality and reliability, the Department should deploy them. This will require the following six steps:

- ¶ Finalize the codification of FDNY operational communications needs and the related technology features of these radios. For example, decide which of the following two features is more important: increasing the power output of transmissions over the command channel vs. the corresponding decrease in the radio's battery life.
- ¶ Establish a detailed testing procedure and a comprehensive testing plan to determine if the radios meet FDNY's operational needs better than the current radios, without compromising personnel safety. The testing plan should ensure proper, rigorous documentation of the results of the tests.
- ¶ Based on the test results, decide whether to deploy the radios.
- ¶ If the radios fail the tests, seek alternative solutions, including issuing a new RFP. If they pass, update communications protocols and procedures as necessary to effectively deploy them.
- ¶ If the radios are deployed, develop and implement a comprehensive training plan that ensures FDNY personnel are fully aware of the features of the radios and know how to use them effectively.
- ¶ Deploy the radios into the field with appropriate performance tracking and feedback mechanisms.

We estimate that the accelerated testing and (potential) deployment of the new UHF radios throughout FDNY should not require additional external funding and could be completed within four months.

2.1.2) Improve communication capabilities in high-rises There are approximately 2,000 high-rise buildings³⁴ in New York City today. Field experience suggests that FDNY personnel can communicate reliably in just a fraction of these buildings.³⁵ To address this shortcoming, the FDNY should immediately evaluate, acquire and deploy equipment, together with the associated procedures and personnel training.

High-rise communications gaps can be addressed with the deployment of repeating infrastructure that receives, amplifies and retransmits radio communication signals to improve coverage. Repeaters that are portable, mobile (e.g., truck-mounted), or air-based (e.g., on a deployable balloon) may help mitigate in-building communications difficulties, but do not provide full coverage for high-rises. Stationary repeating infrastructure can support reliable communications in most cases if it is designed, installed and maintained properly. This kind of infrastructure can be installed inside or outside a building. We propose the Department pursue all of these options, but do it along two parallel and complementary paths.

¶ **Test and deploy portable, mobile and air-based repeaters.** FDNY should complete rigorous tests with portable, mobile, and air-based repeaters to develop and document guidelines for optimal use of this equipment (e.g., where to place the equipment for best coverage, which combinations of equipment types are most effective). FDNY should also develop an understanding of the limitations of this equipment. Once guidelines for optimal use of it are established, the Department should acquire appropriate equipment, train personnel to use it, and deploy it. We believe that deployment of portable or mobile repeaters by FDNY would cost approximately \$1 million to \$2 million³⁶ and could be completed within six months.

¶ **Pursue stationary communications infrastructure.** In addition to accelerating deployment of portable, mobile and/or air-based repeaters,

³⁴ High-rise buildings are defined here as all buildings seven stories and higher. Our recommendations for high-rise buildings should also be applied to other types of buildings such as large malls, hospitals, and jails. Shorter buildings with substantial underground areas should be treated similarly to high rises since FDNY communications in underground environments are also inadequate.

³⁵ Reliable in-building communications means clear point-to-point communications in nearly 100 percent of the building, even in the case of building power loss, fire, or partial destruction. The Department does not have a comprehensive view of how its radios perform in different kinds of buildings and, hence, does not have an exact estimate of the number of buildings where its personnel can communicate reliably. There is some anecdotal evidence suggesting that firefighters and officers would not be able to communicate effectively and reliably in most high-rises in the city.

³⁶ Estimate based on this formula: three repeaters (two portable and one mobile) for each of the Department's nine divisions

the Department must foster the deployment of stationary repeaters that will ensure that FDNY personnel and NYC's other first responders can communicate reliably in high-rise and other large buildings. Therefore, as the second path to effective high-rise communications, we recommend that the FDNY take three simultaneous steps.

- **Step 1: Require high-rises to support first-responder communications.** FDNY should develop and seek adoption of changes in the city building code requiring that all NYC high-rise and other large buildings, existing and new, support first-responder communications needs. The code should not mandate a specific technology or solution, but should require that minimum performance standards for communications are met. One possible solution could be installation of fixed, building-specific repeaters. The city should consider establishing a subsidy system to give incentives to owners of existing buildings to expedite compliance with the new building code. Such subsidies should be structured to reward speed of deploying equipment and cost-effectiveness. We estimate that deployment of this infrastructure for all high-rises in the city would cost approximately \$150 million to \$250 million³⁷ and could be implemented within three years.
- **Step 2: Evaluate the deployment of additional city-owned infrastructure.** It is possible that the most cost-effective way to ensure in-building high-rise radio coverage requires a mix of solutions. An alternative or complementary solution to building-specific solutions might be a citywide radio infrastructure that would be installed, owned and operated by the city or one of its agencies. Therefore, we recommend that FDNY develop and issue an RFI/RFP for building such an infrastructure. The RFI/RFP should be written so that the city may determine the capabilities and performance of this infrastructure, along with the costs to deploy and operate it, and the likely time necessary for deployment. The RFI/RFP should also allow for the possibility of purchasing new end-user radios,³⁸ including radios using different technologies and

³⁷ Estimate based on solution for NYC high-rise buildings above seven stories at the cost of \$0.30-\$0.60 per square foot.

³⁸ It could be the case that deploying citywide infrastructure and replacing all FDNY portable radios is more effective than retaining the current radios (or the UHF radios currently under testing). The Department should seek to understand the costs and benefits of both alternatives: deploying infrastructure compatible with its VHF or UHF radios and deploying infrastructure that would require replacement of all portable radios.

standards than the VHF and UHF radios currently owned by the FDNY.

- **Step 3: Seek ways to leverage the NYPD's infrastructure to meet FDNY's needs.** The FDNY should work together with the NYPD to explore whether and how the citywide communications networking infrastructure of the Police Department can be leveraged to support all or some of FDNY's communications needs. For example, the RFI/RFP mentioned above should determine whether a common NYPD and FDNY communications infrastructure would be more effective for the city, rather than two separate police and fire networks.³⁹ The FDNY should work with the NYPD to understand which facilities and assets (e.g., sites, towers, transport capacity, and power equipment) currently owned or operated by the NYPD can be easily shared with the FDNY in ways that would benefit both Departments – should the FDNY or the city decide to deploy additional network capacity.

2.1.3) Improve communications in the subways. Department personnel also have difficulty communicating via radio in subways. Portable repeaters could provide a limited, interim solution. However, firefighter and EMS communications in the system could be greatly improved with the completion of the Police Radio System (PRS) project, which is managed and funded by the Metropolitan Transportation Authority. This project enables two-way voice radio communication throughout the subway via UHF radios. The project has already covered a small portion of the subway, but important portions of the system will not be finished for at least 12 months and the entire project is not scheduled for completion until December 2004. FDNY preparedness would clearly benefit from earlier completion.

In order for FDNY to use the PRS system, it would have to replace its current VHF portable radios with UHF radios such as those that are now being tested. If this replacement takes place and if the Department elects to use the PRS system, it should have a deployment plan in place. As certain subway areas become operational, this deployment plan should provide for testing the new infrastructure to ensure its adequacy for FDNY use. The plan should also provide for development of procedures to communicate in upgraded subway areas and training of personnel to communicate effectively in the subway.

³⁹ While total cost of ownership is, of course, an important element to evaluate whether or not one or two networks are more effective, redundancy, reliability, and the ability of a common network to meet the different operational needs of both Departments are also important. It is possible that the optimal solution is neither two separate networks nor a single one, but two networks that share multiple elements.

2.1.4) Improve communication in tunnels. The tunnels pose a different problem. FDNY units currently cannot communicate with the Dispatch center by voice or by Mobile Data Terminal as they pass through many of them. FDNY should expeditiously implement a satisfactory communication solution for voice and data communications in tunnels. Such a solution should provide virtually ubiquitous coverage throughout the tunnel – both between units and Dispatch and point-to-point (handie talkie) communications within the tunnels. This solution should also be redundant in case of a major impact on the tunnel (e.g., partial destruction, power loss).

For the four major auto tunnels (Battery, Holland, Lincoln and Midtown), the Department should approach the MTA and the Port Authority of New York and New Jersey to coordinate the evaluation, acquisition, deployment, and maintenance of communications options available to ensure reliable communications in the tunnels. If a tunnel’s oversight agency lacks resources to implement such solutions, FDNY should seek to facilitate the technology acquisition and implementation processes, while closely coordinating all steps with that agency.

Before solutions are implemented, FDNY should develop a deployment plan that involves testing, updating relevant protocols and procedures, and personnel training.

The Department estimates that installing stationary solutions in the four major tunnels would cost about \$6 million⁴⁰ and could be implemented within 12 months.

2.1.5) Determine the most effective EMS radio channel deployment. One of the issues highlighted on September 11 was the potential for congestion on the EMS command channel, which hindered the EMS leadership’s ability to conduct effective radio communication. This situation was due to three factors: 1) the overlapping frequencies between the command and citywide channels that result in all citywide traffic also being heard on the command channel; 2) a breakdown in radio communications protocols; and 3) the increased radio traffic due to the size and complexity of the response.

The Technology Steering Committee should establish the criteria and conduct a detailed evaluation with EMS Operations to determine EMS radio channel needs. One major question for this evaluation is whether to deploy a separate, dedicated command channel and/or an additional citywide channel to support multiple casualty incidents. Deployment of additional radio channels would require a

⁴⁰ Estimate based on proprietary solution for FDNY in four major tunnels, including dedicated radiax cable, necessary radio/electronic and connectivity equipment, and construction of equipment rooms.

comprehensive implementation program, including a new radio configuration (e.g., adding the additional channel), an update of protocols and procedures, testing, training, and a field deployment plan.

In addition to re-evaluating its radio channel needs, EMS should place a major emphasis on enforcing radio discipline and should also explore alternatives for leveraging its existing Mobile Data Terminals (MDTs) to minimize radio traffic congestion.

2.2) Improve the Department's ability to receive and disseminate critical incident information

The second set of FDNY's urgent communications needs involves how it receives critical information about an emergency incident and then disseminates that information to the appropriate personnel. The events of September 11 highlighted the importance of this information sharing within FDNY and among the city's other public safety agencies. The FDNY has already taken an important step by working with the NYPD on protocols to put an FDNY chief officer in a police helicopter when the FDNY feels it would be helpful to manage incidents. The two departments are also exchanging liaison officers and conducting regular meetings of senior NYPD and FDNY personnel. However, more needs to be done. The FDNY should focus its immediate attention on improving information flows in three key areas: 1) receiving aerial surveillance information such as video and audio feeds, from NYPD and media helicopters, 2) streamlining information flows within EMS Dispatch; and 3) ensuring that the FDOC can reliably communicate with other responding agencies.

(While these steps would bring substantial benefits to the FDNY, resolution of the fundamental issues related to information flow among agencies requires an enhanced approach to inter-agency coordination. Part III of this report discusses these coordination issues in greater detail.)

2.2.1) Receiving aerial surveillance. FDNY should seek the ability to receive audio and video feeds from NYPD and media helicopters. These would be made available to the Incident Commander (in the Mobile Command Center, Field Communication Units or elsewhere) and the Fire Department Operations Center (FDOC). This would require formal agreements with the NYPD and local media companies. These agreements should include voice and data communications links between the helicopters and the FDNY. For instance, the helicopter radios might be equipped with channels that allow the FDNY incident commander to request that the pilot offer a specific aerial perspective.

Once such agreements are finalized, FDNY should acquire necessary receiving equipment, update relevant protocols and procedures, and develop a

comprehensive joint training plan that ensures all parties involved know how to work together effectively and that FDNY's chiefs are fully aware of new information flow capabilities available to them, and know how and when to use them effectively. Throughout this process, FDNY should seek input from other fire departments that have already deployed such capabilities in coordination with other agencies.

2.2.2) Streamlining information flows in the EMS Dispatch center.

Another issue highlighted by September 11 was the fact that the current organization of EMS Dispatch impedes operators from effectively handling unusually large amounts of information that are likely to emerge from large incidents. Currently, operators have multiple responsibilities, so that when an incident reaches a certain size, the massive flow of information overwhelms them. Therefore, they are not able to synthesize and disseminate information effectively. In addition, operators work in separate areas of the EMS Dispatch Center with little or no ability to integrate information they receive from different sources.

The FDNY is now re-evaluating the organization of EMS Dispatch. It is working on a pilot program that will test a new configuration for EMS Dispatch, similar to the model used by Fire Dispatch. This will help resolve the question of whether EMS operators should continue to perform multiple tasks or should focus on specific, functionally defined tasks.

2.2.3) Communicating with other agencies. The FDNY needs to ensure that it can effectively and rapidly communicate with other agencies, such as the NYPD, over the radio and over existing data networks. For instance, the FDNY should ensure that SPRINT data messages sent between NYPD and EMS are instantaneously copied to the Fire Department Operations Center as a backstop. The FDOC should also monitor NYPD radio communications on key channels.

2.3) Give chief officers at incident scenes better ways to manage information and track personnel

The FDNY's third group of urgent technology need involves giving chief officers the ability to quickly and reliably locate personnel at any point in time, and improving the functionality and flexibility of the Department's command boards.

It is important for FDNY leadership to know whether an FDNY member is on duty and whether he/she is deployed to a certain incident. Ideally senior FDNY chiefs should also be able to know where this member is located throughout the incident area. There are two steps that, if taken immediately, could allow the Department to materially improve its personnel tracking capabilities.

2.3.1) Ensure discipline on the company level. Beyond addressing discipline issues related to staging and recall, FDNY should take steps immediately to ensure that officers enter reliable information into on-duty databases and riding lists, and that names on riding lists always correspond to the people riding the apparatus. In addition, the Department should explore alternatives to make this entry process more efficient and simple by setting up easy-to-use software in firehouse PCs. The Technology Steering Committee should also evaluate adding new capabilities to Mobile Data Terminals (MDTs) that would allow Fire personnel to log in and log off from their apparatus.

2.3.2) Evaluate and, if appropriate, deploy electronic command boards. The events of September 11 highlighted the need for FDNY to replicate and store up-to-date deployment information. This might be done by replacing the Department's magnetic command boards with electronic boards equipped with wireless transmission equipment. However, it is unclear whether currently available wireless technology and infrastructure is reliable and robust enough for use by the Department. For instance, it is unknown if the infrastructure would continue to operate properly during most major incidents and how well it would operate from inside high-rise buildings and other structures.

Nonetheless, portable PC-based electronic command boards have much greater functionality than magnetic boards. These boards could help communications coordinators and operations chiefs with their tracking, communications and tactical coordination tasks. For example, PC-based boards can store and display maps and multiple building plans. This could enable chiefs to look at structural and electrical characteristics of high-rises and zoom into specific floors or building areas. PC-based boards could also store detailed hazard lists and FDNY procedures.

The TSC should coordinate development of an RFP for electronic command boards. It should evaluate the boards' functionality separately from the capabilities and costs of backing up and updating deployment information through wireless connections.

As with all other technologies, if the Department decides to acquire electronic command boards, it should update relevant protocols and procedures and develop a comprehensive training plan that ensures that the chiefs are fully aware of the features of the boards and know how to use them effectively.

Our estimates show that implementation of electronic command boards throughout FDNY would cost approximately \$500,000 to \$1 million.⁴¹

2.4) Improve EMS's capability to track patients during large-scale incidents

This is the fourth area of urgent communications and technology needs. The events of September 11 highlighted the need for EMS Operations to have a flexible patient-tracking process that can aggregate, verify, and disseminate patient-tracking information during large-scale incidents. There are several technology solutions that could help automate the process of tracking patients and accurately capture patient information. EMS Operations should work with the Technology Steering Committee to evaluate the deployment of such a technology and the associated processes and infrastructure.

If the Department decides to change its patient tracking process, it should coordinate this work with other medical care providers in the region, such as hospitals and private ambulance services. This new tracking system should be formalized and become part of an official agreement among the relevant entities, including voluntary and community-based ambulance operators and hospitals, with each having clear functions and responsibilities. Once such an agreement is established, the TSC and EMS Operations should develop detailed internal protocols and procedures for patient tracking.

We estimate the total cost of enabling EMS to track patients more accurately is \$2 million to \$4 million.

⁴¹ Estimate based on one command board per battalion (including cost of software installation and provisioning of initial wireless connectivity).

