



U.S. Department
of Transportation

Research and
Special Programs
Administration

Final Report

DOT-VNTSC-FHWA-04-04

**EFFECTS OF CATASTROPHIC EVENTS
ON TRANSPORTATION SYSTEM
MANAGEMENT AND OPERATIONS**

**August 2003 Northeast Blackout
New York City**

U.S. Department of Transportation
John A. Volpe National
Transportation Systems Center
Cambridge, Massachusetts

April 2004

Prepared for

U.S. Department of Transportation
ITS Joint Program Office
and
Federal Highway Administration
Office of Transportation Operations

EFFECTS OF CATASTROPHIC EVENTS ON TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

August 2003 Northeast Blackout New York City

Final Report

DOT-VNTSC-FHWA-04-04#

Allan J. DeBlasio
Terrance J. Regan
Margaret E. Zirker
Katherine S. Fichter
Kristin Lovejoy

March 2004

Prepared by

U.S. Department of Transportation
Research and Special Programs Administration
John A. Volpe National Transportation Systems Center
Planning and Policy Analysis Division
Cambridge, Massachusetts

Prepared for

U.S. Department of Transportation
Intelligent Transportation Systems Joint Program Office
and
Federal Highway Administration
Office of Transportation Operations
Washington, D.C.

Foreword

This report documents the actions taken by transportation agencies in response to the August 14, 2003, Blackout throughout the Northeast. It is part of a larger effort to examine the impacts of catastrophic events on transportation system facilities and services and the role of intelligent transportation systems (ITS) in emergencies. It also highlights the importance of good communications between transportation agency staff and the public safety officials who are the first responders during catastrophic events.

The findings documented in this report are a result of the creation of a detailed chronology of events in the New York City metropolitan region, a literature search, and interviews of key personnel involved in transportation operations decision-making during the blackout. A companion case study of the Great Lakes Region (principally Detroit and Cleveland Metropolitan areas) has also been prepared.

As part of a larger effort, four case studies have already been produced examining catastrophic events:

- New York, N.Y., terrorist attack, September 11, 2001
- Washington, D.C., terrorist attack, September 11, 2001
- Baltimore, Md., rail tunnel fire, July 18, 2001
- Northridge, Calif., earthquake, January 17, 1994.

This report was prepared by the U.S. Department of Transportation's (U.S. DOT) John A. Volpe National Transportation Systems Center (Volpe Center) for the Federal Highway Administration Office of Operations and the U.S. DOT's Intelligent Transportation Systems (ITS) Joint Program Office. The Volpe Center study team consisted of Allan J. DeBlasio, the project manager, and Katherine S. Fichter of the Volpe Center Planning and Policy Analysis Division; Kristin Lovejoy of EG&G Technical Services; Terrance J. Regan and Dan Morin from Planners Collaborative; and Margaret E. Zirker from Cambridge Systematics Inc. Vince Pearce is the U.S. DOT task manager of the review.

Table Of Contents

FOREWORD	i
Table of Contents	ii
List of Tables	ii
List of Figures	ii
1. Introduction	1
1.1 Regional Context.....	4
2. Effect on Transportation System	6
2.1 Pre-Event.....	6
2.2 Day of Event.....	7
2.3 Post-Event.....	15
3. Findings	17
3.1 Advanced Preparations and Planning.....	17
3.2 Institutional Coordination.....	22
3.3 Operating Decisions.....	25
3.4 Role of Advanced Technology.....	29
3.5 Communications.....	32
3.6 Redundancy and Resiliency of Systems.....	34
4. Conclusion	37
Appendix A: Detailed Chronology	42
Appendix B: Summary of Installed Intelligent Transportation System (ITS) Technology	56
Appendix C: List of Acronyms	65

List Of Tables

Table 1. Regional statistics.....	4
Table 2. Weekday Transit Ridership.....	7

List Of Figures

Figure 1. Twenty hours before the blackout.....	2
Figure 2. Seven hours after the blackout.....	3
Figure 3. Region of the U.S. affected by the electrical power loss.....	4
Figure 4. New York City Metropolitan area affected by the power loss.....	5
Figure 5. 59 th Street Bridge inundated with pedestrians and vehicles.....	11
Figure 6. Evacuating an elevated section of the NYC Transit subway.....	13
Figure 7. Water ferry docks in New York City area.....	14
Figure 8. TRANSCOM alert at 5 p.m.....	33

1. Introduction

Thursday, August 14, 2003, was a typical mid-August day in the eastern United States, dawning with a layer of heat and humidity hanging from Detroit to Boston. The network of electric transmission lines that brings power to homes, business, and public infrastructure was carrying a standard load for that time of year, powering air conditioning systems throughout the region. Taken together, the system of transmission lines, sub-stations, and power plants that powers the area east of the Rocky Mountains is known as the Eastern Interconnection, a collection of tens of thousands of individual lines, owned by multiple utility companies, all working in concert to supply even and sufficient power. Several components of that system were out of service on the morning of August 14, including a generating unit in northern Ohio, a major transmission line serving Cleveland, Ohio, and a power plant north of Detroit, Michigan. Such outages are routine, however, and the electrical system is designed to accommodate such events while still maintaining a proper level of electric transmission.

Shortly after 2:00 p.m. on the afternoon of August 14, a brush fire caused a transmission line south of Columbus, Ohio, to go out of service. This was followed at 3:05 p.m. by the failure of a transmission line connecting eastern and northern Ohio, which was in turn followed at 3:32 p.m. by the failure – caused by a sudden excess of power flow – of a second line in the same area of northern Ohio. As more and more portions of the electrical network disconnected from the grid, the events on August 14 quickly accelerated: five transmission lines between Ohio and Michigan failed within the 30 minutes between 3:30 p.m. and 4:00 p.m.

At 4:10 p.m., the electrical system connecting the region south of the Great Lakes, including the cities of Cleveland and Detroit, to New York and New Jersey experienced a profound failure due, in large part, to the sudden vulnerability of the transmission system and its compromised ability to transfer power over significant distances. Within a single minute, many transmission lines failed throughout the entire area, creating a cascading effect in which lines sequentially overloaded and then failed, leaving a swath of 3,700 miles – including portions of Vermont, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, and Michigan, up through portions of the Maritime provinces – in the dark. On one August afternoon, a series of seemingly small events, happening in concert, produced the largest blackout in American history.

Electric transmission

Transmission system voltage is needed to transfer electric power from generation stations to load centers – the places in which the power is used – and is somewhat similar in function to water main pressure. Reactive power is the component of total power that assists in maintaining proper voltages across the power system. As transmission lines become more heavily loaded, they consume more of the reactive power needed to maintain proper transmission voltage. In some instances, the reactive power demand within an area is too great for the local generating units to supply. In those cases, the units can trip off-line, either from reactive power overload or because the system voltage has become too low to provide power to the generators' own auxiliary equipment. The power system is designed to ensure that if conditions on the grid threaten the safe operation of the transmission lines or power plants, the threatened equipment automatically separates from the network to protect itself from physical damage.

The blackout of August 14 left tens of millions without electricity and created confusion and disruption across the northeastern United States and portions of Ontario, particularly in the cities of New York, Cleveland, and Detroit. Subways were stopped in their tunnels, airports halted operations, and elevators stalled mid-ride. Water systems shut down. The communications network was disrupted; cellular telephones ceased to work; emergency response networks were hampered; and automated teller machines went dark. Many restaurants and shops shuttered their doors, and streets were rapidly overwhelmed by vehicles and pedestrians trying to find their way home. Without air conditioning, many buildings rapidly became stifling. Stranded commuters spent the night in train stations, hotel lobbies, and emergency shelters. Others spent many hours trying to get home: on foot, in their vehicles, in shared taxis, on rented bicycles, hitchhiking, or on rollerblades.

Figure 1 shows the area of the blackout 20 hours before it began. Figure 2 shows the same geographical area seven hours into the blackout. Figure 3 shows the region of the United States affected by the blackout.

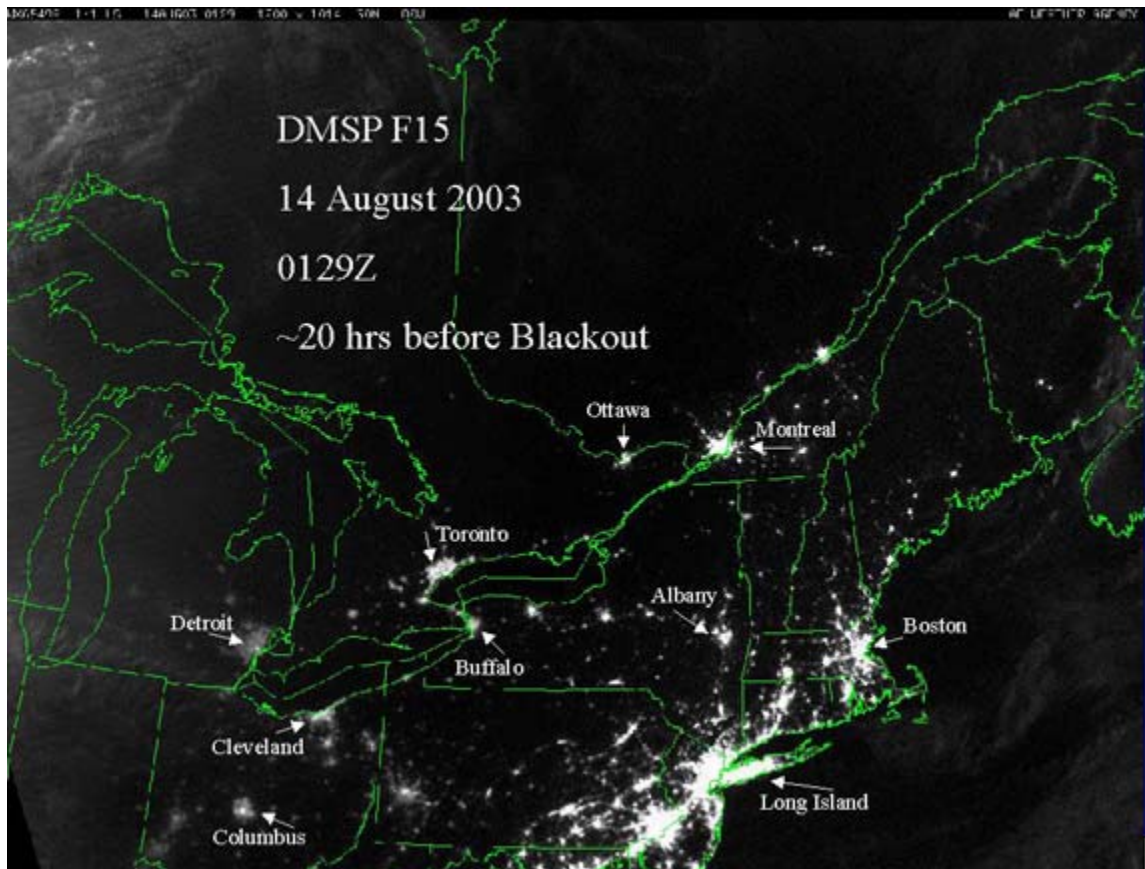


Figure 1. Twenty hours before the blackout
Source: United States Geological Survey

Within a few hours, power began to return to portions of the darkened region, while emergency response teams worked through the night to free those trapped in subways and elevators, to secure public facilities, and to ensure the safety of the general public. Officials in cities most

impacted by the blackout treated August 15, a Friday, as a holiday, as they urged the public to remain at home. Public services were provided on a limited basis. Despite early fears, both arrests and injuries were significantly below anticipated levels. The weekend following the blackout passed quietly as the electrical network returned to operation, and many in the affected areas stuck close to home. Power was restored throughout the impacted region within 30 hours, and water quality was deemed acceptable within several days. By Monday, August 18, the blackout of 2003 was largely over.

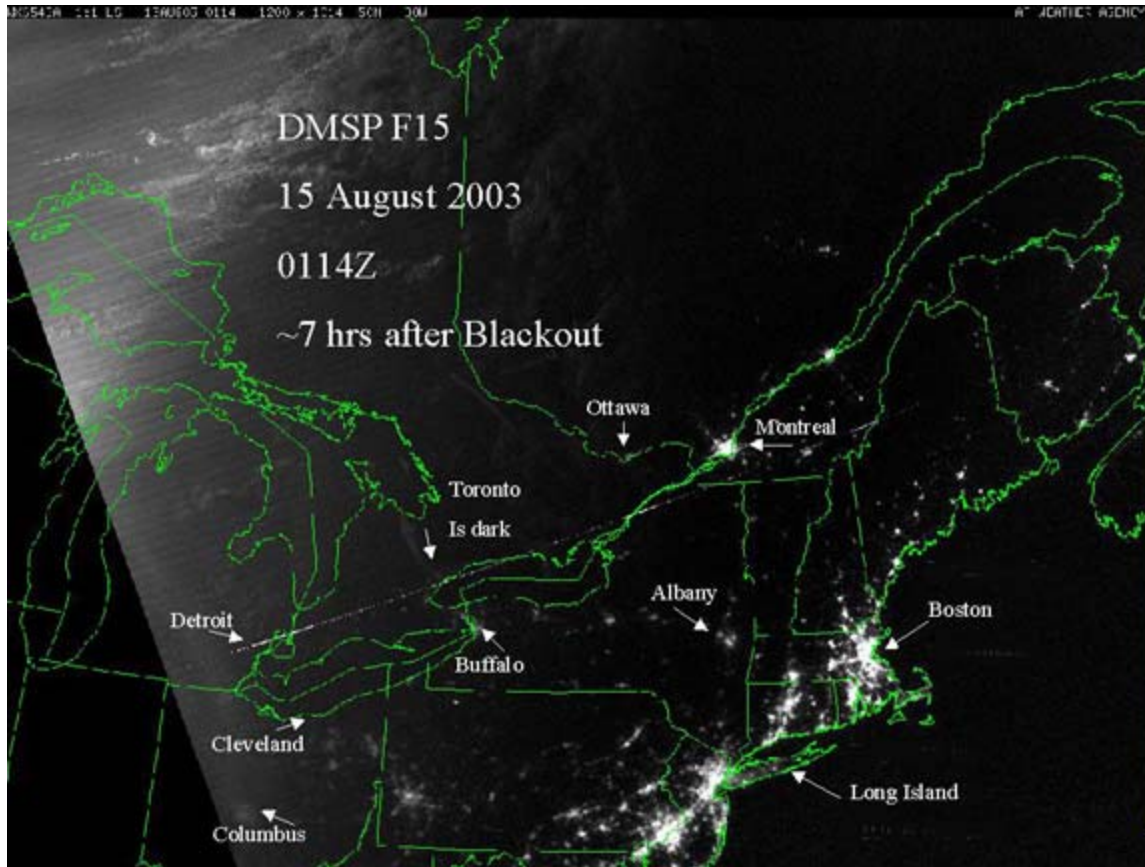


Figure 2. Seven hours after the blackout
Source: United States Geological Survey

In a report released in mid-December, the U.S.-Canada Power System Outage Task Force concluded that the blackout had many causes, some of them still unknown, but most of them small and individually preventable. As the task force reported, widespread, cascading failures of the electrical system are rare, although they occur more frequently than would be statistically expected. Although robust, electrical systems are vulnerable to simultaneous, independent, small failures, which – if not quickly and properly managed – can overwhelm the system and cause the type of massive outage seen on August 14. For this reason, blackouts should be considered as part of standard emergency preparations and planning for all types of public infrastructure, including transportation.



Figure 3. Region of the U.S. affected by the electrical power loss

1.1 Regional Context

This case study focuses specifically on New York City but also examines the event and the response to the event on a regional level. Power was lost from Connecticut to the north to New Jersey to the south. Various transportation agencies along the East Coast, both within the blackout area and outside of it, provided response personnel and equipment to help better manage the event. Figure 4 shows the New York Metropolitan area and its transportation infrastructure.

New York City (NYC) is the most populous city in the nation. Its five boroughs have over 8 million residents and over 3.7 million workers. The borough of Manhattan, 13-miles long and 2.3-miles wide at its widest point, is the most densely populated urban area in the country and is a world center for numerous businesses. It is also one of the most visited tourist destinations in the world. Table 1 gives an overview of statistics for the New York-New Jersey-Connecticut metropolitan area (defined as New York City, Downstate New York, Northeast New Jersey, and Southwest Connecticut), New York City, and Manhattan.

Table 1. Regional statistics

	Region	NYC	Manhattan
Population	20,096,000	8,019,000	1,541,000
Workers	9,582,000	3,700,000	2,400,000
Area (sq. mi.)	7,622	309	28
Density of residents per sq. mi.	2,636	25,960	54,266
Density of employees per sq. mi.	1,257	11,974	85,714
% households owning a vehicle		44%	22%

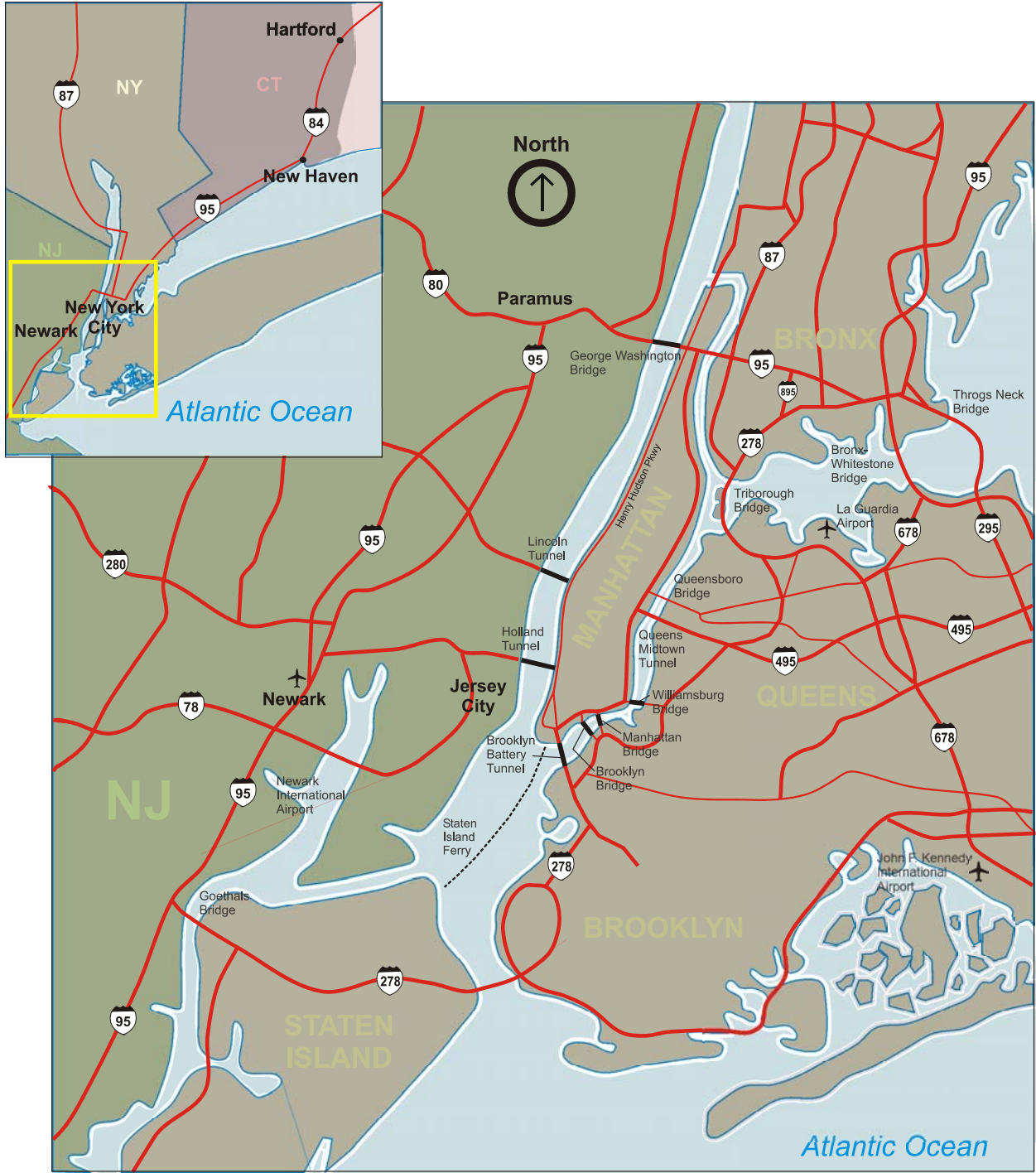


Figure 4. New York City Metropolitan area affected by the power loss

2. Effect on Transportation System

2.1 Pre-Event

2.1.1. Transportation in New York City and Manhattan

The transportation system in New York City is one of the most complex in the nation with numerous state, local, and regional authorities as well as private companies operating various components of the transportation network. Four of the largest public transportation agencies in the country serve the New York City region.

- The Port Authority of New York and New Jersey (Port Authority) operates three major airports (Kennedy, LaGuardia, and Newark), two tunnels, four bridges, the Port Authority Trans-Hudson Corporation (PATH) interstate passenger rail transit system, two interstate bus terminals, and seven marine cargo terminals in the New York/New Jersey Port District.
- The New York City Department of Transportation (DOT) manages the city streets, highways, parking facilities, four major bridges, six tunnels, one ferry service, and oversees five private ferry and seven private bus companies serving New York City.
- The Metropolitan Transportation Authority (MTA) runs the NYC Transit subway and bus system (the largest subway and bus systems in the country), two commuter rail systems, a Long Island bus service, seven bridges, and two tunnels.
- New Jersey Transit Corporation (NJ Transit) operates six commuter rail lines that provide service from New York City through extensive portions of New Jersey, a bus system, intermodal terminals, and a light rail system in Hoboken.

According to the Texas Transportation Institute's indices of roadway congestion, the region ranked 13th in percent of daily travel undertaken in congested conditions, 21st in roadway congestion, and 24th in annual congestion cost per capita. These rankings reflect a 35 percent share of daily travel undertaken in congested conditions and an annual congestion cost of \$595 per capita.

Within New York City itself, there are approximately 2 million registered vehicles, 91 percent of which are passenger vehicles, 4 percent commercial vehicles, 2.5 percent taxis, and the remaining 2.5 percent are rental cars, buses, and motorcycles/mopeds.

The New York-New Jersey-Connecticut metropolitan area has the most widely used public transportation network in the nation. The region's reliance on transit stems from historical trends and land use patterns, principally in New York City where the density makes automobile travel difficult. MTA NYC Transit operates the largest portion of the city's transit system. From outside the city, MTA's commuter rail and bus operations serve suburban New York including Long Island, the Hudson River Valley, and parts of Connecticut; PATH rapid transit brings passengers to New York City from New Jersey; ferries connect other New York City boroughs with Manhattan, as well as carrying passengers from New Jersey. NJ Transit provides an extensive commuter rail network connecting New Jersey with New York. Table 2 shows the

average weekday number of transit trips for the larger transit agencies within the New York City area.

Table 2. Weekday Transit Ridership

Transit type	Passengers/weekday
NYC Transit subway	4,688,000
NYC Transit bus	2,622,000
Private bus	451,000
NJ Transit bus	530,000
MTA Long Island Railroad	300,000
MTA Metro North Railroad	253,000
NJ Transit Rail	209,000
PATH	178,000
Public and private ferries	125,000
TOTAL	9,356,000

(Source: New York Metropolitan Transportation Council 2002 2nd Quarter)

The greatest concentration of people in the city is in Manhattan. The area of Manhattan south of 60th Street contains almost 2 million people on a typical workday. Most people who work in Manhattan take transit or walk. Only 16 percent of all workers rely on the automobile to commute to Manhattan. During the daytime, more than two-thirds of all trips in the 8.4 square miles that comprise central Manhattan are made on foot. Even so, 14,000 motor vehicle trips are made per square mile per day, far exceeding trip density of all other counties in the New York metropolitan area. There are 11,600 signalized intersections in the five boroughs of New York City. Manhattan has 2,700 signalized intersections. Of the 11,600 signalized intersections operated by NYC DOT, 6,000 are computerized and controlled from the city-operated Traffic Management Center within Joint Transportation Operation Center (JTOC). The remaining 5,600 signalized intersections operate independently and are not centrally controlled.

2.2 Day of Event

When the blackout rolled through the New York City metropolitan area at 4:11 p.m., the roadway and rail system ground to a halt. New York City's 11,600 signalized intersections all lost power at the same time. Every one of the 413 train sets that were operating throughout the New York City subway system lost power, stranding over 400,000 customers. The extensive electrified commuter rail network throughout New York, Northern New Jersey, and Southern Connecticut ground to a halt.

The numerous intelligent transportation systems (ITS) pieces of equipment operated by the various agencies for the most part went dark, with some exceptions. The George Washington Bridge did not lose power because it receives power from several locations including one area, the Lower Hudson River Valley, that did not lose power and the MTA Bridges and Tunnels Authority, which had backup power. For the most part, cameras, variable message signs (VMS), highway advisory radio systems (HAR), Internet travel information sites, embedded sensors, traffic signals, and communications systems ceased functioning throughout the region. The

New York City TMC was without power for the first three hours after the event, but then was able to resume limited operations with backup generator power.

Because of lessons learned through past events, the area transportation agencies had response plans in place. Events, including preparations for the Year 2000 (Y2K), the terrorist attacks of September 11, 2001, major blackouts in 1965 and 1977, and the hurricane that hit south of the area only a few weeks before had prepared the region's transportation managers to deal with significant disruptions in the transportation network. Each of the past events has tested various parts of the system, but most agencies were not prepared for the scope and duration of the August 2003 blackout within the metropolitan region.

The first several minutes of the blackout were tense for decision makers as they tried to determine the scope and breadth of the event. Operations control centers were swamped with radio calls from field staff reporting the loss of power. Most agencies began to rely on reports from the media to determine that the event was both widespread, spanning most of the Northeast and Great Lakes region, and potentially of a long duration. The Port Authority, New York City, NJ Transit, and the state of New York all opened their emergency operation centers (EOC) within the first fifteen minutes.

Usually events are more localized in nature and allow for a response of personnel and equipment to help alleviate the problem. But the August 2003 blackout caused outages throughout all of the major segments of the transportation system. The impact was widely felt throughout the region and presented decision makers with difficult choices as to where to allocate resources that included personnel, equipment, emergency power, and lighting.

Abbreviated Chronology: August 14, 2003

Time of Day	Event/Actions Taken
12:05 p.m.	Generators shut down at the American Electric Power plant in Conesville, Ohio, beginning a string of seemingly insignificant events that leads to a massive power outage across the Northeastern U.S.
4:10 p.m.	Power fails on the PATH transit system connecting New York and New Jersey. Power is lost to the signal system, third rail system, fare collection equipment, station lighting, and tunnel lighting.
4:11 p.m.	New York City Transit subway operations cease as the system loses electrical power. A total of 413 trains with approximately 400,000 customers are in service and are affected by the blackout.
4:11 p.m.	The 11,600 signalized intersections in New York City lose power.
4:20 p.m.	New York City Transit begins the evacuation of its subway system with an estimated 400,000 passengers onboard.
4:54 p.m.	Federal officials rule out terrorism as the cause of the blackout.
5:20 p.m.	All operations cease at the New York Marine freight terminal.
6:30 p.m.	All PATH trains are successfully evacuated.
7:09 p.m.	NYC Transit completes the evacuation of the entire New York City subway system, with only 3 minor injuries reported.
7:52 p.m.	New York LaGuardia, JFK International, and Newark Liberty International Airports institute "snow plans," in which they prepare for stranded passengers to spend the night in the airports.
Evening	New York Waterway, which operates the majority of the private ferry service in New York City, carries 170,000 people during the afternoon and evening, 140,000 people more than on a typical day.

2.2.1. Guiding priority: safety

Ensuring the safety of its customers is the number one guiding priority among transportation decision makers. When an event occurs, managers have to quickly assess the situation and decide what decisions need to be made to ensure a safe response and recovery from the event.

The New York City Police Department (NYPD) has a total of approximately 2,000 traffic agents and 400 police officers assigned to traffic duty. In the event of an emergency, NYPD has a non-communication response system in place to help control traffic. Each officer is given a specific intersection to cover in his or her area, and that officer is supposed to report to that location without further notification during an emergency. But because there were so many other urgent needs, most officers were not able to immediately staff their assigned intersections. The police and fire departments spent the first several hours after the blackout rescuing people stuck in elevators or responding to calls for help. New York City personnel received 80,000 calls to its 911-telephone system and logged over 800 elevator rescues. The Fire Department of New York (FDNY) reported its emergency medical services (EMS) crews responding to more than 5,000 calls, twice the normal daily amount.

2.2.2. Traffic Management and Operations Centers

The New York City region has a total of 13 traffic management centers (TMC) that are linked through TRANSCOM's (Transportation Operations Coordinating Committee) Interagency Remote Video Network (IRVN), a network of over 400 cameras. Each of these centers maintains its own set of ITS technologies but shares its video feeds with each other to allow for better coordination of day-to-day operations and response to events. IRVN allows agency managers to view incidents on other facilities and make changes to their own operations in response. While the IRVN system maintained connection with two-thirds of the centers, the system was compromised because most of the cameras in the field failed due to a lack of power.

The region also has over 300 miles of roadway that is covered by TRANSMIT readers. These readers report back speed and congestion data to the TMCs. This information is used by transportation officials to quickly identify problems on the system. Within 15 minutes of the blackout, over 90% of the readers failed. Therefore, even if the TMCs were operating on backup power, they were mostly without video and data readings to understand how the system was operating.

INFORM (INformation FOR Motorists) on Long Island had portable VMS signs that were able to operate with backup power. MTA Bridges and Tunnels had backup power for their installed VMS signs. TRANSCOM asked local agencies and those outside of the area with the capability to post messages to keep the public better informed. Some examples of messages displayed on the MTA signs are shown in the accompanying text box.

**Messages posted on the
MTA Bridges & Tunnels VMS
immediately after the blackout:**

- * Holland Tunnel only 1 lane open to NJ
- * Lincoln Tunnel only 2 lanes open to NJ
- * West St North Expect Delays
- * NYC Subways OOS
- * Fares suspended on NYC Buses while subway is OOS
(OOS- out of service)

One of the primary benefits of certain ITS

equipment, including VMS, HAR, and traveler information sites on the Internet, is the ability to communicate transportation conditions as early as possible so that people can make choices in how they travel. The I-95 Corridor Coalition, a voluntary organization of transportation and law enforcement agencies along the East Coast, has established voluntary protocols among its member agencies to display messages concerning major traffic incidents that may be outside of the agency's borders.

On August 14, the I-95 Corridor Coalition worked to coordinate the posting of messages among its member agencies that were outside of the affected areas. The ability to divert traffic away from an incident can help relieve congestion and speed up the recovery of the system. Numerous agencies that were located outside of the blackout area, including New Jersey DOT, New Jersey Turnpike, Pennsylvania DOT, and Maryland DOT, took advantage of their agency's ITS technology and displayed messages on their VMS for traffic heading to the New York area. Those agencies with HAR placed messages on the system and several put traffic alerts on their web pages. As an example, Maryland DOT placed messages on its I-95 Northbound VMS signs stating:

“Massive power outage in NY-Avoid area-Use alternate routes.”

Because power came back on in small sections at a time, some traffic operations centers (TOCs) switched back to the electrical grid sooner than others. The New Jersey DOT TOC North had power restored in a little more than an hour after the event. INFORM had partial power restored around 4:00 a.m. and full service around 10:00 a.m. on Friday. The JTOC did not go back onto the electrical grid until 10:30 p.m. Saturday night. Worried about power spikes, managers wanted to make the conversion during a quiet time period.

Established in 1996, the New York City Office of Emergency Management (OEM) oversees emergency preparedness for the city, including the transportation agencies' response efforts. On August 14, OEM activated the City's Emergency Operations Center (EOC) at 4:20 p.m. to begin the process of providing coordination and direction to agencies, including the region's 13 traffic management centers. During an emergency, the EOC is staffed by senior officials from City agencies, as well as representatives from state and federal agencies.

2.2.3. Streets

The local street network quickly became overwhelmed with vehicles and pedestrians. This was most pronounced in Manhattan as hundreds of thousands of office workers poured out into the streets at the same time. There were at least three things that complicated the movement of people and vehicles. First, the volume of people trying to use the street system was more than it could handle because of the simultaneous departure of people and the immediate loss of alternative means of travel, most specifically the subway and rail networks. Second, the emergency response system was overwhelmed with rescue calls all at the same time. Third, all of the traffic signals failed with the loss of electrical power. Figure 5 shows the congestion at the 59th Street bridge as pedestrians and vehicles try to exit Manhattan for Queens.



Figure 5. 59th Street Bridge inundated with pedestrians and vehicles

A priority for safety is to maintain clear paths of travel for emergency vehicles to respond to incidents. Because the blackout happened so quickly and people immediately began trying to get out of the city, streets and bridges quickly became inundated with pedestrians and vehicles. At the same time, the police, fire, and emergency response personnel were focused on responding to emergencies; traffic took a secondary priority. The police department and transportation agencies were simply not equipped to direct hundreds of thousands of pedestrians, and vehicles, to certain locations that would allow for a more efficient movement of both modes.

As stated earlier, the 911-system handled a record number of requests for help during those initial hours. At the same time, the city's emergency dispatch and communications system failed for brief periods of time, causing a delay in assigned personnel reaching their designated assignments at key traffic intersections. Because of the volume of calls and the need to respond to people stuck in elevators and other emergencies, traffic management was a secondary priority during those first few hours.

Because none of the traffic signals have any battery backup, all of the traffic signals went out, resulting in chaos at 11,600 signalized intersections in New York City. While some traffic personnel were manning major intersections, there was not nearly enough coverage. In many cases, citizens volunteered and directed traffic to help with the congestion.

Neither the NYPD nor the transportation agencies have reliable numbers for the volume of pedestrians or vehicles that crossed the bridges or major streets that afternoon because the vehicle detectors were not working and no one was available to manually count vehicles or pedestrians. According to a NYPD supervisor, pedestrian and vehicle traffic in Manhattan remained heavy until approximately 11:00 p.m. on Thursday. On Friday, the police reported no serious traffic backups because most people stayed home and treated the day as a holiday. By Monday morning, the first full working day after the event, everything had returned to normal.

2.2.4. Highways, bridges, and tunnels

Once traffic was able to get off of the local streets and onto the highway network, traveling conditions improved. While traffic volume was still heavy, traffic was able to keep moving, unlike the traffic on local streets. The New Jersey Turnpike, the New York State Thruway, and the Garden State Parkway as well as all the non-toll interstates remained open. Tolls were suspended on toll facilities, with the exception of the New York State Thruway. Because this agency maintains emergency generator power at all of its toll facilities as a standard business practice, they were able to operate under normal conditions. While MTA bridges and tunnels were able to operate on backup generator power and their toll collection facilities were operational, agency management suspended the collection of tolls outbound from Manhattan.

Activating emergency operating procedures that were developed as a result of September 11, operators of the many of the tunnels and bridges leading to Manhattan immediately closed or put vehicle restrictions in place for the first few hours after the event. By 5:45 p.m. on Thursday, the Lincoln Tunnel as well as the Brooklyn, Williamsburg, and Manhattan Bridges were closed to Manhattan-bound traffic. The Queens Midtown Tunnel and the Brooklyn Battery Tunnel were closed except for emergency vehicles.

2.2.5. Transit

The subways, commuter rail, and light rail systems in the New York region are all dependent upon electricity for power and all ceased operations at the same time as the blackout hit the region. The NYC Transit subway system had an estimated 400,000 riders on board its 413 subway trains when it ceased operations. PATH had 19 trains in service at the time.

Within five minutes of the blackout, NYC Transit staff had been notified by Consolidated Edison (ConEd) officials that the power outage was extensive and potentially long in duration. Between 4:20 p.m. and 4:30 p.m., both NYC Transit and PATH crews began the process of shutting down their systems and evacuating their passengers. This included making sure that power was disconnected to all third rails to ensure the safety of passengers walking along the tracks in the event that power was restored during the evacuation. The decision to shut down a transit system, evacuate the passengers, and then restore service can be extremely complicated and time consuming. NYC Transit managers estimated that it could take approximately 8 hours to resume full service to the system once it has been totally shut down. Before service can be restored, signals, the third rail, lighting, trains, tracks, and stations all have to be checked for safety.

The New York City subway does not have an automated vehicle locator (AVL) system for its trains, nor does it have emergency lighting in the tunnels. Both of these made the evacuation more difficult. The radio system on the trains consists of battery-powered handheld radios, and it continued to operate during the blackout. After determining the location of each of the trains through radio communication and reviewing schedules, managers prioritized which trains needed additional resources, mostly response personnel, to evacuate. Priority was given to trains based on the number of passengers and location, with those stuck on bridges and underwater tunnels given first priority. Figure 6 shows the evacuation of a subway train stopped on an elevated section of rail track.



Figure 6. Evacuating an elevated section of the NYC Transit subway

By 6:30 p.m., PATH staff had completed its evacuation process. NYC Transit staff completed the evacuation of its subways by 7:09 p.m., a little less than three hours after the event began. Unfortunately, the passengers flowing into the streets from underground met a massive amount of congestion in the streets and on the sidewalks due to the volume of vehicles and pedestrians.

The only forms of transit that continued to operate during the blackout were buses and water ferries. But both of these forms of transportation ran into problems. The NYC Transit bus experienced difficulties with their radio communications network. Therefore communication between the operations center and individual buses was compromised. The buses, while operating, were stuck in the same traffic congestion with all of the cars and pedestrians and were not able to operate efficiently. The buses were also overwhelmed by the passenger demand as people tried to find any way home. The problems were worst in Manhattan, but present throughout the region as the local streets experienced heavy congestion. It was further hindered by the fact that the bus network does not duplicate the subway system. The buses routinely stay within the confines of one borough, while the subway crosses the borough boundaries. This meant most passengers had to take multiple bus trips to get to their final destination.

Shortly after the blackout Port Authority managers made the decision to close the Port Authority Bus Terminal (PABT) in Midtown Manhattan because the facility has emergency power backup designed only to supply the power necessary to evacuate the building but not to keep the building operating. The evacuation was completed in approximately 15 minutes, but this closure complicated the process of getting passengers onto buses and on their way home. On a typical weekday, approximately 7,200 buses and 200,000 people use the PABT.

As people trying to get to New Jersey descended upon the bus terminal, the Port Authority and NJ Transit staffs set up temporary staging areas outside of the building. In order to evacuate as many people as quickly as possible, NJ Transit managers set up a shuttle service from the PABT to a temporary staging area it was setting up at the Meadowlands Stadium. From the Meadowlands, NJ Transit operated buses that tried to duplicate, as best it could, service

throughout its transit district. Several managers commented that installed or portable technology, specifically lights, portable VMS, and communication technology, outside of the PABT, would have benefited the evacuation process.

While the water ferry system continued to operate, it was overwhelmed with passenger demand. New York Waterways typically carries 70,000 passengers a day but carried over double that volume on August 14. Another problem with the ferries is that the piers on both the Manhattan and New Jersey sides were physically inadequate to handle the volume of people. At one point NJ Transit officials had to request that ferries remain in the harbor and not dock because the Hoboken Intermodal Center could not handle the additional volume of people. Figure 7 displays the passenger ferry docks in the New York City area.

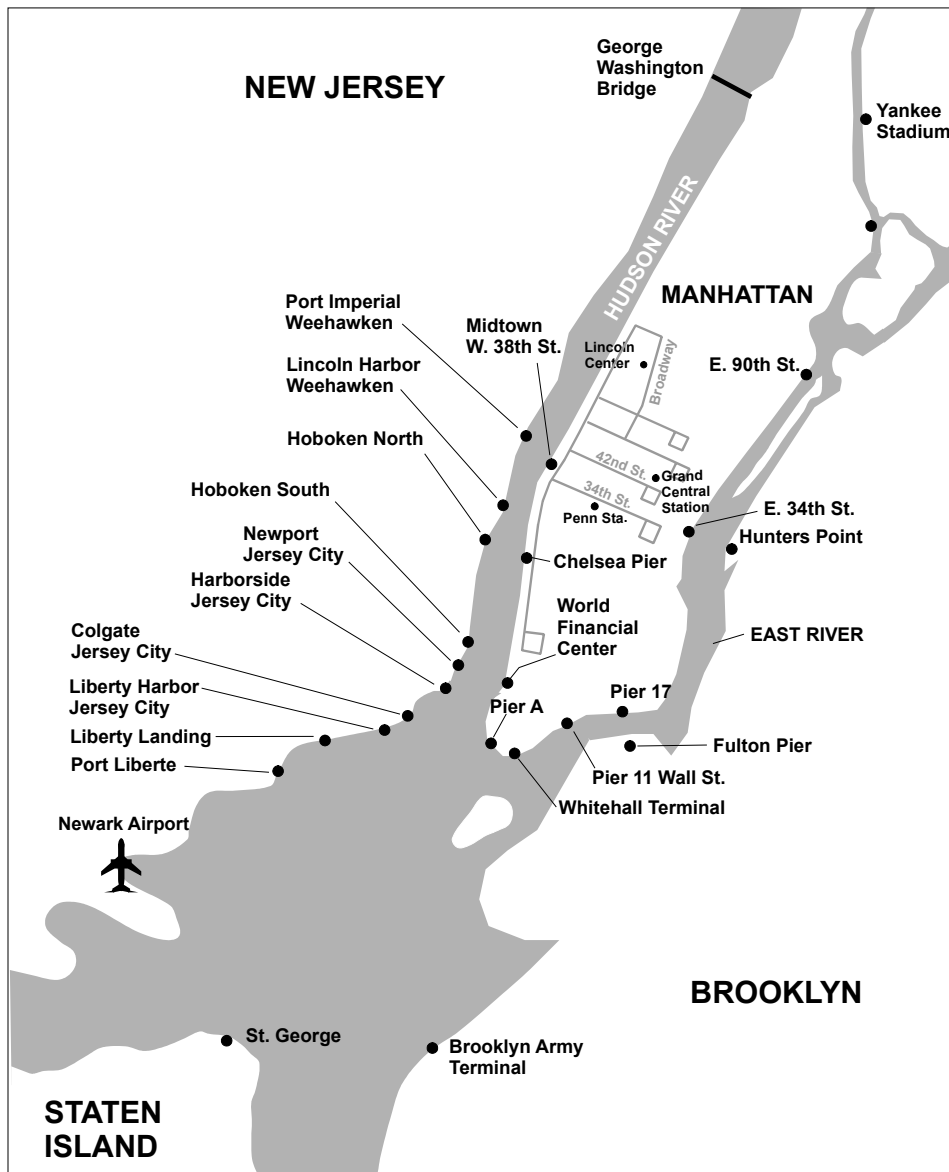


Figure 7. Water ferry docks in New York City area

2.2.6. Freight

The Port of New York and New Jersey is the busiest container port on the East Coast. In addition, the region is a major intermodal center for the shipment of freight by rail and truck. While the marine freight terminals were briefly affected by the power outage, the power outage occurred after the busiest period of loading and unloading for the day. Over the next two hours after the loss of power, each of the water freight terminals ceased operations. Trucks were able to leave the facilities, but in most cases were prohibited from entering. Most freight rail operations ceased during the blackout because of the loss of power to the signal and switching systems.

The largest volume of truck crossings through the region occurs either north of the city across the George Washington Bridge or south along the Staten Island-New Jersey bridges (Goethels, Outerbridge, and Bayonne Bridges). All of the bridges remained open during the blackout, though they each experienced varying degrees of general traffic congestion. As with passenger cars, trucks navigating local streets experienced extreme congestion until late into the evening.

While several agencies did use their operating VMS system and HAR system to post messages to alert drivers of closings and traffic conditions, there were no messages posted specifically to inform truckers.

2.3 Post-Event

Certain parts of the region began to have power restored within a few hours. NJ Transit staff was able to resume some commuter rail service from Newark by 8:00 p.m. on Thursday. PATH crews began partial operations in New Jersey by 9:45 p.m. on Thursday. Power was officially restored to all of New York City at 9:03 p.m. on Friday night, approximately 29 hours the blackout began.

Most businesses were closed on Friday and most workers stayed home resulting in light traffic volumes. Transportation agencies used the weekend to restore services to be able to deal with a normal rush hour commute on Monday. The system was fully restored to normal by Monday, August 18, 2003.

Abbreviated Chronology

Time Of Day	Event/Actions Taken
----------------	---------------------

Friday: August 15, 2003

12:00 mid.	NYC Transit subway system resumes partial service.
2:00 p.m.	The parking lots at New York LaGuardia Airport are completely full; officials announce that they may begin limiting automobile access to the airport.
4:05 p.m.	Power is restored to the Port Authority Bus Terminal.
7:00 p.m.	Con Edison restores power through the New York feeds into the Lincoln and Holland Tunnels.

Saturday, August 16, 2003

6:00 a.m.	The NYC Transit subway system resumes full service.
-----------	---

Sunday, August 17, 2003

Night The New York City Traffic Department finishes the task of inspecting all traffic signals.

In the aftermath of the event, most of the ITS field equipment returned to service with the resumption of power, but it took several days for all the ITS equipment to come back on line. Some had to be reset manually, some suffered damage from the blackout, and some had communications problems that required in-field maintenance visits.

Subsequent to the event, many agencies have already begun the process of purchasing new backup power. New York City DOT staff has already installed uninterrupted power supplies for each of the traffic control servers at the JTOC. Over the past two years, NYC DOT has upgraded many of its signals from incandescent lamps to LED, which require much less power to operate. As a result of the blackout, agency managers are looking at the possibility of adding battery backup to critical intersections. This would allow signals to work for a period of several hours during a similar blackout.

As a result of the congestion caused by an overwhelming number of pedestrians and vehicles trying to share the same space, New York City is looking at developing a transportation plan that would steer pedestrians and vehicles to predetermined streets and bridges. One example would be to designate certain bridges for pedestrians and others bridges for vehicles, while maintaining lanes for emergency response vehicles at key locations.

In the months following the blackout, the U.S. Department of Energy, the General Accounting Office, the Federal Energy Regulatory Commission, the U.S. House of Representatives, the North American Electric Reliability Council, and other interested groups all gathered experts to investigate the causes of the blackout. As a result of the blackout, two commissions were formed to look at how the New York City region responded. NYC Mayor Bloomberg commissioned a report to look at how to enhance New York City's Emergency Preparedness. This report was published on October 28, 2003 (downloadable at www.nyc.gov). The report looked at several areas of emergency response including transportation and communications.

In order to better respond to transportation needs of those crossing the Hudson River into New Jersey, a coalition of transportation and emergency response agencies formed the Trans-Hudson Emergency Transportation Task Force. This task force focused on issues relating to moving people from New York City to New Jersey. Work is focused around six topics:

- Bus terminals, the Lincoln Tunnel, and ferry terminals
- Inter-organization communications
- External communications
- Cross honoring of transit fares during emergencies
- Emergency electrical power
- Alternative ferry landing sites in New Jersey.

3. Findings

3.1 Advanced Preparations and Planning

Staffs from the transportation and law enforcement agencies involved in this review stressed the need for being prepared for catastrophic events as well as daily emergency situations. They recognized that events do not always go as planned and that plans must be flexible and sometimes implemented without direct communications between superiors and staff. They also noted that every event provides them the opportunity to learn, to improve their approach, and to apply their knowledge. Moreover, they understand that many different types of solutions may be available to them and that they should be cognizant of these alternatives.

Develop procedures to guide actions to be taken early in an emergency

All of the transportation agencies within the New York-New Jersey-Connecticut Metropolitan Area that were included in this study had either an emergency response plan or standard operating procedures in place. Most often, these plans and procedures spell out actions that need to be taken early in an event. In some cases, the plan identifies who is responsible for opening the emergency operations center. For example in NJ Transit, the chief of police, the assistant vice president for bus, or the assistant vice president for rail has the authority to open their center.

In the Port Authority of New York and New Jersey, executive managers are sent e-mails, a blast fax, and called by phone in the event of an emergency. During the blackout, however, several line department managers reported to the emergency operations center without being called because they knew the agency's procedures. In New York City Transit, once managers establish that an event will last for an extended time, each department or division positions a senior representative at their emergency operations center. Each senior representative has direct communication with the control center of the mode they represent.

Ensure your plan covers loss of all communications

During the blackout many agencies lost one or more sources of communications. Agency representatives realized the need to develop plans in the event that communications is lost (NonComm plans) identifying what actions must be taken in the event of an emergency when no lines of communication are available. Such plans may be internal or involve other agencies. During roll call, for instance, New York City police officers within the traffic division are assigned locations to which they must proceed without being notified in case of an emergency.

Some agency representatives discussed having a NonComm plan for employees in case they cannot contact their families. This may involve establishing a hotline for family members to call to get information and updates. A "NonComm" plan may also designate that certain employees gather at a staging area to ascertain the extent of the event and make decisions. Another option that was discussed was that the plan identify employees who would proceed to or remain in their homes and work remotely.

Train and practice

Many of the interviewees could not overemphasize the importance of training and practicing responding to significant events. In response to a train derailment, staff at NJ Transit staff trained 100 employees in their rail division on the Incident Command System. This training was followed by two tabletop exercises. NJ Transit executives also stressed training the “second and third string” in the event the “first string” is not available.

Representatives of Niagara International Transportation Technology Coalition (NITTEC) member agencies in the Buffalo, New York, area participate in international tabletop exercises. These exercises include state, provincial, and local transportation and law enforcement agencies and federal custom and immigration personnel from both the United States and Canada.

Supervisors at the MTA Bridges and Tunnels have been trained so that they can make field decisions at any time in the event communications is lost. Agency employees are also cross-trained so that they can perform another employee’s job at a moment’s notice.

NJ Transit staff is devising a training program for the media. This effort will enable the media to identify the responsibilities of the various transportation agencies in the region and the facilities that they manage or operate. Part of this training will involve developing a list of agency points of contact for the media and a list of points of contacts within the media for the agencies.

Based on what they learned during the blackout, staff at one agency will now be training employees for jobs normally performed by a contractor. For example, when a generator failed during the blackout, contractor staff was not available to fix the problem. Agency staff took a while to understand the problem and formulate a solution. These interviewees noted that they need to maintain the capability to repair equipment in case of an emergency and never give up the ability to service equipment with in-house staff.

Learn from past events

Staff at NYC Transit noted that employees were guided by the experience they gained from the blackouts in 1965 and 1977. They said that either staff had first hand experience or those with experience passed it on to others. Previously, people who were working during the earlier blackouts trained those who came onboard later. NYC Transit staff also emphasized that they are continually learning through the many events that occur daily. Every emergency is heavily studied and becomes part of future training, when appropriate.

Some representatives mentioned that preparing for the Y2K event prepared them for this blackout. During these preparations, agency staffs had to plan for the possible loss of electrical power. Many identified their need for backup power sources. Staffs at INFORM and at the NITTEC identified several key intersections at which generators would be installed to operate the traffic signals. INFORM staff also identified key fueling facilities, and they installed generators at those locations.

TRANSCOM staff related that while preparing for Y2K they started to develop strong working relationships with staffs from the various emergency operations centers located in New York and New Jersey. Staff from NJ Transit remarked that during their Y2K preparations, they entered an

agreement with a commercial gasoline firm to provide fuel in case of a power outage. The agreement specified that NJ Transit staff would provide power generators that would be connected to one or more gasoline stations operated by the company. The vendor, in turn, would provide the fuel.

Furthermore, NJ Transit staff noted that they gained experience during the Centennial Celebration and Op Sail 2000. During these events, participants had to be moved from a single location, such as Liberty Park, to various destinations in eastern New Jersey. This movement was similar to what occurred during the blackout - transporting commuters from a single location, such as the New Jersey ferry docks and the Port Authority bus terminal, to surrounding communities.

In response to the events of September 11, staff at INFORM developed emergency management procedures in conjunction with their New York State DOT headquarters in Albany with some assistance by Federal Highway Administration (FHWA) and TRANSCOM staffs. They implemented these procedures during some practice drills in the spring and summer of 2003 and for the U.S. Open and a recent hurricane. Staff at the Port Authority noted that after September 11, they installed a backup generator at the location of their emergency operations center, and it performed as expected.

Almost every representative from the agencies included in the study noted that they were involved in reviews of the August blackout. All were involved in internal reviews and many were involved in interagency discussions. For example, INFORM staff brought local transportation agencies and law enforcement representatives located on Long Island together. Officials from NJ Transit convened a task force of agency representatives responsible for moving people and goods across the Hudson River - the Trans-Hudson Emergency Transportation Task Force.

Consider the movement of pedestrians as well as vehicles

During the September 11 attack and the blackout, severe traffic congestion was caused by employees all leaving work within a short period of time and the conflict between pedestrians and vehicles all wanting the use the same river crossings. It was noted that people walking through tunnels and across bridges could prevent emergency vehicles from entering an event's location. Therefore, some agency representatives discussed the need to plan for the flow of pedestrians. They stressed the necessity to identify and publicize transportation hubs - locations where people can assemble and from where they could take public transportation buses out of the city.

During the blackout, staff at the MTA Bridges and Tunnels worked with staff from the NYC Transit Buses to transport pedestrians across the bridges and tunnels. Bridges and Tunnels staff marshaled pedestrians into staging areas, mainly near the entrances to a few tunnels and bridges. NYC Transit Buses supervisors sent buses to these locations to transport these people across the facility. They foresaw using a public address system in future emergencies to tell pedestrians where to go to catch transportation out of the city.

Representatives from other New York City agencies also discussed controlling the conflict between pedestrians and vehicles. They introduced developing a plan that would identify streets to be used only by people on foot and assign staff or citizens at major intersections along these streets to control traffic. The plan would also identify which bridges pedestrians would use and which ones would be for vehicles. In some cases, such as the 59th Street Bridge, one level would be used for pedestrians and the other for vehicles.

Periodically re-evaluate the need for backup power and generators

Most agencies had some degree of backup power during the blackout. In some cases it was adequate; in others, it was not. For example, over the years, the New York Thruway Authority management installed generators at all facilities when the facilities were being rehabilitated. The Connecticut DOT Newington Operations Center contained an uninterrupted power supply and a backup system run by diesel fuel and batteries. The scheduling and dispatch system in the NYC Transit Paratransit center was also connected to an uninterrupted power supply and backup generator. Fortunately, all three agencies were able to continue operations with minimal interruptions.

Some representatives mentioned that their infrastructure facilities were receiving power from more than one supplier or that their backup operations centers were receiving power from a different source than their main center. They never planned for a power loss from all their sources of electric power. As a result, staff members are identifying additional means of obtaining backup support.

Representatives of some agencies were surprised by what was not covered by their backup systems. Two agencies lost power for the card key systems that governed access to their offices. Some agencies had backup power for their computers but none for the air conditioning units needed to cool the equipment. Agencies that had newer central telephone systems experienced more problems than agencies with older systems.

Some agencies had backup power for only a portion of their fueling facilities. Some had backup for the fuel pumps but not for lighting at the facility. One agency recently converted to electronic fuel dispensing stations. After losing and then regaining power, some of the computers that ran the stations had to be manually restarted.

Some interviewees noted that they had backup power but it had not been tested under a full load, and did not operate as expected. Others noted that on the day of the blackout all their portable generators were being serviced. Some staff mentioned that their generators were centrally, rather than strategically, located. They had trouble deploying the generators because traffic congestion slowed the workers.

Many of the interviewees acknowledged that they are re-assessing their backup capabilities. They are looking at what facilities and what critical functions within the facilities need power and the amount required. Some will be separating backup power for the facility functions (heating, lighting, air conditioning) from their computers and communication equipment. Another will be providing an uninterrupted power supply for each of his computers rather than having a source shared by several machines.

Staffs from the three agencies residing at the Joint Traffic Operations Center discussed the renovations planned for their facility. These staff members noted that based on their experience with the blackout, plans to provide backup power are being revisited and will be amended as needed.

Do not ignore low-tech solutions

As one interviewee declared, “Nothing worked all the time.” Often a low-tech alternative was the solution to a problem. Agency representatives used a combination of facsimile machines, pagers, 800 numbers and conference call lines, older radio systems, and previously installed dedicated landlines to communicate within and among agencies. Both TRANSCOM and NJ Transit have established 800 numbers into which staffs from the various agencies can call and conduct conference calls.

TRANSCOM staff had previously hired a contractor to provide a faxing service. Staff provided information to this “fax vendor” located outside of the region, which in turn sent facsimiles to the member agencies and other parties. One interviewee planned to stock up on glow sticks that can be transported to areas to provide temporary lighting when needed.

Staff at INFORM noted that resetting traffic signal controllers with a limited staff was difficult. After assessing their actions during the blackout, they have grouped intersections according to their snow plowing routes. They will be making laminated sheets of the routes to guide technicians as they check and reset the traffic signal controllers. Police assigned to the Traffic Control Division used scooters to convey messages to officers in the field when their communications was temporarily disrupted.

Because three of the eight carriers under contract to the NYC Transit Paratransit did not have backup generators before the blackout, they were requested to obtain backup generators that can be used to power their fuel stations. Carriers were also requested to maintain a bank of charged batteries for their cell phones and to obtain battery chargers that can be run from a vehicle. Communications between the control center and some carriers was hampered. Paratransit staff printed hard copies of their manifests and trip tickets, and contractors went to the control center to receive them.

Do not neglect the small items

Interviewees identified some preparations that they will be making in response to the lessons learned from the blackout. Several mentioned the need to stock food, such as high-energy food bars, and water for staff that have to operate emergency operations centers over an extended period of time. Others highlighted having additional flashlights and lanterns and charged batteries for cell phones, pagers, portable radios, and portable computers. One interviewee stressed having a portable AM/FM radio and batteries so they could receive information from the media.

The plan for one agency outlined procedures to take if its central facility had to be evacuated, one of which called for having phone calls to the agency forwarded to another location. Unfortunately, the facility had to be evacuated. Staff then realized that forwarding calls was not

an automated process and the telephone carrier had to be contacted. Unluckily, because of difficulty with the phone service, the provider could not be reached. Agency staff have since worked with the provider to establish an automated process to forward calls.

3.2 Institutional Coordination

One interviewee opined, “Look out for people who oversell technology and understate relationships or vice versa. When you lose your technology, people will find ways of getting the information out. Technology is great, but both solutions are needed. Do not exclude one from the other.” Interviewee after interviewee echoed this comment. They stressed that solid working relationships are essential to properly respond to an emergency. These relationships must start within one’s organization and progress to outside agencies. One representative agreed, “You need to know the players and how to connect to them. You need to be inclusive and not exclusive.”

Establish internal coordination

Internal coordination is essential for all agencies, but especially so for those with many different operating entities. For example, during the blackout, staffs within the Connecticut DOT’s highway, transit, commuter rail, and airport divisions were in constant contact. Personnel had previously become familiar with each other through day-to-day operations and joint terrorism exercises.

The MTA is the umbrella agency for several New York City transportation agencies. Staff from MTA Bridges and Tunnels worked with staff from NYC Transit Bus to assist pedestrians in their effort to leave Manhattan and return home. Bridges and Tunnels staff would channel people into staging areas and Bus staff would send buses to these locations.

Bus staff also worked closely with MTA Police to move commuters from New York Penn Station to Long Island. Police cordoned off an area around the station for the buses to enter and collect passengers. The Police then provided escort service for the “Long Island shuttles,” sometimes numbering up to 14 buses, from Penn Station to the Long Island Railroad’s Jamaica Station. All three divisions shared traffic information with each other.

Within the NJ Transit, there are separate control centers monitoring the daily operations of heavy rail, bus, and light rail. These centers are tied together through a phone center, and throughout the blackout staffs remained in contact with each other so each knew what the others were doing.

Build on external relationships with other transportation agencies

Interviewees stressed that coordination with other transportation agencies is essential. As one executive expressed, “We, in the region, understand each other. We recognize the need to know who to talk to.” Some noted that since September 11 and the blackout, some of the major transportation agencies in the region are linked by dedicated telephone landlines into each other’s offices. Some have also installed dedicated landlines into the offices of their contract carriers.

One interviewee stressed that everyone should know what others are doing. Throughout the blackout, all agency staffs were seeking traffic information and providing what information they

had to others. TRANSCOM staff tried to ensure that its member agencies and other parties had the most current information possible. Prior to the blackout, TRANSCOM staff had provided their member agencies and I-95 Corridor Coalition members with an 800 number so member personnel could contact TRANSCOM in the event of an emergency. As information was received, TRANSCOM personnel relayed that information as broadly as possible. They sent facsimile messages to 150 to 200 agencies or companies and sent e-mail messages to 200 to 300 agencies or companies.

Staff from the Port Authority of New York and New Jersey noted that one of the biggest things to happen since September 11 was the establishment of new working relationships, some with atypical partners and agencies. For the blackout, Port Authority staff were able to obtain large generators mounted on trailers from Baltimore and Philadelphia. They attributed this action to the fact that a district manager had developed relationships with others in transportation agencies in those cities after September 11. They also noted that staff from the New Jersey DOT that was not greatly affected by the blackout sent generators to the Port Authority from their yards in the southern part of the state. Again, one individual noted, "We knew whom to call."

New York State DOT staff at the Joint Traffic Operations Center concurred. They noted that after preparing for Y2K and responding to the events of September 11, communications among the area's many agencies improved, some of which started to occur during day-to-day interactions.

Because many of the technologies were not working, staffs from the area's transportation agencies provided each other with verbal reports. NYC Transit bus operators would provide anecdotal information to their supervisors who forwarded it to others. Bridges and Tunnels staff were able to see what was happening at their facilities because their cameras continued to function. They relayed existing conditions to the area's agencies that could no longer obtain video feeds.

The Connecticut DOT management offers space in their building for FHWA Connecticut Division Office staff in the event that the FHWA facility is rendered inoperable. Staffs at the Port Authority of New York and New Jersey, New York City Waterways, and NJ Transit have developed relationships from working together on day-to-day matters as well as preparing for and responding to emergencies.

Involve law enforcement agencies and other non-traditional agencies

Members of several staffs from transportation agencies stressed the need to develop working relationships with others from agencies not considered transportation agencies. Most of these individuals specifically mentioned law enforcement agencies. For example, the Connecticut DOT staffs worked closely with the Connecticut State Police. Video feeds from the Connecticut DOT operations centers are channeled into two communications centers operated by the State Police. In addition, New Jersey State Police assisted NJ Transit Police in securing the New Jersey Penn Station. Because NJ Transit Police had to focus on the outside of the building, State Police patrolled the interior.

Some New York City police officers are located at the JTOC. There they serve as a liaison between the Police Department and other city and state agencies and the media. They verify accidents reported by motorists, inform the media, and coordinate with staff at transportation agencies to provide the resources that are needed to respond to the incident.

Bridges and Tunnels staff worked NYPD to manage traffic; the two agencies were in almost constant contact via the telephone and radio. Within a half hour's notice, Bridges and Tunnels crews modified traffic patterns on some of their facilities to accommodate buses trying to enter Manhattan. They reversed one lane so that there would be three lanes in and one out, rather than two in each direction.

Staff at INFORM remarked that previous events, such as preparing for Y2K, the U.S. Open, and the events of September 11, showed the need to coordinate with the police. At first, they had a difficult time communicating with forces of the State Police and police departments within two counties and several municipalities. Over the years, however, coordination and cooperation has improved immensely. Moreover, in emergencies, INFORM staff has direct contact with the NYPD.

The Port Authority staff contacted an extremely "non-traditional" player. They requested light towers from the New Jersey National Guard.

Working closely with state and local emergency management centers

During an emergency, the States of New York and New Jersey and New York City open emergency management centers. Several interviewees highlighted that working closely with the staffs at these centers produced positive results. For instance, NJ Transit staff was able to acquire portable lighting and water and food bars for stranded commuters through the New Jersey OEM.

TRANSCOM is mentioned in the various emergency response plans for New Jersey agencies and in the incident management plans for each county in New Jersey. In emergencies, TRANSCOM staff is provided space at the New York City OEM and the New Jersey State Police communications center.

Include the private sector

Through a memorandum of understanding between NJ Transit and private carriers, private fleets were available to assist in the movement of stranded commuters. NJ Transit staff had to work with other public sector agencies to ensure that the private carrier vehicles were granted access to the tunnels into Manhattan. Furthermore, NJ Transit staff is sponsoring private carriers so that they can obtain access to the Government Emergency Telephone System.

As a result of the blackout, staffs at NJ Transit and the Port Authority have agreed to coordinate with private carriers when implementing emergency response plans. In particular, Port Authority staff will coordinate with the long haul carriers that operate out of their bus terminal.

Some executives noted that there has to be more coordination with the public utilities. Some suggested that staff at the utilities should send out periodic facsimiles to the public agencies,

similar to TRANSCOM's approach, informing the agencies of when and where power has been and will be restored.

Determine what problems are not solved by strong relationships

Although interviewees highlighted strong working relationships, several staff members raised the issue of differing priorities among agencies. One individual asserted that the interests of New York City and the suburbs differ. New York City emergency managers tried to move people out of the city as soon as possible. These managers urged people to evacuate the buildings and go home in order to lessen the problems in the city. That put everyone on the roads at the same time, straining the suburban transportation network. The problem was compounded by the fact that the public may have felt an urgency to leave because they may have thought that the blackout was caused by terrorism.

The issue of transit agencies honoring tickets and passes from other transit agencies was raised. There was not a uniform approach among the agencies. Some honored the tickets and passes while others did not. Furthermore, some agencies suspended fares while others continued to charge them. Interviewees noted that they are working to develop a consistent policy for suspending fares and cross-honoring passes and tickets of other agencies.

Another issue that concerned some interviewees was the sharing of equipment. Some individuals noted that staffs at many agencies, including their own, did not readily share equipment because no one knew how long the blackout would last. Requests for light towers and generators were either not filled or the equipment went to other locations. Interviewees stressed that more planning is needed in this area.

During the blackout, staffs at transit agencies that operated bus fleets faced a dilemma - how does one allocate buses during an emergency? NJ Transit staff had to decide how many buses to send to the Meadowlands, how many should service the ferry landings, and how many could be used to fulfill the requests of local communities. Staff at New York Transit Bus had to decide how many buses to keep on their fixed routes, how many to send to subway stations to pickup evacuated passengers, how many to use to assist Bridges and Tunnel staff in moving pedestrians through their facilities, and how many to use to move people to commuter rail stations.

3.3 Operating Decisions

Throughout an emergency decisions must be made -- sometimes based on reliable information and other times without. These decisions usually affect both agency personnel and equipment and the general public. Understanding how key decisions are made in an emergency will greatly help in responding to that incident.

Set your priorities as quickly as possible

Agency representatives related that at the start of the blackout, they did not know the cause or the extent of the power outage. Once they learned more about the event, they were better able to respond to it. Most set their priority to be public safety and, as one interviewee described, traffic was secondary for the first couple of hours.

NYPD officers assigned to the Traffic Control Division, who would normally report to an assigned intersection to direct traffic, were called to other emergencies such as people stuck in elevators and to nursing homes with life support systems for residents. On Thursday and Friday, managers at NYC Transit Paratransit focused on serving patrons who required life-sustaining services such as dialysis and chemotherapy.

During the evacuation of the New York City subway system, operators identified passengers with special needs. In some cases, these passengers, such as two pregnant women, stayed in the cars until medical help arrived. In another instance, a passenger was provided special assistance, as NYC Transit crews carrying a wheelchair-bound passenger from a train struck on a bridge to the roadway below.

Managers of the transportation agencies, police officers, and the general public set priorities at the loading areas for buses and ferries. All agreed that woman, children, the elderly, and the sick should board the buses and ferries first. As one executive recounted, “It felt good and the public was appreciative.”

Understand the function of your roadway system

Transportation managers made several key decisions throughout the blackout. One was to close some lanes of traffic within some tunnels. Because the tunnels’ ventilation systems did not have backup power, managers had to reduce the number of cars to reduce the amounts of pollutants. At the same time, however, it was imperative that the tunnels remain open to allow the passage of emergency vehicles. Other facility operators modified the lane configuration for some bridges and tunnels. They reversed one lane so that there would be three lanes for traffic leaving Manhattan and one used to enter the area. This action helped address the amount of vehicles leaving Manhattan.

NYPD supervisors instructed their 2000 traffic agents to stop issuing summons and assigned all of them to direct traffic. Even students from the police academy got called into action. They were assigned to keep the traffic on the 59th Street Bridge flowing. Also supervisors from the Traffic Control Division requested assistance from the department’s Highway Patrol to help manage the pedestrian-vehicle conflicts on bridges and to keep some lanes open for emergency vehicles. This action was able to occur because there was less congestion on the freeway system than on the arterial streets.

INFORM staff expanded hours of operation of the highway emergency local patrols. They started the afternoon shift at 3:00 p.m. and extended the hours past the normal 7:00 p.m. shut down. New York City DOT staff had contractors install stop signs at a few key intersections.

INFORM staff also had to decide whether to operate the drawbridges under their jurisdiction. Some were in the up position when the blackout occurred. They set a priority of ensuring that evacuation routes remained open. Therefore, they lowered the bridges using emergency power generators, locked them down, and then notified the Coast Guard who notified boaters.

Understand the options available in your transit system

Because of the heavy use of transit in the region and its dependence on electricity, the blackout obviously had a major effect on the public transportation systems. Some actions were based on preplanning while others were based on years of experience in the public transportation sector.

One issue that came to the forefront quickly was what mode, if any, should take precedence. Since the events September 11, people became accustomed to using the ferries. On August 14, after learning that the subways were not working, commuters flocked to the ferry terminals. There were also an enormous number of commuters at the PABT. Transit managers had to decide if they should shift everyone over to ferries or establish an alternative bus operation in conjunction with the ferries. They decided that they had to utilize the capacity of both modes.

The closing of the PABT caused a major disruption. Commuters waiting for buses were forced to evacuate the building and move onto the surrounding streets. To alleviate as much congestion and confusion as possible, managers from NJ Transit decided on a load-and-go solution. As buses entered the bus terminal area, commuters were loaded onto buses regardless of their final destination. The buses went to a staging area that was set up at the Meadowlands. At that location, commuters would then board buses to reach their final destination. Similarly, passengers disembarking from the ferries in New Jersey were met by buses that took them to the Meadowlands.

NJ Transit managers also had to deal with loss of the light rail system. In this instance, they created a bus bridge and used private carriers with whom they already have signed memoranda of understanding.

As previously noted, NYC Transit Paratransit staff continued operating service but focused on patron needed life-sustaining services. Because of problems communicating with their contract carriers, some manifests had to be printed in hard copy and picked up in person by the paratransit operators.

Early in the blackout many decisions concerning re-routing within the NYC Transit Bus were handled at the local division level. When communications was restored within the agency, then managers in the main office provided more input on routing.

As soon as the blackout occurred, staff at NYC Transit Subway started to assess the situation and identify the locations of all of the trains. They needed to determine how many trains had been in service and where they were - in stations, in tunnels below water, and on bridges. Once they decided that the blackout would last more than 30 minutes, they began established policies to react to the situation. Following this policy, they issued a directive for all trains to discharge passengers and secure the train if it was in a station and to begin the process of evacuating those not in a station.

Establish and disseminate a policy for displaying messages on variable message signs

Various agencies had differing policies on displaying messages on variable message signs. Staff at some authorities granted requests from other agencies and posted messages. Members of the I-95 Corridor Coalition have developed some consistent messages for message signs. Also

members agreed that if they get a request to post a message for an incident they would try and broadcast it. For example, staff at Bridges and Tunnels posted messages when requested by TRANSCOM staff. Policies at other agencies prevent staffs from posting messages that did not directly affect their facility.

Permanently mounted variable message signs operated by INFORM staff lost power. Staff, however, deployed 28 portable signs and changed the messages on others. Most of the messages alerted motorists of what bridges were closed leading into New York City and to alert motorists to use caution because there were traffic signals at intersections were not functioning. Normally, the messages would have warned motorists of congestion and presented alternative routing, but because of the traffic congestion created by the blackout there were no good alternate routes.

Develop a consistent policy for toll and fare collection

Different authorities and operating agencies suspended tolls and fares while others did not. The New Jersey Turnpike, Garden State Parkway and the MTA Bridges and Tunnels remained open but they waived their tolls. NYC Transit Bus stopped collecting fares late Thursday and all of Friday.

The New York Thruway had backup power for their toll facilities and therefore continued to collect tolls. Staff remarked that they have a responsibility to collect tolls and their policy is to stay open. Also one interviewee noted that one authority had problems in the past when they suspended tolls and it created accidents when drivers slowed down and do not know what to do.

Ferries and some of the bus operators continued to collect fares. Some operators honored passes and tickets from other operators and some did not. Those carriers who lease buses from the NJ Transit are required, in cases of emergency, to honor tickets issued by NJ Transit.

Develop procedures detailing when to restart your system

Several interviewees noted that precautions had to be taken when restoring power to equipment and resuming operations. For example, before NYC Subway managers resumed service, agency crews had to walk the system. Maintenance-of-way employees had to make sure there was no water in the tunnels and no people on the tracks. Signal division personnel also inspected the signals and switches. It took approximately eight hours to restore service on the entire subway system.

Staffs at the Joint Traffic Operations Center and INFORM had to consider additional power outages, surges, and spikes when deciding when to restart their center's equipment. Both suggested waiting for a "quiet time" before starting up. Staff at the New York City DOT waited until Saturday to start. Because intermittent brownouts would also affect the signal systems, decisions had to be made covering often crews would be sent to intersections containing flashing signals.

Develop clear procedures for evacuations

Evacuations were executed with very few incidents. Interviewees noted that experience and training of staff were the key reasons. Several agencies identified procedures they used.

When NYC Transit Subway managers determine that the loss of power will be a long event, they begin the process to evacuate the subway system. First, they identify the locations of the trains. They make radio contact with the train operators and review schedules. Then, they establish a priority of how to evacuate the trains based on their location, the number of people on each train, and the number of passengers with special needs. Trains in tunnels below water and on bridges are given a higher priority. Operators and conductors were then notified through their radio system to discharge passengers and secure trains that are in stations or lead the evacuation of trains in other locations.

In many cases, the train crews were on their own -- they needed to make their own decisions for the best means of evacuation. The fire department was busy evacuating people out of elevators, so they could not help with the evacuation of the subways. New York City subway managers relied on their own staff and their own equipment to remove people and escorted them to the nearest stations. Some supervisors were sent to areas that were the most difficult to evacuate.

Train crews had to walk through the train to inform the passengers of what was happening. They walked the passengers to the last car and informed them how they are going to get off the train. Train crews also notified the control center of people with special needs. Subway crews successfully evacuated 413 trains in approximately three hours.

Staff at the PATH line faced similar situations. Once managers ceased attempts to restore power, they ordered a full evacuation of the trains and stations. They had 19 stranded trains, 16 of which were in tunnel sections. In two hours all stations were evacuated and secured.

The Port Authority Bus Terminal managers had previously made a decision that in cases of emergency the terminal would be evacuated rather than made partially operational. Once the decision was made the terminal was evacuated in 15 minutes. Stranded commuters were ushered into the surrounding streets to wait for buses.

3.4 Role of Advanced Technology

Technology can play a crucial supporting role in aiding transportation decision makers during times of crisis. It can help agency personnel obtain information on which they can make better decisions as events unfold. Advanced technology allows agencies to better coordinate responses with other agencies. It also allows agencies to collect and distribute real-time information so that individuals can make decisions on when and how to travel. As many staffs discovered during the blackout, advanced technology is useless without emergency backup power. Many interviewees spoke of their dependency on Internet and electronic-based information and the realization that loss of power can critically affect their ability to function. The expanded use of ITS has made power redundancy considerably more important. Appendix B contains a summary of the installed ITS technology within key transportation agencies in the affected areas. The summary describes ITS technology installed, which equipment maintained operations capability during the blackout, and which equipment lost operations capability during the blackout. It also provides a set of pre-event preparations that an agency may have taken that allowed it to better respond to the event as well as a set of lessons learned from the event.

Normally, advanced technology helps transportation agencies better manage the complex day-to-day operations of the transportation system. It provides data, visual images, and communications tools not only to the agencies but also to the traveling public. The NYC region has numerous TMCs, over 300 miles of highway instrumented with sensors that transmit highway operating data, and a video system (IRVN) available to all the agencies and the public. The installed ITS equipment in this area was severely affected by the blackout.

The ability to warn motorists to detour or cancel a trip before entering into an area dealing with an emergency is greatly enhanced through the use of ITS technology. ITS equipment outside of the affected area can give advance warning to alert motorists about a problem ahead. On September 11, TOCs all along the Eastern Seaboard displayed messages on VMS and provided traveler information on HAR broadcasts. For the blackout, the use of VMS and HAR was not as widely used. Only agencies in the immediate area of the blackout used their VMS and HAR systems to post advisories.

The I-95 Corridor Coalition is a voluntary coalition of transportation and law enforcement agencies that share information about highway and transit conditions from Maine to Virginia. The coalition has a set of guidelines in place allowing agencies to request other agencies to post information about travel conditions.

Provide power to ITS equipment at both the TMC and in the field

As many managers found out, it is not sufficient to have backup power just at the control center. Although it can be more difficult and expensive to provide backup power to field equipment, certain agencies are exploring the cost of providing this backup power to certain field equipment at key locations. The New York City DOT is looking at prioritizing critical intersections and installing backup capacity to the signals. This would allow intersections to work for a limited amount of time in order to handle the heaviest demand. Many private cell phone companies as a matter of course provide backup power in its cell phone towers in the field.

Examine potential sites to place advanced technology to help better communicate with the public during an emergency

The vast majority of ITS equipment is installed to function during normal operating conditions. Agencies should consider the placement of technology at major transportation centers to better respond to emergencies when those facilities are closed or compromised.

Immediately following the blackout, people tended to head for certain transportation centers without being told. Large numbers of people headed to the Port Authority Bus Terminal, Grand Central Station, Penn Station, water ferry docks and the river crossings. Because of the lack of power, it was difficult to communicate transportation options, or lack of options, to the large numbers of people gathered outside of these facilities. All of the technologies installed to communicate options are located inside the buildings that were evacuated. One official suggested installing emergency powered signs outside of major transit hubs to better communicate options when the hubs are closed to better communicate transportation conditions and options.

Portable VMS is one example of technology that can help during an incident or emergency. In order to better direct people to major transportation nodes, New York City officials are looking at the option of pre-designating certain pedestrian and vehicle routes in the case of an emergency. These routes would need to be identified and publicized alerting the public as to which route to take during an emergency.

Determine the benefits and costs of purchasing and maintaining backup power

The amount of backup generation power available varied widely among agencies as each agency weighs the benefits and costs of maintaining backup power and equipment. Toll facilities, specifically the New York Thruway and the MTA Bridges and Tunnels Authority, appear to have had a greater capacity to operate during the blackout than others. This may be because these agencies are dependent upon toll revenue, and it is a business decision to have backup power capacity.

Even though power was initially restored within several hours in some parts of the region, there were electrical spikes and brownouts for the next several days as power was slowly restored to the entire electrical grid. Therefore, it may be several hours, or even days, after power is restored before it is advisable to restart advanced technology equipment. Several agencies were cautious in switching back to the power grid until they were sure that the power supply was stable. The New York City JTOC waited until Saturday night, two full days after the event began, before they switched from their generator backup power supply to the power grid.

Utilize portable ITS equipment in responding to incidents

INFORM staff was able to deploy its portable VMS equipment because the agency maintains backup power for the message signs. NYC Transit, NJ Transit, and MTA all have mobile command centers that are able to operate and respond depending upon the situation. The Integrated Incident Management System (IIMS), a joint program by New York City DOT, New York State DOT, and NYPD includes installed ITS equipment, including mounted and portable cameras, that allow managers to view an accident or situation from remote locations. After getting a visual identification of the situation, the managers can dispatch the proper response needs, including fire, ambulances, police, and maintenance and repair crews. But during the blackout, the system was not operational, and agency officials were not sure that the IIMS would have been useful because it is designed primarily to respond to isolated incidents.

Automated vehicle location system technology can allow a central command or operations center better manage its fleet. The lack of AVL technology in vehicles made it difficult for some agencies to manage their fleets efficiently. During the blackout, numerous agencies within the New York City were unable to locate the position of the vehicles in their fleet and so were not able to dispatch them efficiently to needed locations. One of the recommendations from the city's Emergency Preparedness report is to integrate AVL into essential city vehicles.

Maintain some older technology, which may be less susceptible to power outages

In some instances, older technology worked while new technology did not. The most dramatic example of this is the plain old telephone system (POTS) that for the most part functioned throughout the blackout. In comparison, cell phones, networked phone systems, and portable phones experienced varying degrees of failures due to the loss of electricity or ceased working

when limited backup power was exhausted. Another example is the implementation of an electronic keyed security system for a TOC or other facility. With a loss of power, an electronic door lock will not work unless it is powered by the backup electrical system.

Realize that with massive outages, the use of ITS to suggest alternative routes may be limited

One value of ITS technology is that it allows agencies to better inform the public of transportation options and to respond to incidents more rapidly. Information relayed during the blackout could have informed the public of certain closures, but because gridlock conditions prevailed on almost all roads for the first three hours following loss of power, there were not many transportation options available. One transportation official was quoted as saying, “we did not have any VMS available to us, but I don’t know what message we would have posted. In most cases, there were no alternatives to offer the motorist.”

3.5 Communications

The greatest obstacle that officials faced in dealing with the blackout was with communications. A NYC Transit dispatcher was quoted in the transit agency’s newsletter “For transportation, I think the blackout was worse than 9/11. And the reason is, no communication.” Communication problems involved both dealing with technology failures as well as the dissemination of informed, timely information within an agency, to other agencies, and to the general public.

The Trans-Hudson Emergency Transportation Task Force identified communications technology as the leading problem from the blackout:

- Most agencies thought they had better backup than they did.
- They did not understand the frailty of their technology.
- Most thought they had better backup power than they in fact had.

Establish direct lines of communication with non-transportation agencies

When the blackout struck, those agencies that had a pre-existing relationship with the energy company, such as NYC Transit, were able to get a quick response from Con Ed, the local energy provider, about the extent and possible duration of the event. Because of that, NYC Transit staff was able to more quickly make the decision to evacuate the subway system. It is important for agencies to have an established communications protocol with agencies such as the energy company, private providers of equipment, and emergency responders, before an event occurs to allow for smoother communications during an emergency.

Establish communications relationships with various media outlets

Most of the public turns to the media (television, radio, or the Internet) to gain information during an emergency. Several transportation agencies were frustrated on August 14 because the media was reporting inaccurate information and the agencies had difficulty getting the proper information to the media.

Establish or strengthen the communication among agencies

For the New York region, TRANSCOM collects and disseminates current transportation conditions information to over 100 member agencies and affiliates. During a normal event TRANSCOM communicates facility status reports to approximately 40 transportation and public

service agencies and this list expands during a large event. During the blackout, it was sending out faxes to approximately 200 agencies or companies, and it was sending e-mail broadcasts to approximately 300 agencies or companies.

Figure 8 shows an example of a fax sent out by TRANSCOM within the first hour after the August 14 blackout.

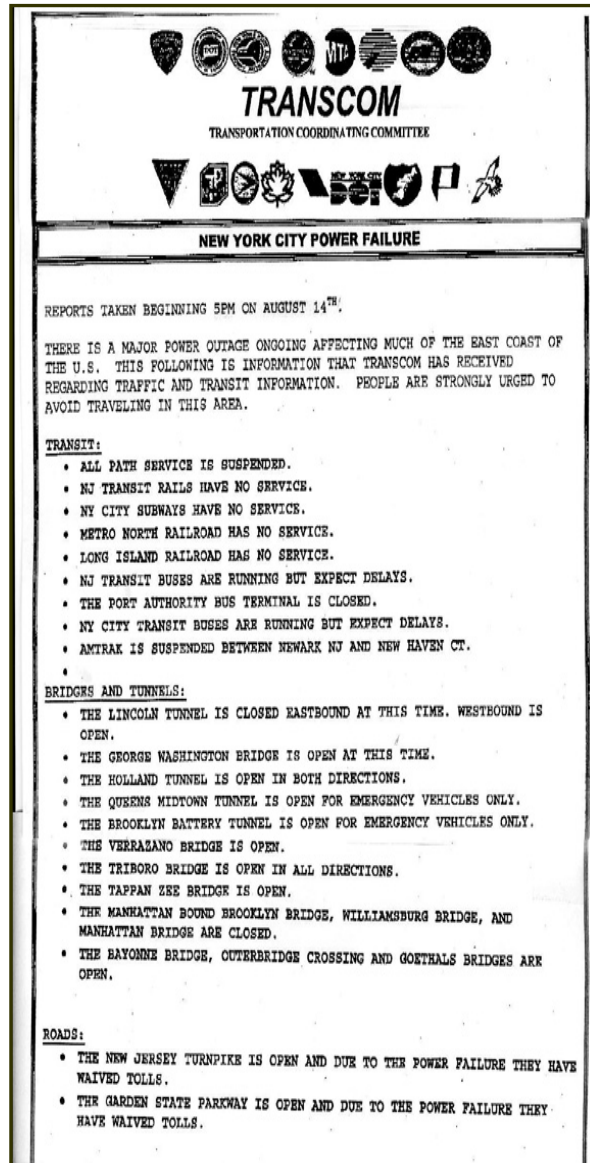


Figure 8. TRANSCOM alert at 5 p.m.

The JTOC provides interagency coordination and communication among the New York City DOT, the New York State DOT, and NYPD. In addition, the NYC Office of Emergency Management (OEM) provides interagency coordination among various branches of city, state, and federal agencies.

Establish a non-communications plan

Because communications failures can and often do occur during the critical first minutes of an emergency, agencies should consider establishing emergency plans that do not depend upon the communication of instructions. NJ Transit has designed emergency bus operations that its drivers know to implement in the event of an emergency. The NYPD as a matter of routine provides officers during the roll call with designated locations to cover in the event of an emergency.

Explore the option of joining the Government Emergency Telecommunications Service and Wireless Priority Service

Emergency situations typically generate significant demand for telephone services, often overwhelming the capacity available within the national telecommunications network. The Government Emergency Telecommunications Service (GETS) and the Wireless Priority Service (WPS) are two government sponsored priority communications systems that provide pre-approved users with priority routing of landline (GETS) and wireless (WPS) calls during times of emergency and crisis, even during periods of peak demand.

GETS and WPS are available to federal, state, and local government agencies, as well as to private companies and organizations, with responsibility for national security or emergency preparedness. Users are given ranked priorities, based on the importance of their role in national security. Transportation agencies are granted a 4th-level priority within GETS and WPS, as are other public utility agencies.

Some City of New York officials reported difficulties accessing the GETS system. As a result, GETS was not heavily used during the period of the blackout and experienced only 1,800 calls. This may be attributable to the inability to access GETS through wireless technology, or perhaps to electrical outages impacting crucial GETS equipment.

3.6 Redundancy and Resiliency of Systems

Redundancy, having backup systems in place in case the primary system fails, is crucial to the day-to-day management and operations of a system. This need for redundancy is even more important during a time of crisis. There are numerous categories of needed redundancy:

- Physical transportation assets
- Personnel
- Communications
- Utilities.

In the New York City metropolitan area, there are numerous forms of transportation. Unlike most regions of the country it is not heavily reliant on the automobile, but instead has a large share of people who walk and take one of the many forms of transit. The region has an extensive highway network, the nation's largest subway, commuter rail system, and fleet of public and private buses, along with numerous water ferries.

This redundancy has served the region well during past major events as people have multiple options. But the blackout affected each of the major modes of transportation and took place all across the system. Usually events are localized in nature and allow for a massive response of personnel and equipment to help alleviate the problem. With the blackout, the impact was felt throughout the region and presented decision makers with difficult choices as to where to allocate the scarce resources that were still operating.

Rethink the definition of redundancy

After the tragic events of September 11, many agencies began to rethink their definition of redundancy. This includes redundancy of personnel, communications technology, operations centers, computer networks, and equipment. It became apparent that having a backup or spare may not be sufficient in and of itself, especially if that backup system shared the same physical space with the primary system. During the blackout, agencies that thought they had provided adequate redundancy within their system discovered gaps in their plans as multiple forms of communications technology failed, generators did not work, and off site locations were sited within the blackout area. In order to provide for better redundancy, some agencies are establishing “virtual operations centers.” By having the capacity to connect a computer into the virtual network, an agency can run its operations from a secondary site or even from the homes of key personnel.

Ensure that an agency has multiple types of communications technology

Sometimes double and even triple forms of communications alternatives are not enough. During the blackout, there were multiple forms of failures of communications technology equipment. Landlines, for the most part, performed better than other communications equipment, but several areas of the city experienced a loss of landline communications because three of Verizon’s central offices experienced outages. Cell phones and radio networks failed as repeaters either were not equipped with backup power or had backup power that ran out after approximately four hours. Call volumes overwhelmed the phone systems. Even the City’s 911-telephone system failed due to the heavy call volume.

Reexamine what components of the system are on backup power

Many of the agencies had backup emergency power for portions of their operations system. In most cases, it may not be cost effective to have backup electrical power for all of the electrical needs of a facility. Therefore, agencies have to prioritize what systems are connected to the backup electrical systems and which are not. Many times, the need for backup power is not obvious until the agency tries to function without it and a gap is identified. Air conditioning, for instance, consumes a large amount of power to cool a building, so it is often not included on the backup power system. But critical technology equipment, like computers, work stations, and monitors, need to be cooled so that they do not overheat.

Several agencies have recently constructed new operations centers and have incorporated technological advances into the building. One example is an electronic security identification system that allows access to doors and portions of a building by the swiping of an employee identification card. Without electricity, this system will not work.

To ensure that there are no critical gaps in what systems are provided backup power, several agencies, including the New York Thruway and MTA Bridges and Tunnels perform regular facility-wide tests of the backup systems. In one instance the agency runs the facility on backup power for an entire night to test that all the necessary parts of the system.

The following is a brief list of some of the items that agencies have noted were left off of the backup power supply but should have been considered for possible inclusion:

- Electronic keyed door entry system
- Centrex phone system
- Fueling system for public and private vehicles
- Sump pumps for tunnels or roadway sections that are prone to flooding
- Spare outlets for small appliances (such as a coffee machine and battery re-chargers)
- Air conditioning for equipment room
- Internet server hosting an e-mail system
- Radio communications system
- Building security systems

Conduct an inventory of resources that might be needed in an emergency

An agency should perform an inventory of its own internal agency assets as well as understand where additional assets could be requested. Because the Port Authority had undertaken an extensive inventory of its assets and had established contact with other agencies outside of the region, it was able to rapidly request additional generators and emergency lighting from agencies in the Philadelphia and Baltimore regions, which were not affected by the blackout.

4. Conclusion

Widespread emergencies each test the people, procedures, and equipment established to manage them in different ways. While emergencies share certain similar characteristics, each is unique, and from each we gain new insight into how to prepare, how to plan, and how to prioritize. The past five years have seen three large emergency preparation and response efforts – for Y2K, for September 11, 2001, and for the 2003 blackout – and the experience of each is adding to a growing base of knowledge on emergency response and planning. This section presents a set of conclusions for emergency planning and response based on the review of the Great Lakes Region as well as the companion review of the New York-New Jersey-Connecticut Metropolitan Area.

Advanced Preparations and Planning

The experiences of Y2K and September 11 encouraged many agencies to draft or revise their emergency response plans—plans that proved invaluable on the day of the blackout. No matter how smoothly an agency may usually operate; efficient and coordinated action during a crisis requires advanced planning and rehearsal. Emergency planning provides agencies with many advantages during a crisis including pre-determined roles, clear and understandable chains of command, availability and readiness of appropriate supplies, and advance identification and rectification of weaknesses in the emergency response. Good advanced planning should include not only planning for the immediate period of a crisis, but for recovery and restoration afterwards.

The accumulation and storage of necessary supplies is a particularly important element of advanced planning, and one that was crucial during the hours of the blackout. The process of advanced planning requires agencies to thoroughly review the resources on which it depends for its operation, and to prepare for the possibility of having to do without these resources during a period of crisis. Emergency supplies can range from the small – including flashlights and glowsticks – to the largest of emergency generators. Effective planning includes developing an inventory of available emergency resources, acquiring any missing elements, and prioritizing the use of limited resources during an emergency. Given the near impossibility of stockpiling sufficiently for every possible emergency, agencies should develop a strategy for the use of precious resources during a crisis and, when possible, for sharing with other agencies and jurisdictions.

A further advantage of effective advanced preparation is the development of plans for the communication of information, within an agency, with other agencies, with the public, with the media, and with elected officials. The importance of accurate, frequent, and calming communication can be forgotten in the height of a crisis, as emergency responders focus on managing the immediate demands of the situation. Communication is vital, however, and can facilitate the resolution of the crisis by encouraging cooperation and discouraging panic. Advanced planning should include communication strategies and the creation of relationships with the media and other important avenues of information dissemination.

Lastly, all emergency response planning should be rehearsed, drilled, and reviewed on a frequent basis. Several interviewees for this case study commented that their agencies had prepared

emergency plans and, more importantly, had practiced them, greatly increasing their effectiveness. Different emergency scenarios should be staged – either through table-top exercises or through in-field exercises – and rehearsed, allowing emergency response to be evaluated and perfected. Emergency drills are also an important way for different agencies to work together in advance of a real emergency, and to identify any preparations that – while sensible on paper – seem unrealistic or unnecessary in practice.

The development of comprehensive plans requires time and effort and the dedication of resources, all for something that may never be used. But, should the need arise, the benefits of having prepared in advance will dramatically increase the chances that an emergency can be managed with a minimum of panic, disruption, and loss.

Agency Coordination

Cooperation between agencies and organizations is vital to successful emergency response, allowing multiple agencies – sometimes covering multiple jurisdictions – to contribute their strengths and skills during a crisis. Without agency cooperation, emergency response can become fractured, with agencies unsure of how to relate to each other or how to jointly participate in a response and recovery operation. Based on the research for this case study, it seems that coordination between agencies during emergencies can exist on two levels: that of the institution and that of the individual. Many interviewees identified the importance of formal multi-agency cooperation during the blackout, but many also identified informal personal relationships as the most efficient and effective way to accomplish much-needed tasks. Both are discussed here.

As part of advanced emergency planning, agencies should establish formal cooperative arrangements with appropriate partner agencies, those agencies with which they would need to work in an emergency. These arrangements should clearly delineate the roles and responsibilities of each agency during an emergency, perhaps indicating that roles will shift as the emergency response moves from one phase to the next. Of particular importance, partner agencies should establish and agree to the use of particular chains of command during a crisis – most likely different from standard chains of command – in which it is clear how authority will be distributed and exercised throughout the duration of an emergency.

The role of personal relationships is harder to quantify but of equal importance during a crisis. It is vital for any individual who will be involved with emergency response to be acquainted with his or her appropriate counterpart at partner agencies, to be able to easily pick up the telephone and place a call to the correct person to request assistance or coordinate response, and to be known and respected by his or her peers in other agencies. All of these elements will combine to make it possible for individuals to cooperate, on behalf of their agencies, for more effective emergency response.

Lastly, it is important to cast as wide a net as possible in developing coordination strategies. Many crises are local – a major fire, for instance, or the break of a water main – but some are regional, with effects felt over a large geographic area. In such a circumstance, as in the blackout, agencies that don't cooperate under normal circumstances suddenly need to work together to manage the situation. The midst of an emergency is not the time to be establishing

relationships and developing a multi-agency understanding of roles, responsibilities, and priorities. Whenever possible, work these elements out in advance.

The Role of Advanced Technology

Technology plays a crucial supporting role in aiding transportation decision-makers during times of crisis. It helps agency personnel make better-informed decisions as events unfold and allows them to better coordinate responses with other agencies. It also allows agencies to both collect and distribute real-time information to people so that they can make individual travel decisions. As many agencies discovered during the blackout, advanced technology is useless without emergency backup power.

The need for the Internet and the use of electronic-based information has been closely woven into day to-day operations at many transportation agencies. The blackout showed these agencies that loss of power could critically affect their ability to function. Additionally, ITS equipment often requires power at both the control center and in the field: As many agencies found out, it is not sufficient to have backup power only at the control center. Backing up field equipment can be more difficult and expensive, but some agencies are exploring that as “a cost of doing business.”

For other types of technology, including traffic signal equipment, sustainability using backup power is an important consideration. Agency staffs should consider the power needs of equipment during the purchasing process and should provide for backup power whenever feasible. Furthermore, agency managers should also consider the restoration needs of the equipment in which they invest. The re-signaling of traffic signals, for instance, is a time-consuming and laborious process. Equipment that is capable of automated restoration can greatly reduce the burden of recovering from a crisis and can free individuals to attend to other, non-automated tasks. For those restoration tasks that require human action, the development of a plan that prioritizes restoration activities and places available staff where they are most needed will be of assistance.

Sustainability in a crisis is of particular importance for variable message signs and other types of technology that can communicate information to the public. During times of emergency, such equipment becomes a vital source of reassurance and instruction for the traveling public, communicating information about the crisis and recommendations for routes and modes of transportation.

Communications

The ability to communicate, internally and externally, is the most critical technological capability required in an emergency. When a crisis occurs, fast communication among all departments of an agency is crucial to stem anxiety, transmit instructions, and begin the process of response and recovery. Reliable communications technology is particularly important for transportation agencies, in which many employees may be working in the field, driving vehicles, or otherwise away from the central offices of the agency. Reaching those individuals with accurate information about a crisis allows them to take whatever action is necessary to protect themselves, their equipment, and the traveling public.

As with more general emergency planning, agency staffs should prepare and drill specifically for the failure of communications equipment. Some interviewees for this case study indicated their surprise that certain elements of their communications networks failed during the blackout, where extensive pre-emergency planning would likely have revealed the weaknesses that led to the failure. Furthermore, advanced planning can provide an opportunity to train employees to perform their responsibilities in an emergency without their standard communications equipment, including establishing communications procedures for times of reduced capacity.

To ensure that communications equipment has the best chance of operating in a crisis, agencies should maintain a mixture of communications technology, particularly a mixture of old and new technologies. In the case of the blackout, many agencies found that their landline telephones operated with minimal interruption, while the newer technologies of mobile telephones and long-distance walkie-talkies were less reliable. Agencies should also do what they can to try to insulate their communications equipment from failure by installing backup power sources – generators or batteries – where appropriate.

Redundancy and Resiliency

The level of appropriate redundancy – for expertise, for equipment, for vehicles, and for technology – will vary from agency to agency. For all agencies, the concept of redundancy is continually being re-evaluated, based on the results of emergency response training and the experiences of actual emergencies. Some large-scale emergencies, like the blackout however, may always exceed the amount of available redundancy. Therefore, given financial and other constraints, managers must assume the most likely types of potential emergencies when planning for redundancy.

In planning for an appropriate level of redundancy, certain strategic decisions can be made that will help to increase the value of planned redundancy. From the experience of the blackout, it is clear that a source of backup power is the most important investment an agency can make. Backup power is crucial because most other systems – including communications, life-safety, and security systems – will operate so long as emergency power is available and sufficient. Without it, every other system will somehow have to be re-created or worked around, leaving agencies hobbled in many areas. Backup power sources must be tested and maintained, however, and must be connected to the appropriate systems. During the blackout, some agencies discovered that crucial operating systems were not connected to backup generators or batteries. In addition, an agency needs to explore the option of having off-site backup facilities. During an emergency that somehow incapacitated the headquarters, the off-site facility may be able to continue functioning.

Beyond backup power sources, agency managers must consider other important areas for the inclusion of redundancy. Based on the particular mission of an agency – to transport passengers, to distribute transportation information, or to oversee an international freight route – different elements will require redundancy. Whatever those elements may be, agencies should use the process of emergency response planning to categorize and prioritize their needs for redundancy and begin to accumulate the necessary equipment and expertise to ensure that all vital systems would have some type of backup in an emergency.

To manage localized emergencies, agencies should consider establishing mutual-aid agreements with partner agencies and neighboring communities. Such agreements make it possible for proximate communities to share resources and expertise during times of crisis, thereby reducing the amount of investment in redundancy that any one community needs to make. This strategy has its limitations, however, as was seen during the blackout: regional crises make it very difficult for communities to pool resources.

Lastly, agencies should prepare for the possibility of a long-term loss of power or other basic resources, a loss that will outlive the availability of backup power. Intense planning is required for such situations, in which agencies would have to learn to execute their responsibilities over an extended period with reduced resources and minimal technology. The demands of such a potentiality again underscore the need for advanced planning as the key to weathering a crisis with a minimum of disruption and loss.

Appendix A: Detailed Chronology

Thursday, August 14, 2003

- 12:05 p.m. Generators shut down at the American Electric Power plant in Conesville, Ohio.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 1:14 p.m. Generators shut down at DTE Energy's Greenwood power plant, north of Detroit.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 1:31 p.m. Generators shut down at FirstEnergy Corporation's Eastlake power plant in northern Ohio, along the southern shore of Lake Erie.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
www.energy.gov
- 2:02 p.m. Due to a nearby brush fire, DPL's Stuart-Atlanta transmission line, which supplies power to the area south of Columbus, goes out of service.
Shaw Power Technologies, Inc.
- 3:05 p.m. FirstEnergy's Harding-Chamberlain line, running from eastern Ohio to northern Ohio, goes out of service.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 3:32 p.m. Extra power traveling through FirstEnergy's Hanna-Juniper line, which runs from eastern Ohio to northern Ohio, overheats the wires, causing them to sag into a tree, short-circuit, and fail.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 3:41 p.m. An overload on FirstEnergy's Star-South Canton line, which runs from eastern Ohio to northern Ohio, trips a breaker at the Star switching station, where FirstEnergy's grid connects with a neighboring grid owned by American Electric Power.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 3:45 p.m. FirstEnergy's Canton Central-Tidd line, which runs from eastern Ohio to northern Ohio, disconnects and reconnects 58 seconds later.
- 4:06 p.m. FirstEnergy's Sammis-Star line, located in northeast Ohio, disconnects.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 4:08 p.m. American Electric Power's Galion-Ohio Central-Muskingum and East Lima-Fostoria Central transmission lines disconnect, blocking the flow of power from southern and western Ohio into northern Ohio and eastern Michigan.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 4:09 p.m. Kinder Morgan's generating unit in Central Michigan is interrupted.
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 4:10:38 p.m. The Perry-Ashtabua-Erie West transmission line trips, severing the path into northern Ohio from Pennsylvania.
www.energy.gov
- 4:10:40 p.m.–
- 4:10:44 p.m. Four transmission lines – Homer City-Watercure Road, Homer City-Stolle Road, South Ripley-Dunkirk, East Towanda-Hillside – disconnect between Pennsylvania and New York.
www.energy.gov

- 4:10:41 p.m. The Beaver-Davis Besse line, which connects the Cleveland and Toledo areas, disconnects, leaving Cleveland isolated from the Eastern Interconnection . Cleveland loses power.
www.energy.gov
- 4:10:42 p.m.–
- 4:10:45 p.m. Transmission paths disconnect between northern Ohio and New Jersey, isolating the northeast portion of the Eastern Interconnection. The Eastern Interconnection is now effectively split in half, with northern New Jersey, New York City and portions of New York state, New England, the Maritime provinces, eastern Michigan, the majority of Ontario, and Quebec all to the north of the dividing line. The areas south of this line remain unaffected by the blackout.
www.energy.gov
- 4:10:46 p.m.–
- 4:10:55 p.m. The New York power system splits east-west. New England, except for southwestern Connecticut, and the Maritimes separate from New York and remain operational.
www.energy.gov
- 4:10:50 p.m.–
- 4:11:57 p.m. The Ontario system just west of Niagara Falls and St. Lawrence separates from New York. Southwestern Connecticut separates from New York and goes dark.
www.energy.gov
- 4:10 p.m. Power fails on the PATH transit system connecting New York and New Jersey. Power to the signal system, third rail system, fare collection equipment, station lighting, and tunnel lighting is lost.
PATH presentation at 2003 APTA Annual Meeting
- 4:11 p.m. New York City Transit subway operations cease as the system loses electrical power. A total of 413 trains with approximately 400,000 customers are in service and are affected by the blackout.
NYC Transit
- 4:11 p.m. INFORM, the transportation management center serving Long Island, loses connection to its closed-circuit cameras and signalized intersections.
INFORM
- 4:11 p.m. Most of Ontario blacks out and the remaining transmission lines between Ontario and eastern Michigan fail. Separate
CBSnews.com, www.cbsnews.com/htdocs/blackout/
- 4:11 p.m. New Jersey Transit loses power in portions of its service area.
Volpe Center notes
- After
- 4:11 p.m. 300,000 users suddenly disconnect from America Online.
Washington Post 8.15.03, C. Mayer, page A08
- After
- 4:11 p.m. Lines begin to develop at pay phones in New York City, as the cellular phone network becomes overwhelmed by the unexpected volume of calls and ceases to function.
Washington Post 8.15.03, C. Haughnery, page A10
- After
- 4:11 p.m. The 11,000 signalized intersections in New York City lose power.
Enhancing New York City's Emergency Preparedness: A Report to Mayor Michael R. Bloomberg
- 4:13 p.m. The cascading sequence is essentially complete, with the blackout stretching from eastern Michigan and southeast Canada to New York state, New Jersey, and parts of New England. 3,700 square miles

are in the dark. One area remains in operation, mostly in western New York. This service was maintained by generating stations south of Lake Ontario, and formed the basis for the restoration of power.

CBSnews.com, www.cbsnews.com/htdocs/blackout/

- 4:15 p.m. The lights go out in the Office of Emergency Management of the Port Authority of New York and New Jersey (PANYNJ)
PANYNJ Situation Status Report
- 4:15 p.m. The tunnel between Detroit and Windsor, Ontario closes.
Volpe Center notes
- 4:15 p.m. The SMART transit system in Detroit loses power.
Volpe Center notes
- 4:20 p.m. The emergency power system at New York's JFK International Airport switches on.
New York Daily News 8.15.03, J. Lemire
- 4:20 p.m. NYC Transit determines that power will not be restored quickly and begins evacuation procedures for its subway system.
NYC Transit
- 4:30 p.m. The PATH transit system ceases efforts to restore power and a full evacuation of all trains and stations is ordered.
PATH presentation at 2003 APTA Annual Meeting
- 4:40 p.m. Two plumes of black smoke are visible on the New York City skyline.
PANYNJ Situation Status Report
- 4:54 p.m. Federal officials rule out terrorism as a cause of the blackout.
Newsweek, MSNBC 8.25.03, M. Hirsch
- 5:00 p.m. Four of Cleveland's water pumping stations and their backup systems – used to pump and clean drinking water from Lake Erie – lose power and fail.
The Cleveland Plain Dealer 8.16.03
- As of
5:00 p.m. PATH, New Jersey Transit, New York City subway, Metro-North Railroad, and Long Island Rail Road – all serving the greater New York area – are out of operation. New Jersey Transit and New York City buses are running with delays, and the Port Authority Bus Terminal is closed.
Transcom 8.14.03
- As of
5:00 p.m. The eastbound lane of the Lincoln Tunnel is closed. The Holland Tunnel is open and the Queens Midtown and Brooklyn Battery Tunnels are open for emergency vehicles only. The George Washington, Verrazano, Triboro, Bayonne, Outerbridge Crossing, Goethals, and Tappan Zee Bridges are open. The Manhattan-bound Brooklyn, Williamsburg, and Manhattan Bridges are closed.
Transcom 8.14.03
- As of
5:00 p.m. The New Jersey Turnpike and the Garden State Parkway are both open and tolls are waived, due to the lack of power.
Transcom 8.14.03

- Just after
5:00 p.m. The U.S. Department of Homeland Security mobilizes several emergency response teams to assist with telecommunications and other needs in areas impacted by the blackout.
Newsweek, MSNBC 8.25.03, M. Hirsch
- Just after
5:00 p.m. North American Aerospace Defense Command (NORAD) orders two F-16 airplanes from Tyndall Air Force Base in Florida to patrol the East Coast.
Newsweek, MSNBC 8.25.03, M. Hirsch
- 5:20 p.m. All operations cease at the New York Marine Terminal of PANYNJ.
PANYNJ Event Log
- 5:45 p.m. Mayor Bloomberg of New York gives a press conference, describing the blackout as an “inconvenience rather than a crisis.”
Washington Post 8.15.03, B. Gellman, page A01
- 6:00 p.m. Power begins to return in Toledo.
Washington Post 8.15.03, M. Weil, page A01
- 6:10 p.m. Trucks are exiting normally at the New Jersey Marine Terminal of PANYNJ and roadblocks are established to prohibit additional trucks from entering.
PANYNJ Event Log
- 6:12 p.m. PANYNJ staff work to stage buses outside the Port Authority Bus Terminal in order to transport commuters out of midtown Manhattan.
PANYNJ Situation Status Report
- 6:15 p.m. Operations cease at the Howland Hook Marine Terminal and the Red Hook Marine Terminal, both of PANYNJ.
PANYNJ Event Log
- 6:30 p.m. All PATH trains are successfully evacuated.
PATH presentation at 2003 APTA Annual Meeting
- 6:32 p.m. All railroad crossing lights are operational at the Port Newark Marine Terminal. The Coast Guard is not restricting inbound ships.
PANYNJ Event Log
- 6:42 p.m. The George Washington Bridge Bus Station, in upper Manhattan, is evacuated and secured.
PANYNJ Event Log
- 6:54 p.m. The George Washington Bridge is operating in both directions.
PANYNJ Situation Status Report
- 7:00 p.m. New Jersey Governor James McGreevey declares a state of emergency.
PANYNJ Event Log
- 7:00 p.m. Mayor Jane Campbell of Cleveland receives a call from the White House to assure her that the blackout does not appear to be related to terrorism.
The Cleveland Plain Dealer 8.16.03
- By 7:00 p.m. New York LaGuardia, JFK International, and Newark Liberty International Airports resume limited operations.
cnn.com 8.14.03

- 7:09 p.m. The evacuation of the NYC Transit subway system is complete. Three minor injuries are reported system-wide.
NYC Transit
- 7:16 p.m. Power is restored to the central terminal at Newark Liberty International Airport.
PANYNJ Situation Status Report
- 7:52 p.m. New York LaGuardia, JFK International, and Newark Liberty International Airports institute “snow plans,” in which they prepare for stranded passengers to spend the night in the airports.
PANYNJ Situation Status Report
- 8:00 p.m. A few Amtrak trains move through Penn Station, using power from the New Jersey grid.
Washington Post 8.15.03, D. Phillips, page A08
- 8:00 p.m. Orange County, New Jersey imposes a curfew.
Washington Post 8.15.03, B. Gellman, page A01
- By 8:00 p.m. Partial power is restored on the PATH system, as well as full traction.
PATH presentation at 2003 APTA Annual Meeting
- 8:12 p.m. New York Governor George Pataki declares a state of emergency.
PANYNJ Situation Status Report
- 8:23 p.m. Power is restored in some parts of Buffalo.
msnbc.com 8.14.03
- 8:28 p.m. Power is partially restored in New York, with the boroughs of Queens and the Bronx the first to come back on-line.
msnbc.com 8.14.03
- 8:30 p.m. Power is restored at the Port Newark Container Terminal.
Shipping News 8.18.03
- 8:38 p.m. The Marine Terminals at Port Elizabeth and Newark are accepting ships and allowing ships to depart.
PANYNJ Event Log
- 8:44 p.m. New York LaGuardia, JFK International, and Newark Liberty International Airports agree to accept some flights throughout the night.
PANYNJ Situation Status Report
- 8:45 p.m. Mayor Jane Campbell of Cleveland requests and receives a declaration of a state of emergency from Governor Bob Taft of Ohio.
The Cleveland Plain Dealer 8.16.03
- 8:45 p.m. Power is restored in most areas of Pennsylvania affected by the blackout.
CBSnews.com 8.15.03
- As of
8:45 p.m. PATH, New York City subway, Metro-North Railroad, and Long Island Rail Road rail services – all serving the greater New York area – are out of operation. New Jersey Transit rail service is running very limited service. New Jersey Transit and New York City buses are running with delays, and the Port Authority Bus Terminal remains closed, but passengers can be picked up outside the station and taken to a staging area at the Meadowlands Sports Complex for transportation to areas around the region.
Transcom 8.14.03

- As of
8:45 p.m. The eastbound lane of the Lincoln Tunnel is closed. The Holland Tunnel and the Queens Midtown Tunnel are both open, and Brooklyn Battery Tunnel is open with suspended tolls. The Henry Hudson, Throgs Neck, Bronx Whitestone, George Washington, Verrazano, Triboro, Bayonne, Outerbridge Crossing, Goethals, and Tappan Zee Bridges are open, some with suspended tolls. The Verrazano Bridge is operating without lights. The Manhattan-bound Brooklyn, Williamsburg, 59th Street, and Manhattan Bridges are open to emergency vehicles only.
Transcom 8.14.03
- As of
8:45 p.m. The New York State Thruway is open without incident.
Transcom 8.14.03
- Evening New York Waterway, which operates private ferry service in New York City, carries 170,000 people during the afternoon and evening, 140,000 people more than on a typical day.
Enhancing New York City's Emergency Preparedness: A Report to Mayor Michael R. Bloomberg
- 9:00 p.m. NBC airs a videotaped message from President Bush, who reiterates that terrorism was not a factor in the blackout.
msnbc.com 8.14.03
- 9:00 p.m. The Cyber Division of the FBI announces that computer hacking does not appear to have played a part in the blackout.
msnbc.com 8.14.03
- 9:30 p.m. Amtrak restores limited service in the tri-state area of New York, New Jersey, and Connecticut.
wNBC.com 8.14.2003
- 9:30 p.m. Municipal officials in Cleveland impose a curfew for anyone under the age of 18.
msnbc.com 8.14.03
- 9:30 p.m. Mayor Bloomberg of New York holds a press conference, and urges residents to take care of themselves and their neighbors. Mayor Bloomberg also announces that all of the New York City subways have been evacuated safely, as have most of the elevators in the city. He estimates that approximately 10 to 15 percent of the power in New York City has been restored, and that the majority will be operational by 1:00 am EST.
msnbc.com 8.14.03
- 9:30 p.m. Power returns to portions of Long Island.
cnn.com 8.14.03
- 9:34 p.m. The emergency power system at New York LaGuardia Airport fails.
New York Daily News 8.15.03, J. Lemire
- 9:45 p.m. PATH service is restored between Journal Square and 33rd Street.
PATH presentation at 2003 APTA Annual Meeting
- 9:45 p.m. TRANSCOM, the collaborative transportation operations center serving the New York region, experiences a generator fire. The facility is evacuated.
PANYNJ Situation Status Report
- By 9:45 p.m. Power has been restored to 650,000 customers in New Jersey, leaving 350,000 without power.
msnbc.com 8.14.03
- 9:48 p.m. Power is restored at Teterboro Airport in Teterboro Borough, New Jersey.
PANYNJ Situation Status Report

- 9:55 p.m. The Lincoln and Holland Tunnels are open eastbound to buses and westbound to buses and cars.
PANYNJ Situation Status Report
- 10:15 p.m. PATH service is restored between Newark and Exchange Place.
PATH presentation at 2003 APTA Annual Meeting
- 10:15 p.m. The tunnel between Detroit and Windsor, Ontario re-opens.
Volpe Center notes
- 10:24 p.m. New York LaGuardia, JFK International, and Newark Liberty International Airports are all accepting limited arrivals and supporting limited departures.
PANYNJ Situation Status Report
- 10:24 p.m. The Port Authority Bus Terminal is officially secured.
PANYNJ Situation Status Report
- 10:24 p.m. The Holland Tunnel has one lane open to automobiles in each direction.
PANYNJ Situation Status Report
- 11:00 p.m. New York Governor George Pataki holds a press conference, and announces that there have been no serious injuries or deaths related to the blackout.
Washington Post 8.15.03, B. Gellman, page A01
- 11:00 p.m. The final person is freed from a Cleveland elevator.
The Cleveland Plain Dealer 8.16.03
- By 11:00pm Only 250,000 New Jersey residents remain without power, out of 1 million originally in the dark.
cnn.com 8.14.03
- 11:04 p.m. PATH is running normal service.
PANYNJ Situation Status Report
- 11:31 p.m. The Federal Emergency Management Agency establishes a Regional Operations Center for the New York area.
- 11:41 p.m. Traffic in the Holland Tunnel is light in both directions.
PANYNJ Event Log
- Overnight New York City officials log 800 elevator rescues and 80,000 calls to 911.
Newsweek, MSNBC 8.25.03, M. Hirsch
- Overnight About 10,000 New York City policeman are on duty, one-third of the total force.
Washington Post 8.17.03, D. Von Drehle
- Overnight New York City Fire Commissioner Nicholas Scoppetta reports that EMS crews answer more than 5,000 calls, twice the typical number.
Washington Post 8.17.03, D. Von Drehle
- Overnight Cleveland police make 19 arrests, fewer than half the summer average of 50. Cleveland deploys twice the typical number of officers.
Washington Post 8.17.03, D. Eggen, page A01

- General 17 General Motors plants, located in Lansing, Pontiac, Detroit, Toledo, Parma (Ohio), and Ontario, are closed. 23 Ford plants, located in southeast Michigan, Cleveland, and Ontario, are closed. 14 DaimlerChrysler plants, located in southeast Michigan and Ontario, are closed.
Washington Post 8.15.03, J. Porretto
- General Starbucks closes all of its shops in areas without electricity.
- General New York City opens emergency shelters for stranded commuters.
Washington Post 8.15.03, B. Gellman, page A01
- General Authorities in Cleveland relocate approximately 100 prisoners from the city jail to more secure facilities in Youngstown, Ohio.
cnn.com 8.15.03
- General The MGM Grand Casino in Detroit closes for the first time since its opening in 1999.
Washington Post 8.15.03, B. Gellman, page A01

Friday, August 15, 2003

- 12:00 a.m. The NYC Transit subway system resumes partial service.
NYC Transit
- 12:45 a.m. Lights inside the Cleveland Terminal Tower flicker, signaling the beginning of restoration of power to downtown and other parts of Cuyahoga County.
The Cleveland Plain Dealer 8.16.03
- 2:00 a.m. The North Bergen, Little Ferry, and Kearny rail freight terminals of CSX – all located in New Jersey – resume operations.
Shipping News 8.18.03
- 3:00 a.m. Power is restored at the Howland Hook Container Terminal on Staten Island.
Shipping News 8.18.03
- 3:00 a.m.–
6:30 a.m. Metro-North is able to run several trains, using diesel locomotives, from Grand Central Station to the suburbs of New York and Connecticut.
wnbc.com 8.15.03
- 3:23 a.m. The Lincoln Tunnel is closed eastbound.
PANYNJ Situation Status Report
- 4:00 a.m. Partial power is restored to INFORM, the transportation management center serving Long Island.
Volpe Center notes
- 4:10 a.m. Power returns to the rail yard of the Greater Cleveland Regional Transit Authority.
Volpe Center notes
- 4:31 a.m. Power is restored to portions of the southeast Bronx, Manhattan, Brooklyn, Westchester County, and Staten Island.
Con Edison Press Release 8.15.03

- 5:40 a.m. The Holland Tunnel is open with one lane in each direction and is collecting tolls, but reporting some ventilation problems.
PANYNJ Situation Status Report
- Early Morning New York City buses run on schedule and are free to all passengers.
wnc.com 8.15.03 and New York Daily News 8.16.03, P. Donohue.
- 6:20 a.m. Staten Island Railway service is restored.
NYC Transit
- 6:30 a.m. The Lincoln Tunnel is open with two lanes in each direction.
PANYNJ Situation Status Report
- 7:23 a.m. Cleveland Hopkins International Airport regains power and resumes limited passenger operations.
The Cleveland Plain Dealer 8.16.03, A. Garrett
- 7:40 a.m. Full power is restored at New York LaGuardia Airport. 400 stranded passengers are reported to be on-site.
PANYNJ Situation Status Report
- 8:00 a.m. The Federal Aviation Administration suspends all operations at New York LaGuardia Airport until 12:00pm.
PANYNJ Situation Status Report
- 8:45 a.m. Power is restored at Brooklyn Marine Terminal but Terminal employees have not reported for work.
PANYNJ Situation Status Report
- 9:00 a.m. Metro-North restores limited service from Grand Central Station to the northern suburbs of New York and Connecticut, using diesel locomotives, but halts service shortly thereafter due to a failure in the signal system.
wnc.com 8.15.03
- 9:00 a.m. Power is completely restored to Staten Island.
Con Edison Press Release 8.15.03
- 10:00 a.m. Complete power is restored to INFORM, the transportation management center serving Long Island. 80 percent of the INFORM closed-circuits cameras return to operation.
INFORM
- 10:03 a.m. Con Edison reports that rolling blackouts are affecting all of Staten Island.
NYC Transit
- 10:15 a.m. The first flight since the blackout departs from Cleveland Hopkins International Airport.
The Cleveland Plain Dealer 8.16.03, A. Garrett
- 10:32 a.m. Power is restored to the #6 NYC Transit subway line. No customer service is in operation.
NYC Transit
- Morning The Long Island Rail Road resumes limited service from Jamaica Station.
wnc.com 8.15.03
- Morning Airlines resume near-to-normal operations from Newark Liberty International, Cleveland Hopkins International, Albany International, Buffalo Niagara International, and Montreal Airports.
New York Daily News 8.16.03, J. Marzulli

Morning 150,000 Cleveland residents remain in the dark, out of 1.4 million without power on Thursday afternoon.
CBSnews.com 8.15.03

Morning 130,000 Michigan residents remain in the dark, out of 2.1 million without power on Thursday afternoon.
CBSnews.com 8.15.03

Morning Responding to a question about the lack of cellular service, a spokesman from Nextel explains that cellular towers require electricity in order to function. Most towers have back-up systems that can run for 3-6 hours only.
MSNBC.com 8.15.03

11:00 a.m. Con Edison New York elects to reduce power to parts of its service area – New York City and Westchester County – in order to avoid volatile fluctuations. Customers are asked to turn off appliances.
Con Edison Press Release 8.15.03

Mid-Morning 20,000 New Jersey residents remain without power.
CBSnews.com 8.15.03

Late Morning Power is restored to the Norfolk Southern rail freight terminals in Bellevue (Ohio), Toledo, Buffalo, Cleveland, and portions of the New York City region.
Shipping News 8.18.03

Late Morning Power is not yet restored to Penn Station.
wNBC.com 8.15.03

12:20 p.m. Greater Cleveland Regional Transit Authority restores power to its light rail system
Volpe Center notes

2:00 p.m. The parking lots at New York LaGuardia Airport are completely full; officials announce that they may begin limiting automobile access to the airport.
Washington Post 8.16.03, S. Goo, page A08

3:10 p.m. Power is restored to the third rail on selected portions of the IRT tracks (portions of Lexington Avenue, 7th Avenue, and Eastern Parkway) in New York City. No customer service is in operation.
NYC Transit

4:05 p.m. Power is restored to the Port Authority Bus Terminal.
PANYNJ Situation Status Report

Day Amtrak resumes limited service between Washington, DC and New York.
wNBC.com 8.15.03

Day Without electricity to operate their pumps, most gas stations in New York City are closed.
NYI 8.16.03, J. Ramirez

Day A spokesman for Verizon Communications reports that the use of landline telephones was 300 percent greater than typical during the period of the blackout.
MSNBC.com 8.15.03

- Afternoon In a press conference, Governor Pataki announces that power has been restored to most of New York state, including 85 percent of New York City.
Washington Post 8.15.03, D. Cohn
- 5:00 p.m. Over the next several hours, power is restored to portions of the NYC Transit subway system. No customer service is in operation.
NYC Transit
- Early Evening FirstEnergy Corporation declares that full service has been restored to the Cleveland area.
Newsweek 8.25.03, J. Adler
- Evening Most flights in and out of Cleveland Hopkins International Airport are running on schedule.
Washington Post 8.16.03, S. Goo, page A08
- 6:36 p.m. Power is restored to New York LaGuardia Airport.
PANYNJ Situation Status Report
- 7:00 p.m. Con Edison restores power through the New York feeds into the Lincoln and Holland Tunnels.
PANYNJ Situation Status Report
- 7:40 p.m. Full power is restored in the passenger terminals at JFK International Airport.
PANYNJ Situation Status Report
- 9:02 p.m. Power is restored at cargo buildings at JFK International Airport.
PANYNJ Situation Status Report
- 9:03 p.m. Power is completely restored to all areas of New York City and Westchester County.
Con Edison Press Release 8.15.03
- 10:15 p.m. The Office of Emergency Management of the Port Authority of New York and New Jersey is deactivated.
PANYNJ Situation Status Report
- 11:00 p.m. Sixty-three of the major NYC Transit bus lines are operating fare free, and will continue to operate without fares until subway service is restored.
NYC Transit
- Overnight City officials report that six people are arrested in Detroit for incidents related to the blackout.
Pittsburgh Post-Gazette 8.17.03
- General During the 29 hours of the blackout, 132,000 calls were logged by the New York City 911 system. This represents a 187 percent increase over the same period during the previous year.
Enhancing New York City's Emergency Preparedness: A Report to Mayor Michael R. Bloomberg
- General During the 29 hours of the blackout, the Emergency Medical Service of New York City transported 133 percent as many patients as is typical.
Enhancing New York City's Emergency Preparedness: A Report to Mayor Michael R. Bloomberg
- General During the 29 hours of the blackout, 150,000 calls were logged by the New York City 311 Citizen Service Center.
Enhancing New York City's Emergency Preparedness: A Report to Mayor Michael R. Bloomberg
- General The ports of Toronto, Detroit, and Cleveland are without power.
Shipping News 8.18.03

- General American Stock Exchange spokesman Robert Rendine reports that the Stock Exchange opened for only 15 minutes on Friday, in order to set closing prices for the day before.
Washington Post 8.19.03, G. Schneider, page E01
- General Amtrak reports operating 80 percent of its scheduled service.
Washington Post 8.16.03, S. Goo, page A08
- General The NYC Transit subway system remains out of service all day.
Washington Post 8.16.03, S. Goo, page A08
- General The public bus system in Detroit remains out of service all day.
Washington Post 8.16.03, S. Goo, page A08
- General Traffic signals in New York are out of service.
Washington Post 8.16.03, S. Goo, page A08
- General Peter Pan Bus Lines runs 2-3 times their regular service into and out of New York City.
Washington Post 8.16.03, S. Goo, page A08
- General The Long Island Rail Road commissions 100 school and tour buses to transport 40,000 stranded commuters from Manhattan to Queens and Long Island.
Washington Post 8.16.03, S. Goo, page A08
- General Most shuttle flights between Washington, DC and New York are cancelled.
Washington Post 8.16.03, S. Goo, page A08
- General American Airlines delays or cancels nearly all of its outbound flights from JFK International Airport.
New York Daily News 8.16.03, J. Marzulli
- General Officials in Cleveland and Detroit urge motorists to limit their driving due to non-functioning traffic lights.
Washington Post 8.16.03, S. Goo, page A08
- General Mail delivery is limited in Detroit.
Washington Post 8.16.03, R. Pierre, page A01
- General New York City closes its public beaches due to concerns about water quality.
NY1 8.19.03
- General A spokesman for the NASDAQ reports that 80 percent of the 270 firms listed on the NASDAQ exchange were open for business. The NASDAQ itself was able remain operational due to an off-site generating facility.
Washington Post 8.19.03, G. Schneider

Saturday, August 16, 2003

12:00 a.m.–

1:00 a.m. Partial to full customer service is resumed on the following NYC Transit lines: 6, 7, 2, 4, 5, 1, J, A, L, M, W, Q, A shuttle, R, D, and N.
NYC Transit

1:00 a.m.–

3:00 a.m. Partial to full customer service is resumed on the following NYC Transit lines: F, E, and G.
NYC Transit

- 5:00 a.m. NYC Transit reinstates fares on the bus system.
NYC Transit
- 6:00 a.m. The NYC Transit subway system resumes full service.
NYC Transit
- Morning 450 Connecticut customers, down from a peak of 278,000, remain without power. 50,000 Michigan residents are still in the dark, as well as 5,000 New Jersey residents.
cnn.com 8.16.03
- Day All 24 of the New York City subway lines are operational.
cnn.com 8.16.03
- Late Evening Power returns to the SMART system in Detroit.
Volpe Center notes
- General Amtrak restores regular service between Boston and Washington, but cautions that service is still limited or delayed in Michigan.
Washington Post 8.17.03, S. Goo, page A15
- General Detroit Mayor Kwame Kilpatrick announces that public transportation will be free for all passengers throughout the weekend.

Sunday, August 17, 2003

- Late Afternoon The North American Electric Reliability Council announces that the power grid is operating reliably again, with all but one transmission line back in service.
Washington Post 8.18.03, J. Glanville
- Night The New York City Traffic Department finishes the task of inspecting all traffic signals.
Inside ITS 9.15.03
- General The SMART system in Detroit is running almost normally.
Volpe Center notes
- General Air travel returns to near normal after three days in which airlines canceled more than 1,700 flights.
Washington Post 8.17.03, S. Goo, page A15

Monday, August 18, 2003

- Morning Metro-North and the Long Island Rail Road, serving the New York suburbs, both announce that they are running on or near to schedule.
Washington Post 8.18.03, J. Glanville
- Morning General Motors, Ford, and DaimlerChrysler resume manufacturing operations.
Motortrend 8.1.8.03
- 9:00 p.m. 3,000 Staten Island customers lose power. It is restored two hours later.
NYI 8.19.03

General Air traffic controllers at New York LaGuardia Airport, JFK International Airport, and Newark Liberty International Airport lose contact with all airplanes following a loss of power at the Federal Aviation Administration's control center on Long Island, most likely an after-effect of the blackout. A back-up system switches on after 30-45 seconds.
New York Daily News 8.18.03

Tuesday, August 19, 2003

General New York Stock Exchanges and major Wall Street firms said that they have little cleanup work to do and that the emergency backup plans they put into place after the attacks of September 11, 2001, had worked well.
Washington Post 8.19.03, G. Schneider, page E01

General New York City businesses lost about \$800 million in products and services and another \$250 million from spoiled food and perishables, said a spokesman for the city comptroller, William C. Thompson, Jr.
Washington Post 8.19.03, G. Schneider, page E01

On-Going

October 21 Officials from the Federal Reserve, the U.S. Treasury Department, and the Security and Exchange Commission testify before Congress that there was no evidence of panic or disruption in the banking system during the period of the blackout.
The Boston Globe 8.21.03

Appendix B: Summary of Installed Intelligent Transportation System (ITS) Technology

Agency:	Connecticut Department of Transportation
Facilities:	ConnDOT Operations Centers
Location:	Newington and Bridgeport, Connecticut
Responsibility:	State-owned transportation facilities and services for roads and highways

ITS Technology Installed

- Vehicle detection devices – 35 microwave radar sensors
- Highway advisory radio (HAR) system – 70 miles covered
- Variable message signs (VMS) – 93
- Advanced traveler information systems (ATIS) – dedicated website, automated paging and facsimile notification systems
- Electronic sharing of data with public safety and other transportation agencies
- Closed circuit television (CCTV) system – 112 miles covered

Operations Capability Maintained during the Blackout

- Equipment within the Newington Operation Center, using a backup system (a generator using both diesel fuel and batteries)
- The telephone system within the Newington Operation Center facility
- Closed circuit television cameras on I-84, I-91, and I-95

Operations Capability Lost during the Blackout

- The telephone system within the Bridgeport Operation Center
- Some field equipment, including traffic signals and variable message signs along I-95

Pre-Event Preparation

- Arrangements with Connecticut Transit for coordinated action during emergencies
- Arrangements to establish the Office of Emergency Operations Center to coordinate/receive all incident information from all bureaus of Connecticut DOT including airports, ports, public transportation (rails and transit), engineering, and highway operations
- Established relationship with the Connecticut State Police

Lessons Learned

- The root causes of a loss of power – storm, technological failure, violence or sabotage – are irrelevant. All blackouts present the same challenges and require the same types of response, and the response systems should be designed to function no matter the specifics of the situation
- Communication is key and should be maintained whenever possible

Agency:	New York State Department of Transportation – Region 10- Long Island- Information For Motorists (INFORM)
Facility:	Long Island Traffic Information Center (TIC)
Location:	Hauppauge, NY
Responsibility:	Long Island's 35-mile central corridor, comprising the Island's major east/west highways and its north/south connecting routes

ITS Technology Installed

- Vehicle detection devices – 2,700 loop detectors, 81 video detectors
- Closed circuit television (CCTV) system – 120 cameras
- Road weather information system (RWIS) – 9 weather stations
- Highway advisory radio (HAR) system – 5 stations – covering 25 miles on 3 major highways
- Variable message signs (VMS) – 153
- Traffic signals – 180 signalized intersections
- Ramp meters – 70
- Advanced traveler information system (ATIS) – dedicated website and automated notification by facsimile

Operations Capability Maintained during the Blackout

- Most equipment within the traffic information center, using backup power
- Email, landline telephones, and fax (received real-time faxes from TRANSCOM)
- Cellular telephones and point-to-point radios (during the early hours of the blackout)

Operations Capability Lost during the Blackout

- Closed circuit television (CCTV) system
- Many traffic signals
- 1-2 sign controllers, several conflict monitors, and a number of traffic signal controllers at intersections
- Many overhead variable message signs
- Cellular telephones and point-to-point radios within a few hours of the blackout, as backup power ran out
- Climate control in the traffic information center

Pre-Event Preparation

- During the preparations for Y2K, certain priority intersections had been identified for the use of portable generators. These generators were under repair on the day of the blackout, however.
- Emergency management procedures, developed after September 11, 2001, were implemented on the day of the blackout. These procedures called for the establishment of emergency operations centers throughout the state of New York.
- In preparation for the U.S. Open, emergency response planning had been done during the spring and summer of 2003.

Lessons Learned

- The system for recording and prioritizing non-functioning intersections was inadequate
- There were insufficient personnel and vehicles to reset the traffic signals following the blackout.
- Additional backup power is required for the equipment at the traffic management center and for key pieces of equipment in the field.
- Additional variable message signs would have been of limited value in easing traffic congestion, as there were no alternate routes to which to direct motorists.
- “Old” technologies, such as landline telephones and battery-operated radios, become very important in widespread crises.
- In order to keep emergency vehicles on the road, backup power is necessary for fueling facilities.

Agency:	Metropolitan Transportation Authority Bridges & Tunnels
Facilities:	Bridges – Bronx-Whitestone, Crossbay, Henry Hudson, Marine Parkway, Gil Hodges, Throgs Neck, Triborough, and Verrazano Narrows Tunnels – Brooklyn Battery and Queens Midtown
Location:	New York City boroughs
Responsibility:	Seven bridges and two tunnels with toll facilities

ITS Technology Installed

- Electronic toll collection (ETC) – EZ-Pass
- Vehicle detection- TRANSMIT
- Closed circuit television (CCTV) system
- Road weather information system (RWIS)
- Variable message signs (VMS)

Operations Capability Maintained during the Blackout

- Fully operational, including electronic toll collection, closed circuit television systems, road weather information system, and variable message signs
- Radio and phone communications
- On-ground traffic conditions observed via video was relayed to six other agencies

Operations Capability Lost during the Blackout

- Some fuel pump computers (although the pumps themselves continued to work)
- One repeater, disrupting radio communications until signals were re-routed
- Landlines when Verizon Communications battery power expired
- TRANSCOM traffic information reports

Pre-Event Preparation

- Full backup generator power; generators are tested weekly and undergo contracted preventative maintenance
- Special Operations Division established after September 11 to run a central command center

Lessons Learned

- Although it was believed that everything had been planned for, there were still a few glitches
- When generator maintenance is performed by an outside contractor, in-house maintenance capability should be retained for emergency situations
- There is a need to accommodate the pedestrians who want to walk across the bridges and through the tunnels. A plan to stage and bus pedestrians could assist in the evacuation process and keep the tunnels clear for emergency vehicles and other needs

Agency:	Metropolitan Transportation Authority New York City Transit
Facilities:	Bus and subway vehicles and infrastructure
Location:	Headquartered in New York, NY
Responsibility:	The provision of transit service in the five Boroughs of New York City

ITS Technology Installed

- Advanced traveler information systems (ATIS) – dedicated website, and automated telephone notification system
- Interagency Remote Video Network (IRVN) provides closed circuit television (CCTV) images to the NYCT Bus Control Center

Operations Capability Maintained during the Blackout

- Within a few hours, partial power to the signal system using backup generators (Bus)
- Landline telephone system (Bus and Subway)
- The radio system with a backup generator (Subway)

Operations Capability Lost during the Blackout

- The radio system (Bus)
- Point-to-point radios (Bus)
- Rail lines (Subway)
- Cellular telephones (Subway)

Pre-Event Preparation

- The development of an emergency plan that includes a blackout scenario (Bus)
- The stockpiling of emergency flashlights and batteries (Subway)

Lessons Learned

- The loss of the communications equipment was the most challenging aspect of the blackout
- Importance of prioritizing the use of backup generators
- Importance of prioritizing the use of buses, both to serve regular routes and to serve emergency services
- It is important to have backup generators for fueling facilities
- It is important to have established priorities for system evacuations (Subway)
- Emergency response training is crucial
- Sufficient staffing during emergencies is a challenge

Agency:	New York City Department of Transportation
Facility:	Traffic Management Center
Location:	The city-state Joint Traffic Operations Center in Queens, New York
Responsibility:	City streets, highways, sidewalks, bridges, street signs, traffic signals, street lights, parking meters, and municipal parking facilities in the five boroughs of New York City

ITS Technology Installed

- Vehicle detection devices – 3800 loop detectors
- Variable message signs (VMS) – 30
- Closed circuit television (CCTV) system – 224 cameras
- Advanced traveler information system (ATIS) – dedicated cable television station, public kiosks, dedicated website, and automated telephone, facsimile, and e-mail notification systems
- Centrally controlled signalized intersections- 6,000

Operations Capability Maintained during the Blackout

- Several hours into the blackout, equipment within the traffic management center, supported by backup power
- Radio communications
- Landline telephones

Operations Capability Lost during the Blackout

- Equipment within the traffic management center (for the first few hours of the blackout)
- All field equipment, including traffic signals
- The central telephone system within the traffic management center
- Cordless telephones

Pre-Event Preparation

- Had begun a survey of priority intersections at which to install backup power
- An established contingency plan required a manager-level duty officer to be on-call at all times in case of emergency

Lessons Learned

- The communications equipment in the traffic management center should have a separate source of backup power
- Backup power for the computers controlling the centralized traffic signals – those run from the traffic management center – should be provided by multiple backup batteries. Combination of backup power/UPS sources should be used for all of the computers controlling the traffic signals
- The functions and staff of the traffic management center require additional redundancy
- Contractors are a vital extension of the New York City DOT staff during times of crisis

Agency:	New York State Department of Transportation
Facility:	Traffic Management Center
Location:	The city-state Joint Traffic Operations Center in Queens, New York
Responsibility:	State-owned transportation facilities and services for roads and highways

ITS Technology Installed

- Vehicle detection devices – 5 video imaging detectors, 35 microwave radar sensors
- Highway advisory radio (HAR) system – 4 systems with 20 miles covered
- Variable message signs (VMS) – 18
- Advanced traveler information system (ATIS) – dedicated website
- Closed circuit television (CCTV) system – 40 miles covered with 83 cameras
- Lane-use control signals – 5 miles covered
- Electronic sharing of data with public safety agencies

Operations Capability Maintained during the Blackout

- Lights and equipment in the TMC (after the first hour of the blackout), supported by an emergency generator
- Some telephone service

Operations Capability Lost during the Blackout

- Lights and equipment in the TMC (for the first hour of the blackout)
- The emergency generator failed after an hour
- Those telephone lines connected to electricity did not function
- Some variable message signs
- Many closed circuit television cameras
- Climate control in the traffic management center

Pre-Event Preparation

- Following the events of September 11, 2001, improved mechanisms for communication between the agencies were established
- Security needs are now considered as part of the development of the regional ITS architecture

Lessons Learned

- Field equipment requires its own source of backup power, separate for that of the traffic management center
- Additional backup power is required for the traffic management center
- The ability to provide information to the public was hampered by the loss of the variable message signs. Other methods should be developed for use during emergencies
- Additional emergency supplies (e.g. batteries) should be stockpiled
- Basic facilities (e.g. for sleeping and showering) should be provided for staff members who may have to work multiple shifts during an emergency

- Because every staff members will not be available or able to reach the traffic management center during an emergency, each staff member should be trained to perform additional duties if called upon to do so. The current staff is cross-trained to cover other workers' tasks.
- Communication between agencies is vital, and communication technology should be designed or modified to allow for easy cross-agency and cross-jurisdiction communication
- Traffic management centers should be designed with emergencies in mind and should include requisite backup power and other facilities.

Agency:	New Jersey Department of Transportation
Facilities:	Traffic Operations Center – North Bureau
Location:	Mount Arlington, NJ
Responsibility:	State-owned transportation facilities and services for road and highways

ITS Technology Installed

- Vehicle detection devices – 163 loop detectors
- Variable message signs – 41
- Advanced traveler information systems (ATIS) – dedicated website, pager, telephone, and e-mail notification systems
- Closed circuit television (CCTV) system – 80 miles covered
- Highway advisory radio (HAR) system

Operations Capability Maintained during the Blackout

- The highway advisory radio (HAR) system
- Traffic Operations Center, powered by a backup generator
- VMS for southernmost equipment out of the blackout area
- Nextel direct-connect cell phones
- Point-to-point radios

Operations Capability Lost during the Blackout

- Some in-field equipment, including permanent variable message signs
- Landline telephones

Pre-Event Preparation

- The purchase of point-to-point radios
- The purchase of Nextel direct-connect cell phones purchased after September 11

Lessons Learned

- Having generators, both for the Traffic Operation Center and portable, in place allowed for continuity of most service.
- The evaluation of needs after September 11 and the subsequent purchase of equipment helped during the next emergency, the August blackout.

Appendix C: List of Acronyms

ATIS	automated traveler information system
CCTV	closed circuit television
ConEd	Consolidated Edison
DOT	department of transportation
EMS	emergency medical services
EOC	emergency operations center
ETC	electronic toll collection
FDNY	Fire Department of New York
FHWA	Federal Highway Administration
HAR	highway advisory radio
ICS	Incident Command System
IEN	Information Exchange Network
INFORM	Information FOR Motorists
IRVN	Interagency Remote Video Network
ITS	intelligent transportation systems
JOC	joint operations center
JTOC	Joint Traffic Operations Center (NYC DOT, NY State DOT, NYPD)
MTA	Metropolitan Transportation Authority
NYC	New York City
NYMTC	New York Metropolitan Transportation Council
NYPD	New York Police Department
OEM	Office of Emergency Management
OIC	Operations Information Center
OOS	Out of service
PABT	Port Authority Bus Terminal
PANYNJ	Port Authority of New York and New Jersey
PATH	Port Authority Trans-Hudson Corporation
SOV	single occupancy vehicle
TMC	traffic management center
TRANSCOM	Transportation Operations Coordinating Committee
VMS	variable message sign
Y2K	Year 2000