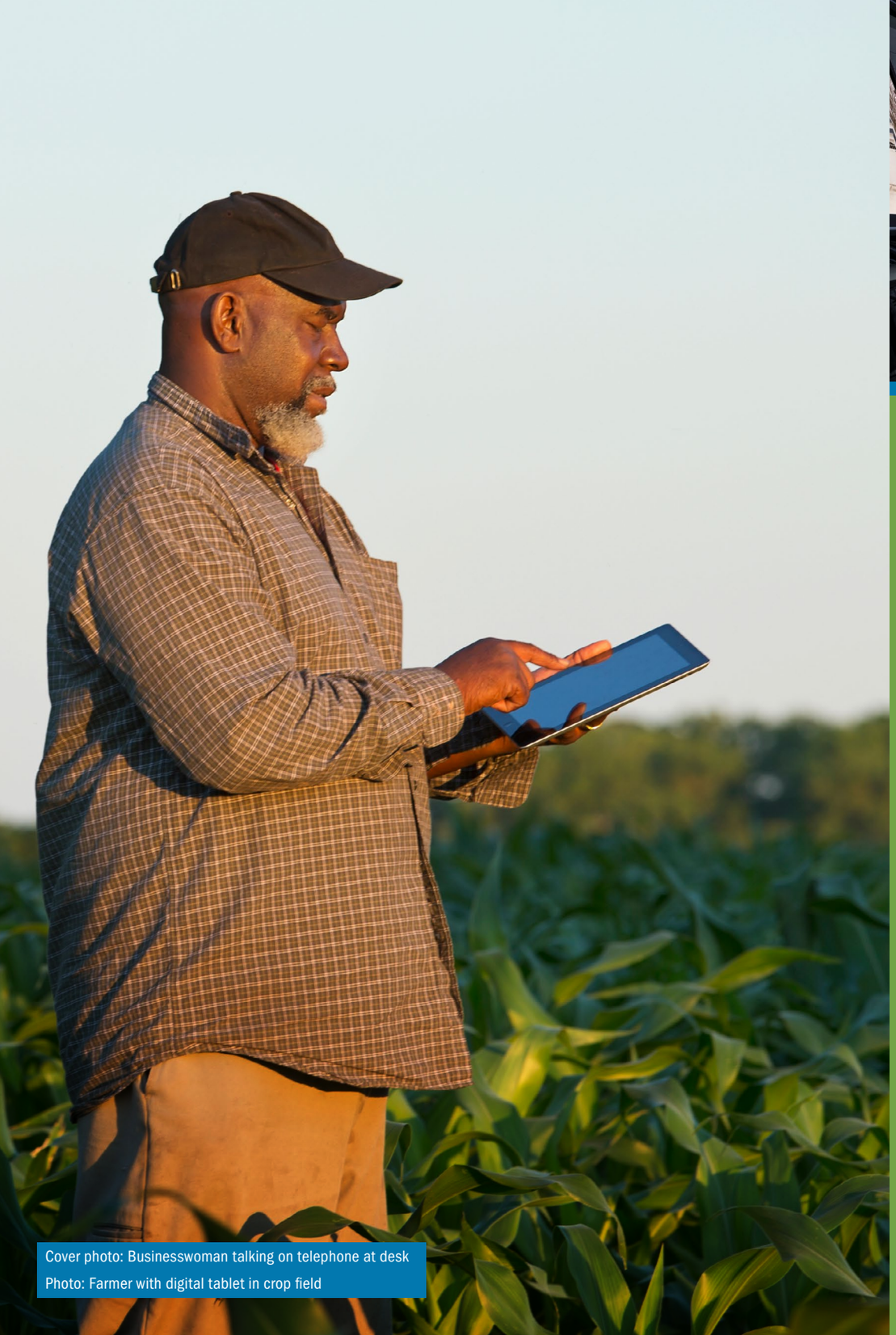
Guide to Expanding Mitigation

MAKING THE CONNECTION TO COMMUNICATIONS SYSTEMS

FEMA



Cover photo: Businesswoman talking on telephone at desk
Photo: Farmer with digital tablet in crop field

Photo: Security officer working in control room

Communications systems keep communities connected. From phone calls to internet browsing, virtual learning to streaming movies, our world is broadened and brought together by the technology around us.

In times of crisis, it is even more important for communities to have resilient communications systems.

- Before a disaster, these systems can broadcast warning information about what is happening and prompt people to take action to protect property and lives.
- During a disaster, they allow essential communications to keep critical local and government services running for disaster response, safety, reporting, and emergency care.
- After a disaster, communications systems can provide a way for people to connect to important resources or provide safety and general welfare updates through emergency calls, text messages, or social media updates.

Disasters such as hurricanes, earthquakes, floods and wildfires can jeopardize communications systems by compromising their infrastructure and power supplies. Considering such impacts of intense heat, severe winds and rising waters in hazard mitigation plans and projects can bolster a community's communications systems now, before the next disaster hits.

This *Guide to Expanding Mitigation* provides recommendations for working with the public and private sectors in telecommunications to support hazard mitigation, especially in the planning process and project development. This guide is designed to help community officials engage in a conversation about mitigation investments that can help make communications systems more resilient.

This *Guide to Expanding Mitigation* is part of a series highlighting innovative and emerging partnerships for mitigation.

HOW NATURAL DISASTERS AFFECT COMMUNICATIONS SYSTEMS

In the wake of disasters, communications systems are vulnerable to physical destruction, lack of compatibility between technologies and network overload or delays if too many users are using the same technology. Network infrastructure may also be weakened physically due to a low degree of redundancy or backup systems in case the primary system fails. Even radio waves can be disrupted by atmospheric changes caused by hazards like hurricanes or typhoons.

Our reliance on internet service also adds to the impact of disasters on communications systems. In many communities, internet is only available through old telephone and cable television network copper wires rather than more modern fiber optic cables. Disruption to supporting infrastructure like power and cooling systems can also cause communications systems to fail during disasters. Power outages and insufficient fuel for power generators are the main reasons for stopping communications. Cooling system failures and difficulty transporting fuel supplies and backup power sources can also affect telecommunications systems.

Connectivity is crucial in times of crisis. Telecommunications are needed for early warning systems before disasters, as well as for response during and recovery after events. Maintaining a stable and efficient communications system is key to creating a resilient community and engaging with experts in this sector will help ensure your community stays connected.

Photo: Team has meeting via video conference

COMMUNICATIONS AND THE PANDEMIC

The recent pandemic revealed how communications systems are critical to maintaining day-to-day operations, especially for governments. Pivoting to a virtual setting enables us to stay connected through telework, telemedicine, online education for all levels of learning and services like delivery of goods and foods. In an environment of overlapping disasters like hurricanes and wildfires on top of a pandemic, communications systems enable flexibility and are essential in our ability to keep society running through the future.

COMMUNICATIONS IN YOUR COMMUNITY

Keep in mind that connectivity and intensity of use can vary between urban and rural environments and across resource-constrained individuals and communities.

- Broadband is not deployed evenly across the nation, which limits the use of certain communication channels such as websites, apps and social media.
- Many Americans have broadband access but do not subscribe because the cost is prohibitive; they instead turn to mobile networks as their primary internet access point.

A number of efforts are underway across many communities to help address issues of access and equity to telecommunications. Many rural areas have rural electric cooperatives that support telecommunications initiatives and are working to upgrade infrastructure in their communities.

In urban areas with limited broadband access, community organizations are similarly deploying ad hoc wireless systems to help ensure that everyone has access to the internet.

The telecommunications sector is diverse in application, infrastructure and technology. The way your community interfaces with it may be just as diverse. Identifying and learning more about the vulnerabilities in your infrastructure systems can be helpful for communities seeking to design more effective mitigation strategies that strengthen those essential resources, so they are available when needed.

The Federal Communications Commission (FCC) estimates that more than 18 million Americans lack access to fast broadband. Are you curious about how your service compares? Most internet service providers have online speed tests.

Photo: Two women working with computer in server room

MAKING COMMUNICATIONS SYSTEMS MORE RESILIENT

A resilient communications network can maintain the same level of functionality when faced with internal and external disturbances from natural disasters. As local communities are able to strengthen their telecommunications sector and infrastructure, this can help a community be more resilient before, during and after a disaster. Leaders collaborating with telecommunications professionals may consider asking these questions:

- How is the communications system mapped, and where do we see potential vulnerabilities?
- Who owns and/or manages the infrastructure and equipment for this resource? How can we best engage and collaborate with them?
- How can we create an ecosystem where it is easier to collaborate with competitors on mitigation efforts?
- How do hazards such as wildfires, hurricanes, floods or earthquakes affect the communications infrastructure?
- How can we increase the reliability of our communications system by diversifying it and adding redundant system components?
- What impact have past disasters had on this system? What was the impact to connectivity? What component(s) of the system failed? What component(s) of the system functioned through the disaster?

Resilience in telecommunications requires both structural and operational interventions. At the structural level, resilience is achieved through redundancy and diversity. *Redundancy* includes both replication of components and communications links; redundant parts pick up the task of any failing entities. *Diversity* helps avoid challenges of the same kind affecting system components in the same way. At the operational level, resilience is achieved through active detection, remediation, and recovery actions.

To maintain continuity of operations during and after a disaster, it is important to install flexible infrastructure that can be up and running in the critical days following the event. This period is when the most lives can be saved.

In addition to evaluating how hazards affect communications operations, emergency managers and local officials should include mitigation actions for communications systems in hazard mitigation plans. Telecommunications professionals recommend considering the following mitigation strategies for communications systems:

1. **Regular Upgrades and Inspections:** Reinforce or upgrade infrastructure to mitigate the risk of physical damage. Perform regular inspections of both physical infrastructure (cables, server rooms, telephone poles, etc.) and digital infrastructure (software updates).
2. **Autonomous Power Supplies:** Provide an autonomous power supply and enough fuel for generators because electricity failure may last for a long time. Consider alternative power sources like wind or solar to ensure continuity in the event of power outages.
3. **Safer and More Accessible Equipment Locations:** Install equipment in safer places that are farther from at-risk areas. When reviewing or updating the location of essential equipment, make sure it is accessible, that it has security measures like fencing, and that surrounding vegetation is trimmed.
4. **Critical System Backups:** Ensure redundancy and backups for critical systems and implement interoperable systems and diversified access technologies.
5. **Computer System Networking:** Embrace mesh topologies to provide redundancy routes and reduce the risk of network failure.
6. **System Monitoring:** Install a warning system that uses sensors to monitor and provide digital data about environmental conditions.
7. **Co-location with Other Utilities:** Work with other utility sectors, including electric power, to ensure resilient communication considerations, like undergrounding, are addressed within their mitigation plans and projects.

WHAT ARE “MESH TOPOLOGIES”?

In a mesh topology, the network is set up where each node (computers and network devices) is interconnected with at least one other node and usually to more than one. These nodes act as relays, passing on a message toward its final destination. This setup allows for most transmissions to be distributed even if one of the connections goes down. The advantage of mesh topologies is that a failure of one device does not cause a break in the network or transmission of data since traffic can be rerouted to other nodes. Full mesh topologies can be costly to implement, so partial mesh topologies are often deployed to balance cost and the need for redundancy. Military organizations and emergency services often use mesh topologies to ensure that communications systems are reliable. Wireless mesh networks are gaining popularity because they are simple and cheap to connect using radio signals. For example, in New York City the youth-development nonprofit Red Hook Initiative built a local mesh network using interconnected wireless routers. Red Hook is a low-income community that is highly vulnerable to flood risk and was significantly damaged during Hurricane Sandy. This Wi-Fi network provides the neighborhood a communication alternative to broadband providers to use during disasters and all other times.

DON'T FORGET ABOUT ACCESSIBILITY

Not all individuals within a community have the same access to, or knowledge of, digital and communications technologies and how to most effectively use them.

- For example, when you are shifting activities to a digital setting, you may consider pairing those efforts with a public outreach initiative so that the community is familiar with the new systems.
- Providing essential or important information through more than one type of communications channel ensures that no individuals or groups are left out. These essential communications may be shared through in-person meetings, postcards, reverse 9-1-1/4-1-1, physical flyers posted in key locations, text messages and other ways.

COMMUNICATIONS REPRESENTATIVES

Which organizations should you invite to engage in the planning process? The answer will vary from county to county and state to state, but consider individuals and/or organizations like these:

- Municipal technology officers.
- Public works department.
- Telecommunications providers (e.g., phone, cable, broadband, satellite, etc.).
- Utility companies.
- Academic institutions—especially those with programs in telecommunications and energy.
- Local chapters of relevant trade unions (e.g., International Brotherhood of Electrical Workers, Communications Workers of America, Utility Workers of America).
- Rural electric cooperatives, including those who focus on solar and wind power.
- State agencies or departments responsible for public utilities or telecommunications oversight.
- Local businesses with subject matter experts in telecommunications and/or electrical providers.

Photo: Man using smart phone on subway train in New York, N.Y.

RESOURCES

Guides to Expanding Mitigation
https://www.fema.gov/mitigation-risk-reduction
Link to all available Guides to Expanding Mitigation.

FEMA Hazard Mitigation Planning
https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning
Review standards and guidance for the planning process.

FCC Bridging the Digital Divide for All Americans Initiative
https://www.fcc.gov/about-fcc/fcc-initiatives/bridging-digital-divide-all-americans
Learn about FCC initiatives to increase broadband access.

FCC Lifeline Program for Low-Income Consumers
https://www.fcc.gov/general/lifeline-program-low-income-consumers
Learn about discount phone services for qualified consumers.

USDA e-Connectivity Initiatives
https://www.usda.gov/broadband
Learn about programs for rural communities.

Photo: Communication towers sit atop Steptoe Butte in eastern Washington

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ACKNOWLEDGEMENTS

We thank the following organizations, whose staff contributed their time toward advancing our understanding of mitigation and communications systems: Cybersecurity and Infrastructure Security Agency; FEMA Region 2; Qri; University of Pennsylvania; and Witt O'Brien's.

ENGAGE WITH US

Are you a state, local, tribal or territorial official interested in making the connection between telecommunications and hazard mitigation? Are you a telecommunications professional interested in connecting with local officials to reduce risk from hazards? Please contact us at FEMA-ExpandingMitigation@fema.dhs.gov.