
Unit 4: Interoperable Communications

STUDENT GUIDE

Objectives

By the end of this unit, students will be able to:

- Identify methods for the application, coordination, and use of interoperable communications.
- Define the concept of interoperability.
- Identify and describe the five lanes of the SAFECOM Interoperability Continuum.

Methodology

This unit uses lecture and discussion based activities.

Knowledge of unit content will be evaluated through administration of the final exam (to be administered upon completion of the course).

The purpose of this unit is to provide students with a high-level orientation to interoperable communications.

The purpose of Exercise 4-1 is to provide the participants with an opportunity to develop deployment strategies for portable repeaters in all-hazards environments, explain the challenges their strategy overcomes, and identify any challenges created by their strategy.

The purpose of Exercise 4-2 is to provide the participants with an opportunity to identify the challenges specific to communications in certain all-hazards environments and explain how to use existing communications technology to overcome these challenges.

Knowledge of unit content will be evaluated through administration of the final exam (to be administered upon completion of the course). Instructors will evaluate students' initial understanding through facilitation of Exercises 4-1 and 4-2.

Time Plan

A suggested time plan for this unit is shown below. More or less time may be required, based on the experience level of the group.

Topic	Time
Lesson	2 hours
Exercise 4-1	30 minutes
Exercise 4-2	30 minutes
Total Time	3 hours

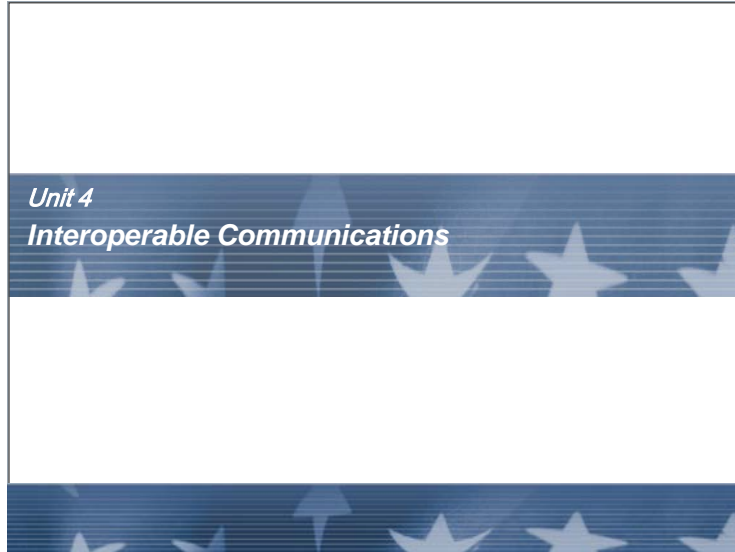
Reference Materials

- Projector & other equipment as necessary for PowerPoint presentation
- Easel pad
- Marking pens
- Exercise 4-1
- Exercise 4-2

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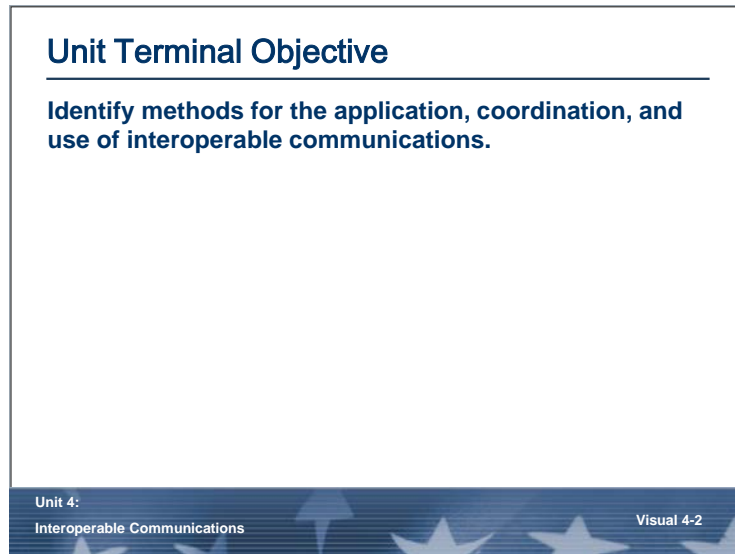
Topic

Unit Title Slide



Key Points

Topic**Unit Terminal Objective**

**Key Points**

Unit Terminal Objective:

Identify methods for the application, coordination, and use of interoperable communications.

Unit Enabling Objectives:

- Define the concept of interoperability.
- Identify and describe the five lanes of the SAFECOM Interoperability Continuum.

TopicSAFECOM Definition of Interoperable Communication

SAFECOM Definition of Interoperable Communications

The ability of Public Safety responders to share information via voice and data communications systems on demand, in real time, when needed, and as authorized.

Unit 4:
Interoperable Communications

Visual 4-3

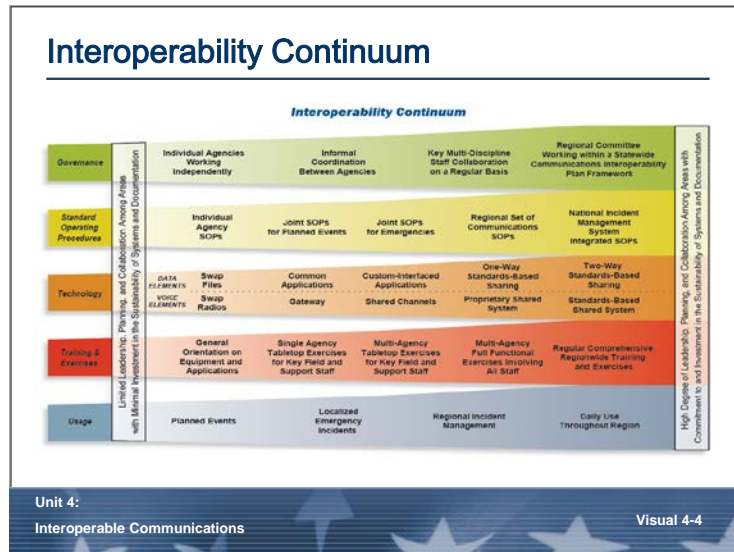
Key Points

Interoperability does not refer to all parties speaking to one another. Rather, it refers to systems and processes that allow parties to communicate even if their equipment differs.

Interoperability must be carefully managed to avoid mass confusion.

Interoperable systems can grow quickly in complexity and are therefore easy to overload

Topic Interoperability Continuum



Key Points

A full copy of the Continuum is on the last page of this unit.

What is the SAFECOM Continuum?

The Interoperability Continuum is a tool designed to aid the emergency response community and local, tribal, state, and Federal policy makers to ensure they address critical elements for success as they plan and implement interoperability solutions.

What are the lanes in the SAFECOM Interoperability Continuum?

- Governance
- SOPs
- Technology
- Training and Exercise
- Daily Use

All of the items listed in these lanes are tools for interoperability. All are acceptable and even essential for effective interoperability. Interoperability is a lot more than technology.

Topic

Governance Lane

Governance Lane

- May establish authority through elected officials or executive councils
- The ability to codify relationships and make relationships sustainable
- Provides for Operations and Technical working groups
- Strategic Plan
- Identifies future funding sources
- Establishes agency rights and responsibilities

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Visual 4-5

Key Points

Governance refers to actions and programs undertaken by leadership for the purposes of managing the organization. Good governance in advance of an incident helps secure funding for communications operations, avoid confusion, and establish rights and responsibilities.

It is the ability to codify relationships and make relationships sustainable. It is also about having a problem solution before the problem occurs.

Topic

Standard Operating Procedures Lane

Standard Operating Procedures Lane

- Establishes Rules of Use
- Procedures for the activation, response, and deactivation of communication resources
- Provides a process for problem resolution
- Adopt Incident Command System (ICS) to integrate communications into the National Incident Management System (NIMS)
- Technology is not an unconditional solution to interoperability
- SOPs are essential to effective interoperable communications

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Visual 4-6

Key Points

The SOPs lane promotes a set of SOPs at the local agency level to a regional set of communication SOPs that adopt ICS and integrate communications into National Incident Management Systems (NIMS) SOPs.

They establish rules of use, procedures for activation, response, and deactivation of communications resources. They provide a process for problem resolution.

- The SOPs lane promotes a set of SOPs at the local agency level to a regional set of communication SOPs that adopt ICS and integrate communications into NIMSSOPs.
- Using common terminology provides everyone on the incident a common dialect for describing the “who, when, why, where, what, and how” of operations. It is necessary when planning, running operations, or forming SOPs.
- Technology is not an unconditional solution to interoperability. SOPs are essential to effective interoperable communications.

Technology Lane

- Cache radios (swap radios):
 - Both large and small caches have great utility
 - Small caches can be agile
 - Six portable radios in the back of a police sergeant's car can be deployed quickly to fill gaps in interoperability



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Visual 4-7

Key Points

Cache of radios may be maintained as State, shared regional or local resource; the radios are fully charged, include extra batteries and chargers, and are labeled with the owner agency name, frequencies, band and system. Identify caches and put them in your MOB Guide. Personal knowledge of State, regional or local communication equipment caches is not generally known.

It is important to know:

- Where your caches are
- Ordering procedures for a cache
- Are there costs involved
- Can you account for the cache you use

EMAC: Agreements are in place for the use of resources between states
www.emacweb.org

Topic Other Swap Radio Resources

Other Swap Radio Resources

- **NIFC: National Interagency Fire Center**
 - **Manages USFS, BLM, and aviation frequencies for primarily wildland fire fighting to provide a coordinated effort between Federal and State land management agencies**
 - **Manages portable communication equipment and systems**
 - **May provide a Communications Coordinator, depending on size, complexity, and number of incidents**

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Visual 4-8

Key Points

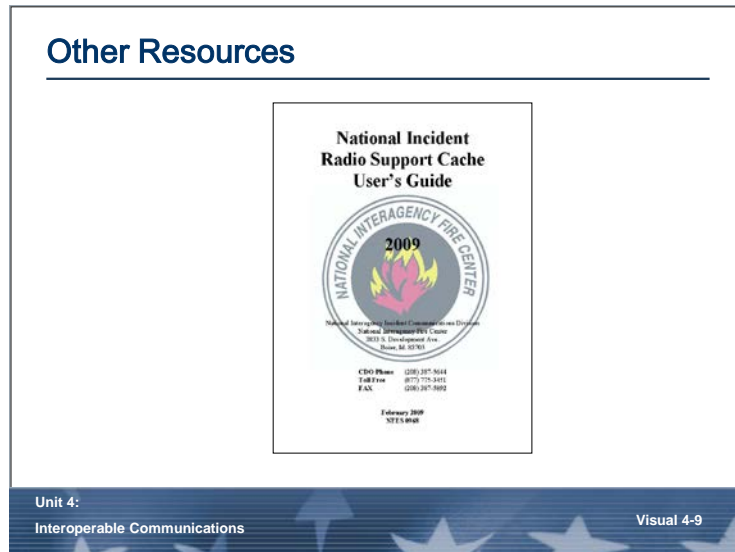
- The NIFC manages USFS, BLM, and aviation frequencies, primarily for wild land firefighting.
- NIFC manages portable communication equipment and systems and may provide a communications coordinator, depending on size, complexity, and number of incidents involved.
- The National Incident Radio Support Cache also has equipment available for federally recognized incidents.

National Interagency Incident Communications Division
(<http://www.fs.fed.us/fire/niicd/index.html>)

To download the Radio Inventory Database, go to
<http://www.fs.fed.us/fire/niicd/documents>, and select Radio Inventory Database under NIICD Documents.

Topic

Other Resources



Key Points

This document is available online and on the Student CD.

You must have a prearranged reimbursable agreement in place to request this resource. As alternative, request through a State Forestry Agency, Department of Natural Resources, or through the emergency management procurement process.

This cache was designed primarily to support wildfire and land management agencies. Resources may be scarce during fire season.

Topic

Technology Lane (cont.)

Technology Lane (cont'd)

- **Gateways: Gateway systems interconnect channels of disparate systems**
 - **Fixed gateways, such as console patches, are in use in many dispatch centers**
 - **Mobile gateways, portable interconnect switches, require technical support**

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Visual 4-10

Key Points

What is the basic function of a gateway, also referred to as an audio bridge or audio gateway?

- Gateways interconnect disparate communications devices (typically two-way radios) and allow audio to be patched between devices as needed. These communication devices can be in any frequency band (HF, VHF low band, VHF high band, UHF, 800 MHz, satellite bands...). The devices can be portable and mobile radios, base stations, telephones, cell phones or satellite phones. Fixed gateways, such as console patches, are used in many dispatch centers.
- Mobile gateways, portable interconnect switches, require technical support

What are the two basic types of gateways?

- Fixed and Mobile

What is a mobile gateway?

- Portable or Transportable which is taken to the incident, event or exercise.

What is a fixed gateway?

- Centrally located in a fixed location to operate with the local area communication assets.

What is a console patch?

- Console patches are preconfigured/hardwired into the console.

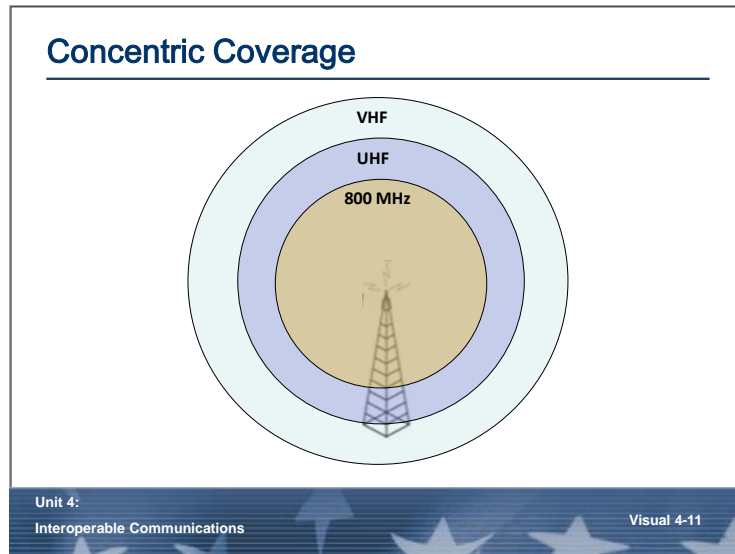
How does a audio gateway differ from a console patch?

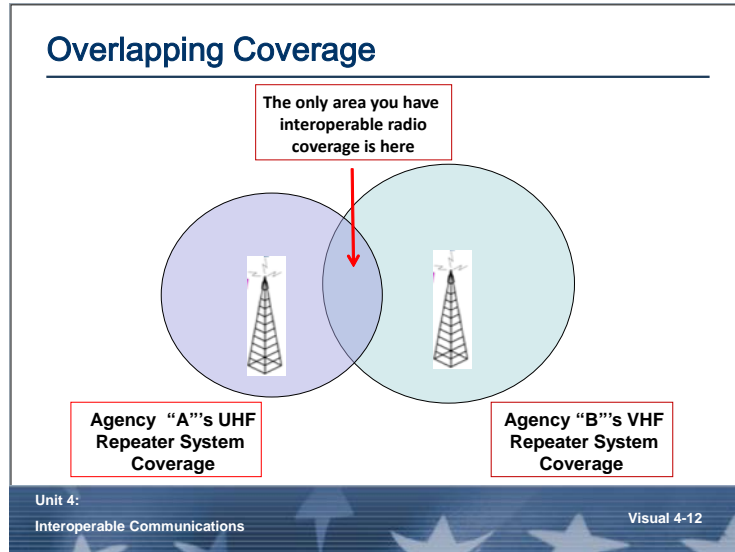
- This allows flexible patching between any/all systems interfaced with the audio gateways.

Are you using a gateway when a simpler method is available?

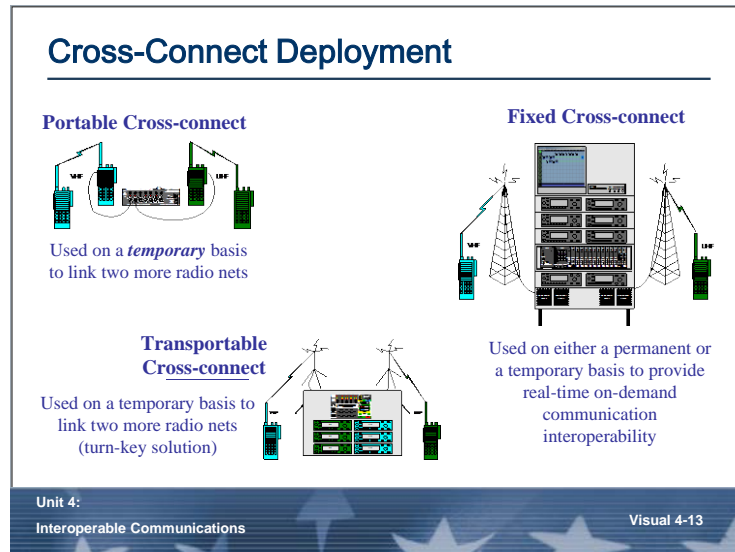
Topic

Concentric Coverage

**Key Points**



Key Points

Topic Cross-Connect Deployment**Key Points**

Fixed gateways are simple to deploy, can be test and trained with regularly. Overlap coverage of disparate system should be mapped.

Mobile gateways may have range limitations (simplex) and can have interference issues.

Portable gateways can have power supply limitations, reduced performance of portable receivers, and antenna limitations.

Topic

Technical and Operational Resources



Key Points

What are some things to consider when choosing a gateway?

- What will the gateway be used for? (i.e. deployment environment, mobile, fixed, in building, tunnel...)
- How many interfaces are required?
- Where will the interface devices be connected? (i.e., directly to the gateway, remotely via the Internet...)
- What types of patches are needed? (Many , one to many, many to one, one way monitor only...)
- What is your budget?
- How are you going to troubleshoot interference?
- How are you going to troubleshoot major system failure?

Topic

Gateways - Pros

Gateways - Pros

- Gateways provide a connection between unlike audio sources or radio systems
- Gateways can make interoperability a reality, with quality audio and clean signals
- Properly configured gateways will allow all radios to hear all the traffic, taking system delays, etc., into consideration
- Fixed gateways can be engineered, tested, and exercised

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Visual 4-15

Key Points

What is the biggest advantage of a gateway?

Gateways provide interoperability between public safety service and support providers (i.e. law enforcement, firefighters, EMS, emergency management, the public utilities, transportation, and others). Gateways allow public safety agencies to communicate with staff from other responding agencies, to exchange voice and/or data communications on demand and in real-time.

Topic

Gateways - Cons

Gateways - Cons

- Coverage is only equivalent to the smallest footprint created by the overlap of all interconnected systems
- Incorrectly managed, joined audio sources can create major operational problems
- Mobile Gateways are not “plug and play” and have the potential to cause connected communications networks to fail
- Failure to adjust audio levels correctly will result in difficult-to-understand audio from different sources

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Visual 4-16

Key Points

Why don't you use a gateway to patch everyone at an incident to everyone else?

Only patch those systems that really need to talk to each other for the time they need to talk, to prevent excess chatter. It will cut down on the confusion of hearing different organizations on your net and there will be less people vying for air time. Remember, just because you can patch someone doesn't mean you should.

How can you ensure gateways are properly configured prior to deployment?

Many mobile radios require special programming; some require hardware modification to properly interface with a gateway. Interface radios should be tested and adjusted with the audio gateway when it is first received and prior to deployment.

Why are audio levels of the gateway important?

- Correct level are required for proper operation
- Too high levels will cause flat-topping and distortion
- Too low levels will not provide adequate audio volume to drive the interface devices

Patched channels may not have identical coverage:

- Different location of transmitter
- Different frequency band characteristics

Topic

Gateways – Cons (cont.)

Gateways – Cons (cont'd)

- Not fully understanding the methodology used in the gateway can result in the “ping-pong” effect and other issues that make a combined system unusable
- Gateways require knowledgeable personnel with the skills to troubleshoot problems at all times
- Gateways must be used as a part of a coordinated plan at an incident; knowing where they are and what they are patching is essential for the COML
- Gateways are not plug and play

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Visual 4-17

Key Points

Ping Ponging is the effect when the radios in the patch begin bouncing between TX and RX with no signal present.

Why do you need a gateway specialist?

Gateways are not plug and play. A knowledgeable person can recognize and fix a problem before it affects the people in the field.

When at an incident where multiple gateways are used, what is the key to interoperability?

Coordination is the key; always go through the Communications Unit Leader prior to creating a patch and know what is being patched.

Portable and Mobile gateways should have a specialist with them at all times.

Caution to address itinerate gateways.

Gateway management is essential. Communications Unit Leaders should have the authority over any inventory on the scene.

Topic

Technology Lane (cont.)

Technology Lane (cont'd)

Shared channels: Common frequencies or talkgroups that have been established and are programmed into radios to provide interoperable communications among agencies.

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Visual 4-18

Key Points

Interoperability is promoted when agencies share a common frequency band, air interface (analog or digital), and are able to agree upon common channels.

Why don't public safety agencies all use the same shared channels?

The general frequency congestion that exists across the United States can place severe restrictions on the number of independent interoperability talk paths available in some bands. Also, different bands have different characteristics.

Shared channels are often ignored for more complex solutions. Shared channels are the most direct form of interoperability.

The selection of shared channels is often heavily dependent on the governance lane, as long-term decisions about which organizations use which frequencies must be made.

Topic

Technology Lane (cont'd)

Technology Lane (cont'd)

Shared system: The use of a single radio system infrastructure to provide service to several first responder agencies within a region.

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Visual 4-19


Key Points**Why are regional shared systems a solution to interoperability?**

With proper planning of the talk group or channel structure, interoperability is provided as a byproduct of system design. Usually these are established at the request of the members of the governance lane, and require considerable coordination so that the shared system that is selected fits all of the local organization's needs.

Topic Technology Lane (cont'd)

Technology Lane (cont'd)

- **Standards-based Shared System - P25 is synonymous with Public Safety Digital Radio Standards in the United States**
- **Ongoing joint effort since 1989 between Association of Public-Safety Communications Officials, Intl. (APCO), the National Association of State Technology Directors (NASTD), the Telecommunications Industry Administration (TIA) and agencies of the Federal Government**



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Visual 4-20

Key Points

Why are standards-based shared systems better than proprietary shared systems? Proprietary systems limit the user's choice of product with regard to manufacturer and competitive procurement, standards-based shared systems promote competitive procurement and a wide selection of products to meet specific user needs. P25 is not the Public Safety Radio Standard. It is the Public Safety Digital Radio Standard. Common elements of a standards-based system are:

- **Common Air Interface (CAI):** Point of connection between radio transmitters and receivers; defines the technical form and function of the digital signal that goes over the airwaves
- **Console Subsystem Interface (CSSI):** Defines how radio frequency components of a standards-based system and dispatcher consoles connect with one another

Data Interface:

- **Fixed Station Interface (FSI):** Defines how components of a shared standards radio system that are fixed in place connect with other components of the system
- **Inter-RF Subsystem Interface (ISSI):** Defines how different standards-based radio networks can connect with one another
- **RF Subsystem Interface (RFSS):**
- **Subscriber Data Peripheral Interface (MDTs, etc.):**

- Telephone Interconnect Interface:

The goal is to ensure a future with an open standards-based alternative for Public Safety digital radio systems.

Future technologies should incorporate elements of a standards-based system.

Topic

Standards-based Shared System

Standards-based Shared Systems

- The goal of P25 is to ensure a future with an open standards-based alternative for Public Safety digital radio systems
- Phase One is for 12.5 kHz channels and Phase Two is for 6.25 kHz channels
- P25 has eight defined interfaces
 - Common Air Interface (CAI)
 - Console Subsystem Interface (CSSI)
 - Data Interface
 - Fixed Station Interface (FSI)
 - Inter-RF Subsystem Interface (ISSI)
 - RF Subsystem Interface (RFSS)
 - Subscriber Data Peripheral Interface (MDTs, etc.)
 - Telephone Interconnect Interface

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Visual 4-21

Key Points

Project 25 is a phased approach to fielding new Public Safety communications technology as quickly as it is available; development of standards; and the testing of the technology in the field.

The goal of P25 is to ensure a future with an open standards-based alternative for Public Safety digital radio systems in the United States and across the globe (P25 is also used in many other countries).

P25 is an ongoing phased effort to introduce technology promoting interoperability, providing a backward/forward migration path to related technologies.

P25 also ensures lifecycle competitive procurement, spectrum efficiency, and is operationally user friendly.

Topic**Training and Exercises Lane**

Training and Exercises Lane

- Single agency to regional training and exercise of the Tactical Interoperable Communication Plans (TICPs)
- Following Homeland Security Exercise and Evaluation Program (HSEEP) guidance
- Discussion-based Table Top Exercises (TTX)
- Operationally focused:
 - Functional Exercises (FE)
 - Full-Scale Exercises (FSE)

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Visual 4-22

Key Points

The Training and exercise lane provides for single agency training and exercises, to regional training in using a Communication Plan.

Regional exercises are an excellent opportunity to establish a Communications Unit Leader for the area, in addition to the benefits of working cooperatively, and aid the goal of interoperability accordingly.

Exercises should follow the HSEEP for discussion-based exercises, tabletop exercises (TTX), or the operational-based exercises of functional exercises (FE), or full scale exercises (FSE).

Technology is great but it must be incorporated into training and exercises.

Query students on what kind of training they provide to users.

The complexities of systems available today require an additional level of training. Does your agency/locality have a strategy for that training?

Topic

Usage Lane



Key Points

This lane encourages the use of the TICP for planned events, local emergencies, regional incidents, and on a daily basis.

Does your agency have any planned large events or exercises where you could participate as a Communications Unit Leader?

Usage is the keystone of all interoperable communications. If it is not used on a daily basis, it will not be used in incident response.

Routine usage of interoperable elements promotes familiarity and consistency.

The Usage lane of the Interoperability Continuum encourages daily use of a communication plan whenever staffing:

- Planned events
- Local emergencies
- Regional incidents

TopicExercise 4-1 - Communication Asset Deployment Strategies

**Key Points**

Exercise: The purpose of the exercise is to provide the participants with an opportunity to develop deployment strategies for portable repeaters in all-hazards environments, explain the challenges their strategy overcomes and identify any challenges created by their strategy.

TopicExercise 4-1 - Image 1

Exercise 4-1



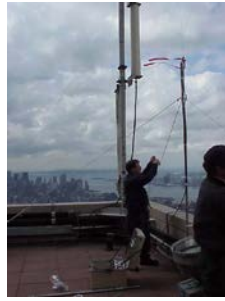
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Visual 4-25

Key Points

TopicExercise 4-1 - Image 2

Exercise 4-1



Unit 4:
Interoperable Communications

Visual 4-26

Key Points

Exercise 4-1



Unit 4:
Interoperable Communications

Visual 4-27

Key Points

Exercise 4-1



Unit 4:
Interoperable Communications

Visual 4-28

Key Points

TopicExercise 4-1 - Image 5

Exercise 4-1



Unit 4:
Interoperable Communications

Visual 4-29

Key Points

Topic

Exercise 4-2



Key Points

Exercise: The purpose of this exercise is to provide the students with an opportunity to identify the challenges specific to communications in certain all-hazards environments and how to use existing communications technology to overcome these challenges. The exercise is scheduled to last approximately 30 minutes, including small group discussions and presentation of group findings. Students will break into small groups and compile a list of potential challenges and solutions to operating within the urban environment in the train derailment scenario. Students will then present their findings to the class.

Topic

Objectives Review

Objectives Review

1. *Define the concept of interoperability.*
2. *Identify and describe the five lanes of the SAFECOM interoperability continuum.*

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Visual 4-31

Key Points

Unit Terminal Objective:

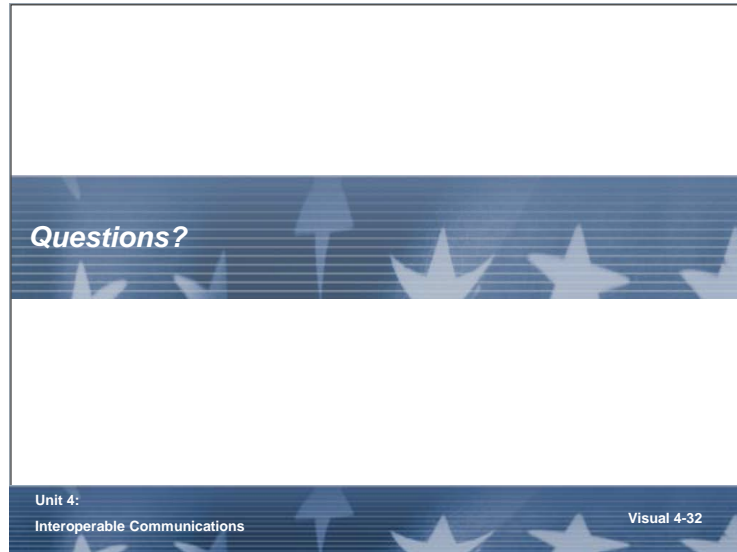
- Identify methods for the application, coordination, and use of interoperable communications.

Unit Enabling Objectives:

- Define the concept of interoperability.
- Identify and describe the five lanes of the SAFECOM Interoperability Continuum.

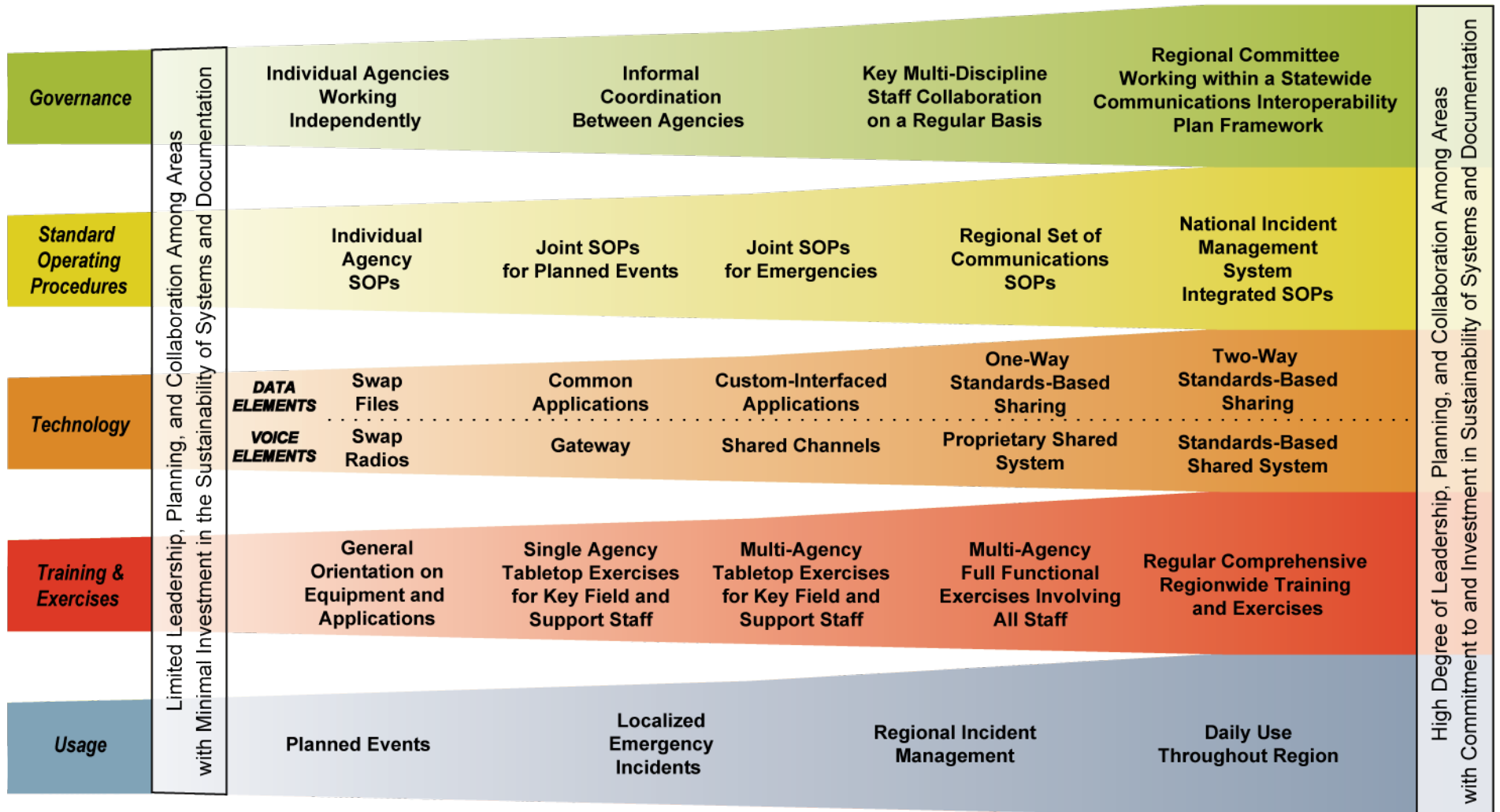
Topic

Questions?

**Key Points**



Interoperability Continuum



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