



NATIONAL TRANSPORTATION SAFETY BOARD  
**Investigative Hearing**

Washington Metropolitan Area Transit Authority Metrorail train 302 that encountered heavy smoke in the tunnel between the L'Enfant Plaza Station and the Potomac River Bridge on January 12, 2015

<b>GROUP</b>	<b>D</b>
<b>EXHIBIT</b>	
4	

Agency / Organization

Montgomery County Fire and Rescue Services

Title

Metro Tunnel Communications

# METRO TUNNEL COMMUNICATIONS



*"Gentlemen, the officer who doesn't know his communications and supply as well as his tactics is totally useless."-*  
*Gen. George S. Patton, USA*

# PREMISE

- The equipment that should allow communications from the platform level to the street level has failed before and is suspect on a good day
- There are two basic technologies used in tunnel communications: leaky lines and bi-directional amplifiers (BDAs)

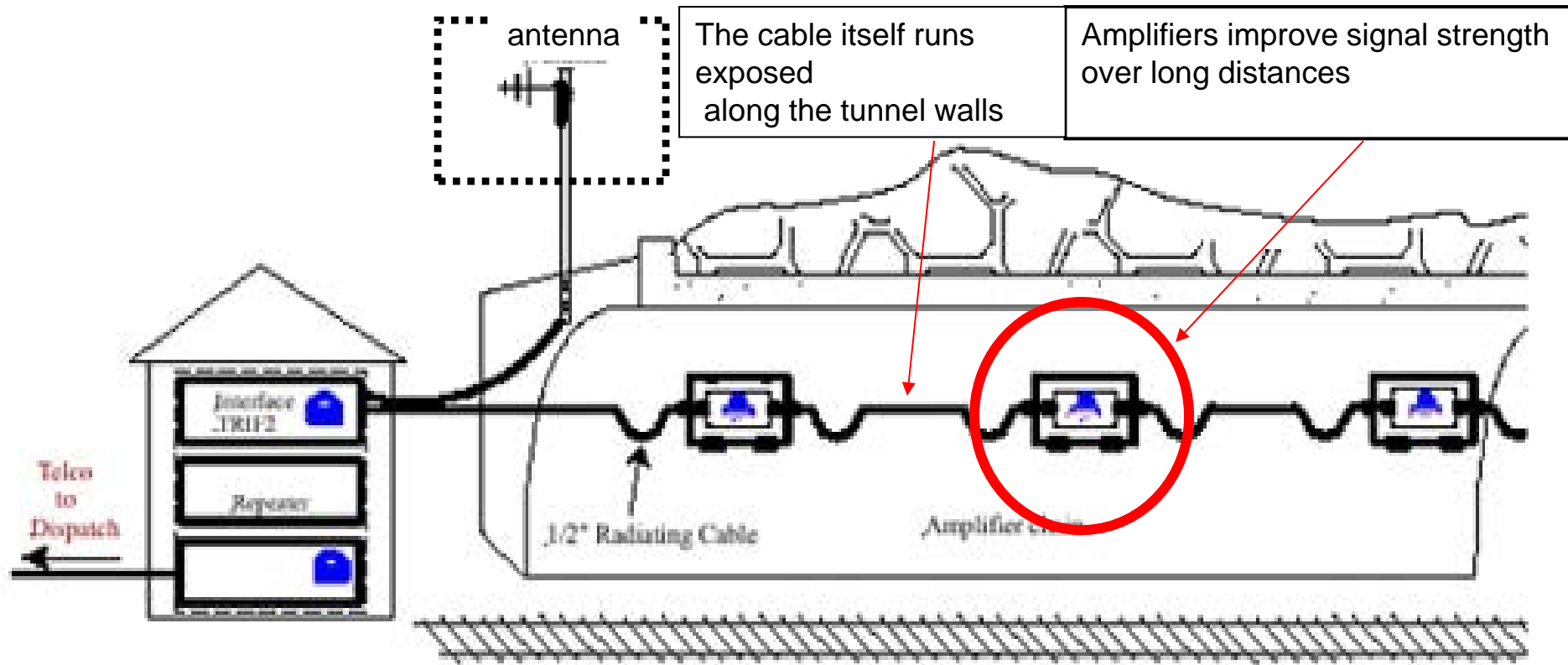
# METRO

## Tunnel Communications

Wikipedia definition: *(NOT TECHNICALLY PERFECT BUT IT WORKS)*

- A leaky feeder is a **communications** system used in **underground mining** and other tunnel environments. It consists of a **coaxial cable** run along drivages which emits and receives **radio waves**. The cable is leaky in that it has gaps or slots in its outer conductor to allow signal to leak into or out of the cable along its entire length. Because of this leakage of signal, line amplifiers are required to be inserted at regular intervals, typically every 350 to 500 metres, to boost the signal back up to acceptable levels.
- The system has a limited range and because of the **high frequency** it uses, transmissions cannot pass through solid **rock**, which limits the system to a **line-of-sight** application. It does, however, allow two-way mobile communication.

# Basic Diagram for Tunnel Communications



# Problems

- Tunnels are hot and when on fire and lines burn through
- Tunnels are dusty and lines clog
- Crashes and explosions result in sharp fragments of metal that slice through cable
- The spans are long and subject to other insults

## The Conventional Channel Basics

- 7 Oscar is a conventional channel it is not repeated
- 7-Oscar has a finite range-the signal can only go so far
- Many things affect the range including concrete, steel, and the power of the radio
- METRO has a lot of concrete and steel and the portables are “relatively” low power

# A Radio Relay

A radio relay is a communications chain that bridges distances over which one could not usually talk....

Build a chain of people with radios to bridge large distances full of concrete and metal...





# Relay Basics

Imagine that radio A was close enough to radio B to talk and radio B was close enough to radio C to talk...but radio A was too far from radio C to talk...

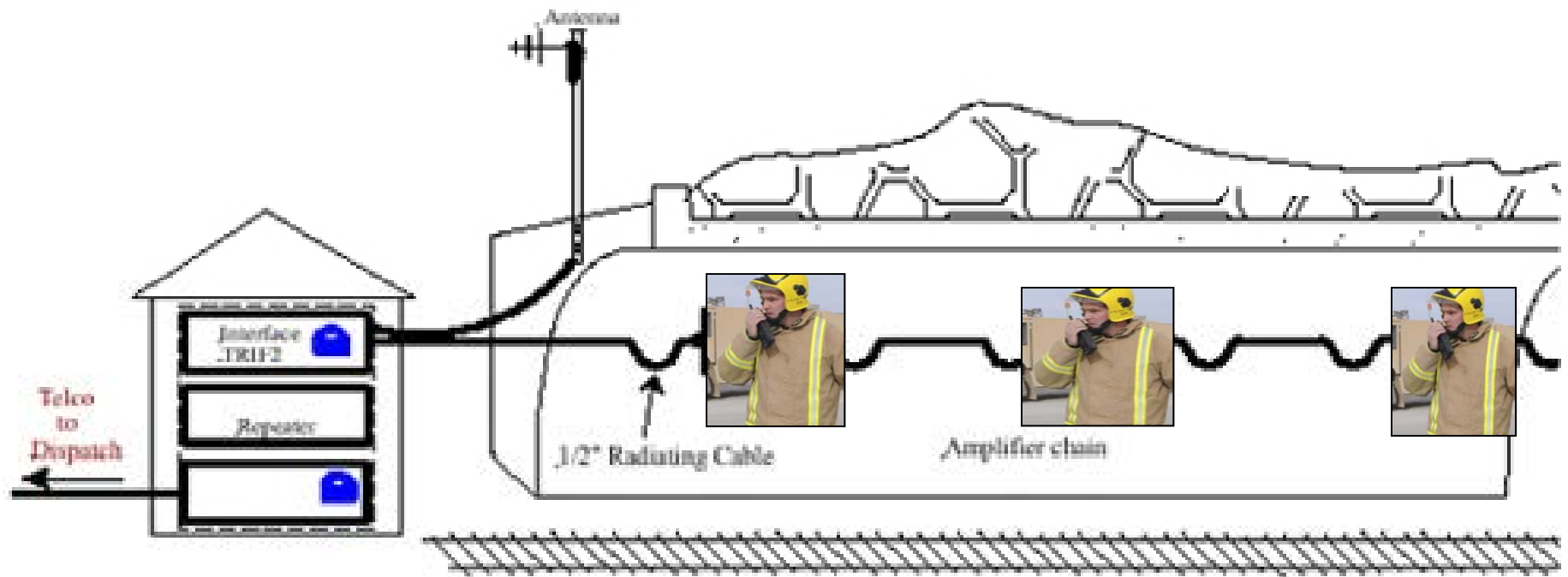


The way to get a message from A to C is for A to send it to B and B to relay it to C



# Another way to look at the relay

*Take out the amplifiers and insert firefighters with radios*



# Viabile Practice

## General Behavior

- When assigned to a METRO event in the ROW...
- As the first arriving major unit is gathering incident information they are listening for their radio to “honk” or display “Out of Range”
- If the radio honks then they should consider the tunnel bore an IDLH and follow two-in-two-out rules until radio relay can be established

# Viabile Practice

## General Behavior

- Crews stop at each turn or bend in the ROW to confirm communications
- If the radio honks then they should consider the tunnel bore an IDLH and follow two-in-two-out rules until radio relay can be established

# Viabile Practices

## Radio Relay

### Example set-up

- Make the guy at the top, “mezzanine comm”
- Make the guy at the platform “platform comm”
- When transmitting a message that needs to be repeated begin with “message for relay”

Ex. Platform Comm to Mezzanine Comm, message for relay...”  
“Mezzanine comm to platform comm ready for message...” “Platform comm to Mezzanine comm, advise command rescue group supervisor is requesting two additional companies for support.”  
etc...

**If you are in the operational area and you hear, “..message for relay...” that would be your clue to stop talking so the message could get out...**

# Limitations

**DO NOT BELIEVE THAT THE  
COMMUNICATIONS WILL BE PERFECT  
ON CONVENTIONAL CHANNELS**

**YOU STILL HAVE TO DEAL WITH WAVE  
PROPAGATION ISSUES**

# Things to think about

- A train in the station affects communications
- There was no IDLH so we could all hear and speak clearly...
- It would take an entire 4-person engine crew to set up this relay while assuring that no-one was alone...
- The mobile is more powerful than the portable..if you can get a mobile close on 7-Oscar top side and leave the drive with it that would help
- Think about all the talking the relay radios will have to do you will need more batteries
- Prioritizing and sending quality relay messages is not the job for a rookie!



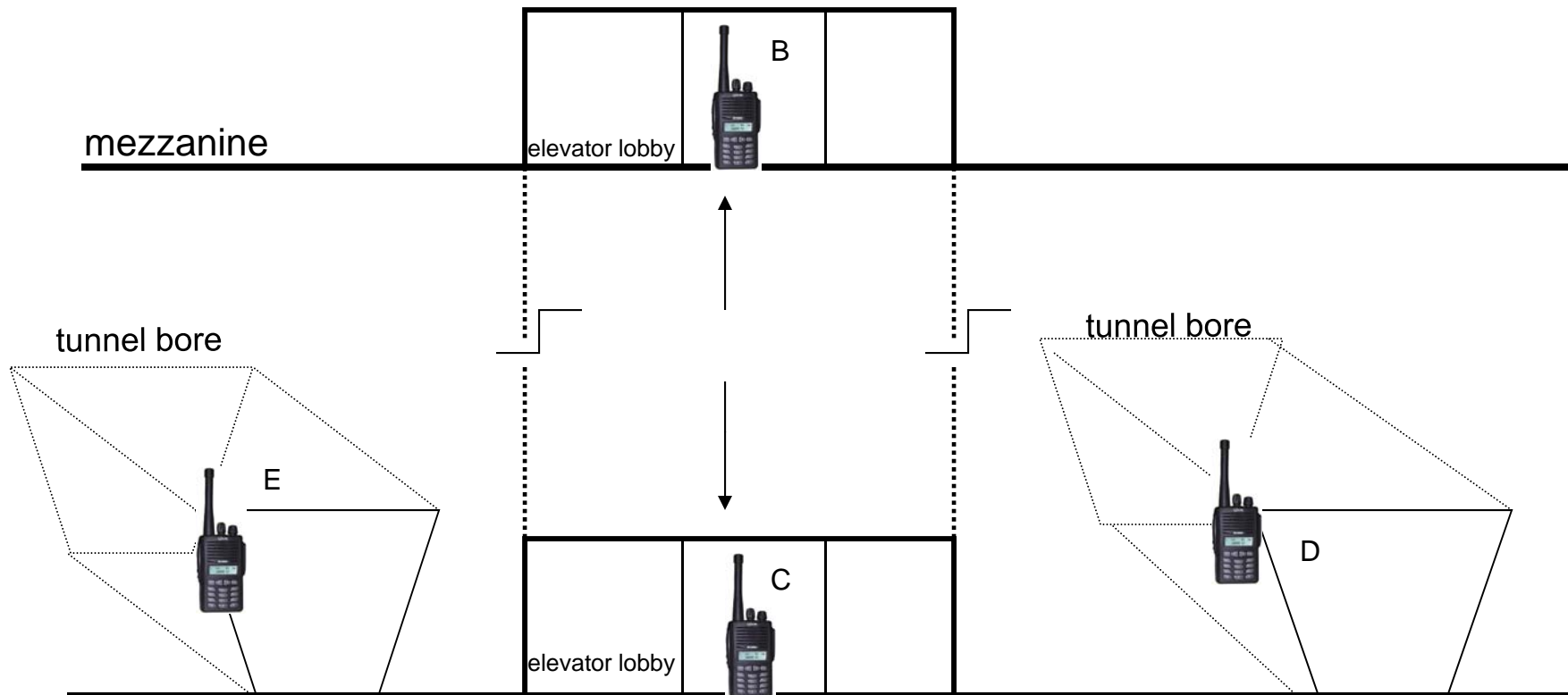
Forest Glen

# The Layout

- Street level
- Kiosk
- Mezzanine elevator lobby (area between the two elevator banks on the mezzanine level)
- Platform elevator lobby (area between the two elevator banks on the platform level)

# Forest Glen...radio A is top side

A

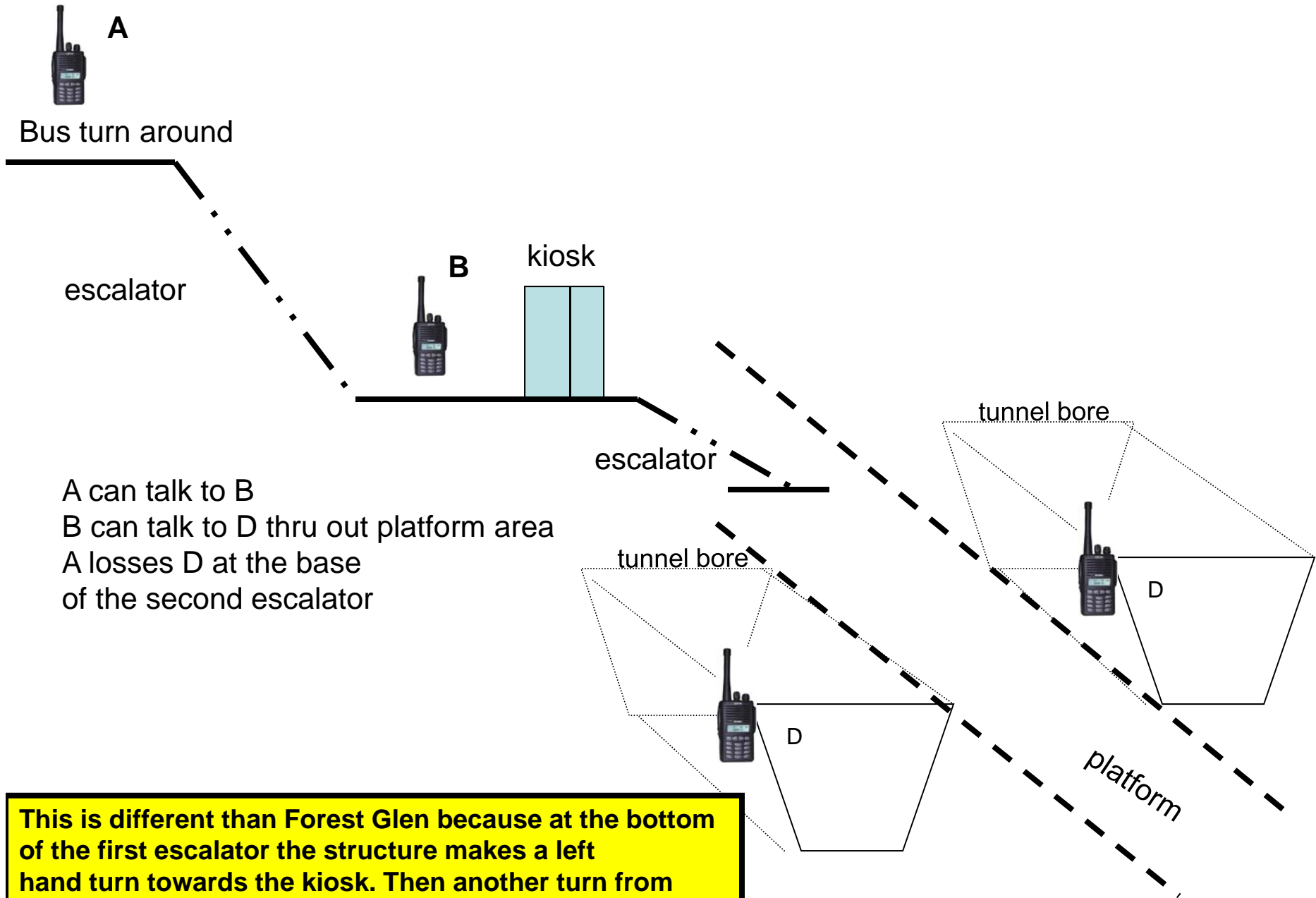


platform

## The Findings:

- Radio A can talk to radio B
- Radio B can talk to radio C IF both stay in the elevator lobby
- Radio C can talk to radios B, D, &E but not to radio A
- Radio D can talk to radio C and MAYBE radio E
- Radio E can talk to radio C and MAYBE radio D

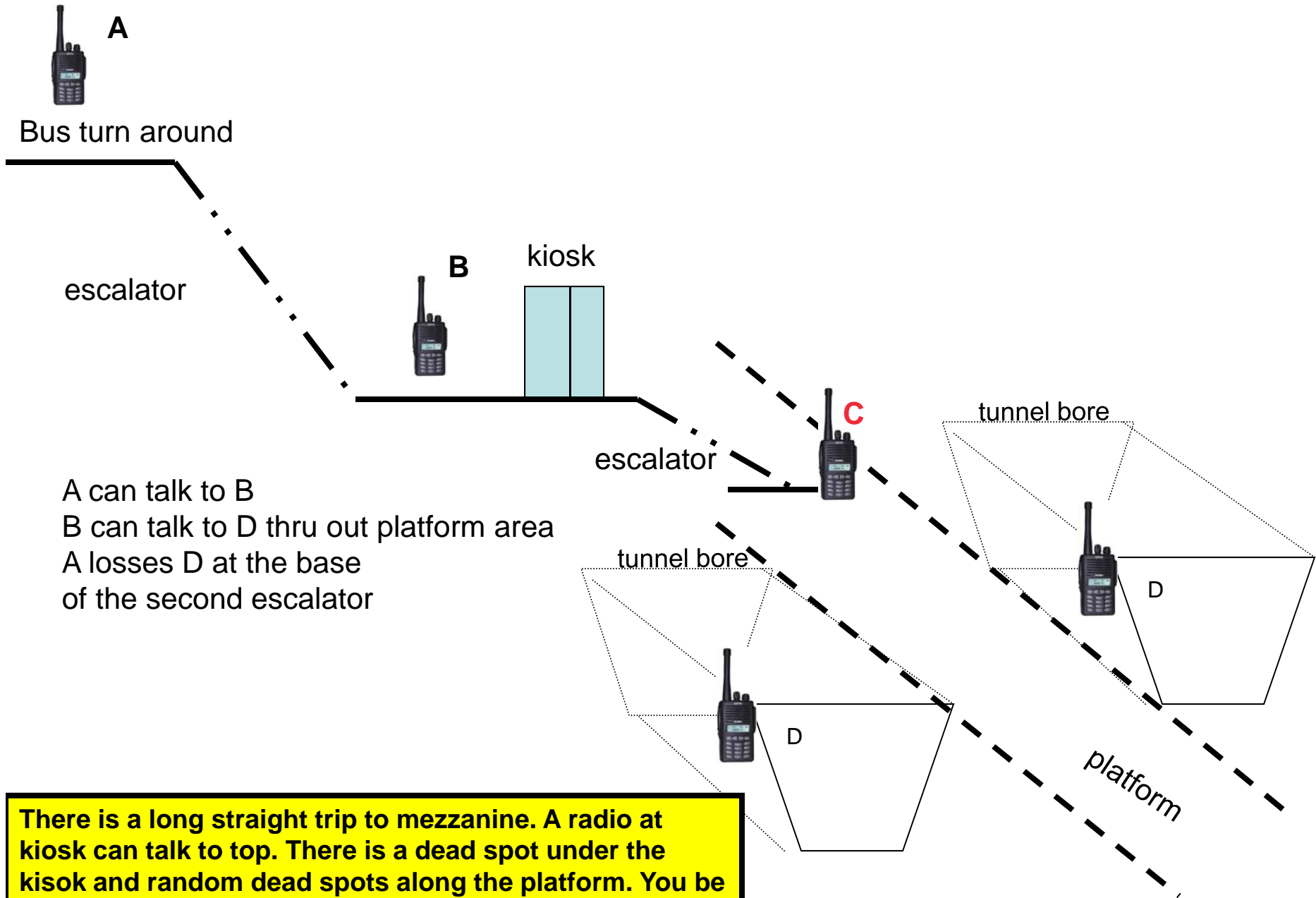
Bethesda



A can talk to B  
 B can talk to D thru out platform area  
 A losses D at the base  
 of the second escalator

**This is different than Forest Glen because at the bottom of the first escalator the structure makes a left hand turn towards the kiosk. Then another turn from kiosk to second escalator. Signal will make first turn but will not make the second turn.**

Medical Center



A can talk to B  
 B can talk to D thru out platform area  
 A losses D at the base  
 of the second escalator

**There is a long straight trip to mezzanine. A radio at kiosk can talk to top. There is a dead spot under the kiosk and random dead spots along the platform. You be advised to have a relay person at the bottom of the second escalator.**

# VRS?

7O and 7N are similar enough that if 7-O cannot reach all the way back to the top it is unlikely that 7N will.



# NCR-CIG

They bring:

- Advanced understanding of wave behavior
- Portable repeater devices
- Practice operating in tunnel spaces



# NCR-CIG

- Consider reflex time for deployment
- Consider reflex time for set-up
- Consider the need to conduct operations in smoke filled tunnel with zero visibility