# LCWC P25 Radio System Update


Presented by:
Rob Anderson

Date Presented:
September 11th, 2024

# Overview

- Equipment Upgrade
- System Usage
- Phase 2/LSM
- AVL Data/Emergency

# Past Upgrades

- System Commissioned (~2014)
- Microwave Upgrade (2017)
- Tait Software Upgrade (2022)
- Equipment Upgrade (2024)

# Equipment Upgrade/Maintenance

- New Equipment
  - GPS Timing
  - DC Power
  - Network Routers
  - TB9100 for TB9400 Repeaters
    - New Features
      - Phase II
      - C4FM/LSM
- Maintenance
  - Check and confirm Power Levels
  - Antenna Sweeps

# Subscriber Radio Maintenance

- Radios should be maintained
- New Radios should be Licensed for Phase II with LSM capability

# System Usage

- System Commissioned in 2014
  - Clusters were designed for the population at the time of installation

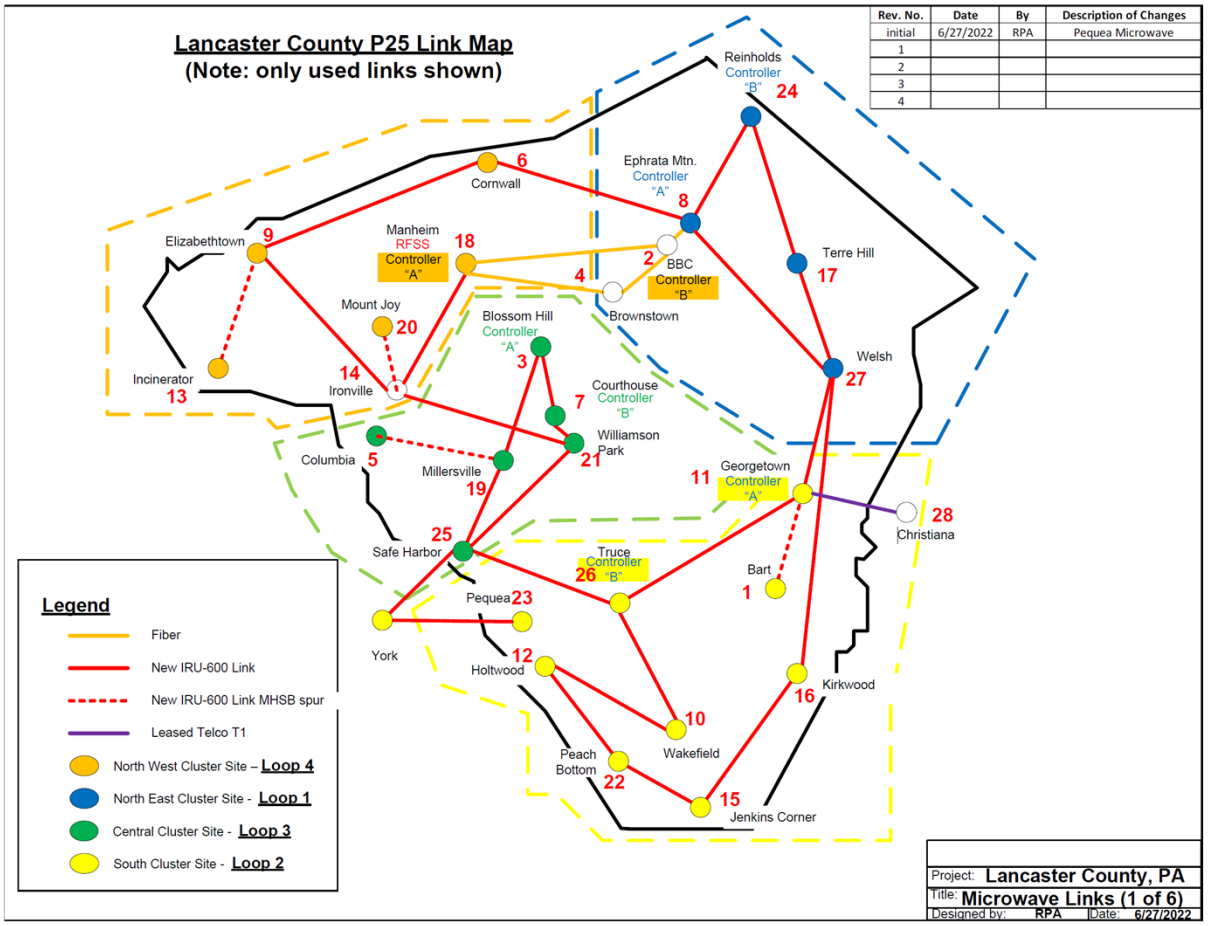
| Month | Year | Call Counts |
|---|---|---|
| March | 2023 | 755,686 |
| April | 2023 | 1,128,883 |

| Month | Year | Call Counts |
|---|---|---|
| March | 2024 | 1,819,702 |
| April | 2024 | 2,191,767 |

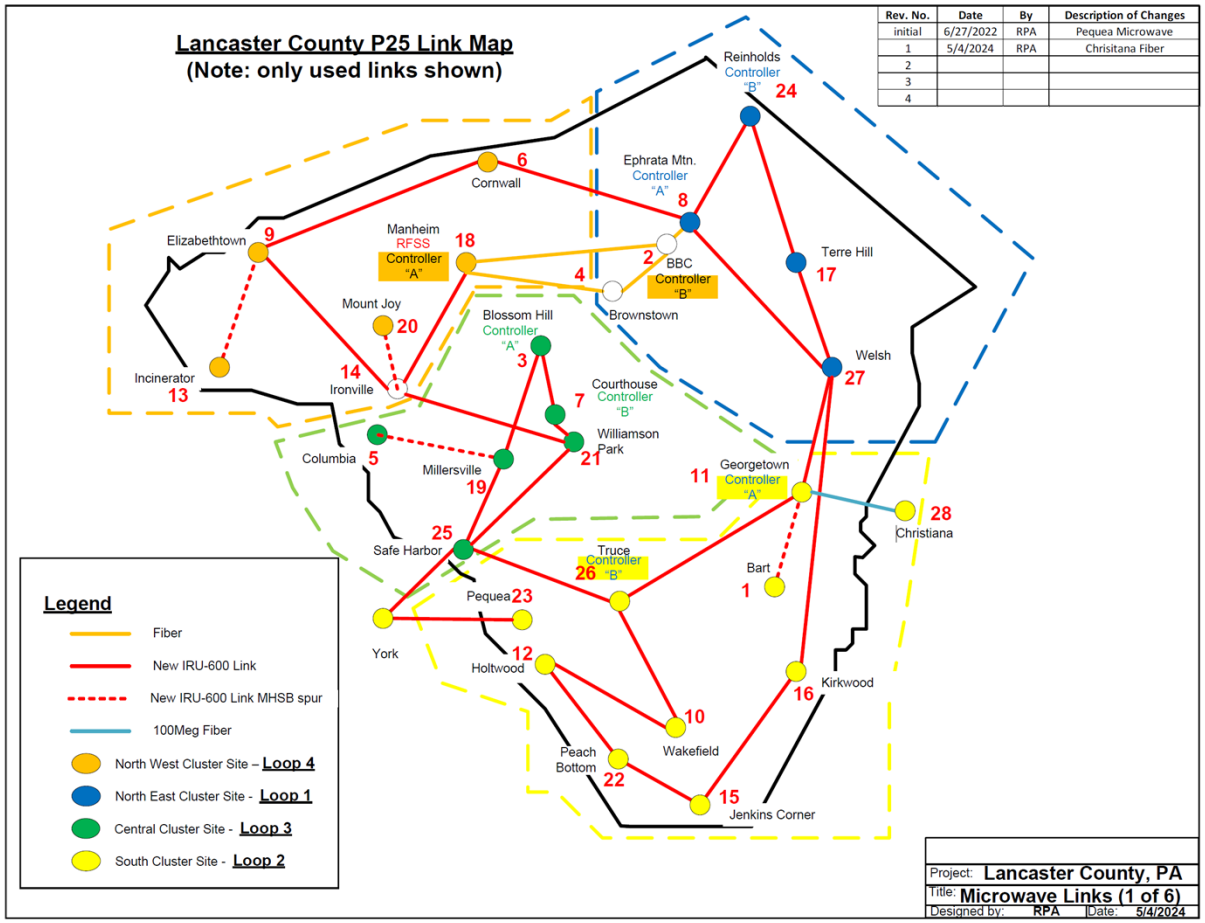
# Subscriber’s Registered

| Average Subscribers 2016 | Average Subscribers 2024 |
|---|---|
| 500 | 1500 |

# Cluster Overview



# Updated Cluster Overview



# System Busy

- System Busy
  - Talk group – Someone is currently transmitting on the same talk group
  - Queue A – Cluster is over-subscribed, and no other inbound traffic channels are available
  - Queue B – Calling Cluster is available, but the adjacent cluster is busy

# System Busy

Percent of system-queued calls from 2023 vs 2024

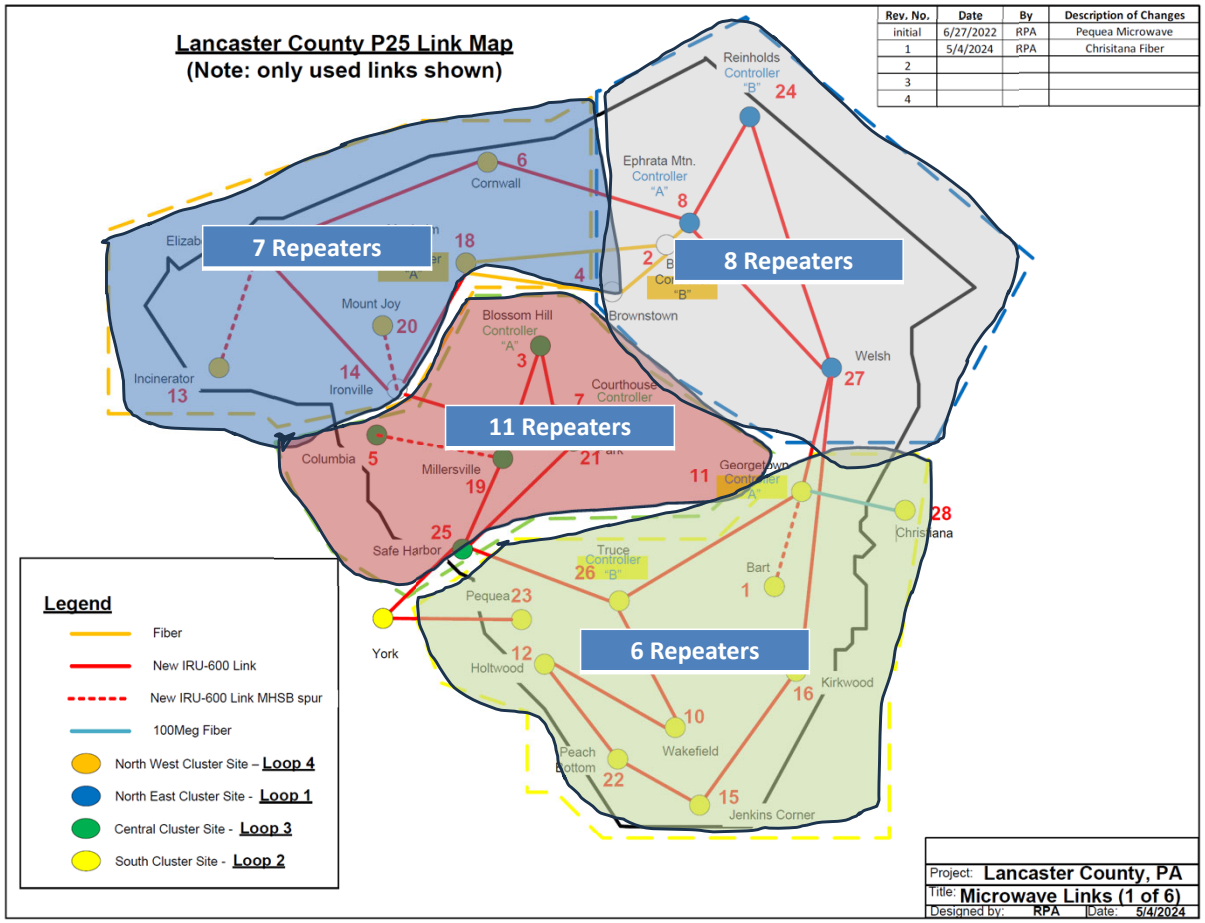
| | Jan-24 | Feb-24 | Mar-24 | Apr-24 | May-24 | Jun-24 | Jul-24 | Aug-24 |
|---|---|---|---|---|---|---|---|---|
| Queued A | 267% | 376% | 1392% | 762% | 123% | 119% | 591% | 62% |
| Queued B | 286% | 142% | 646% | 738% | 374% | 189% | 464% | 168% |

# System Busy

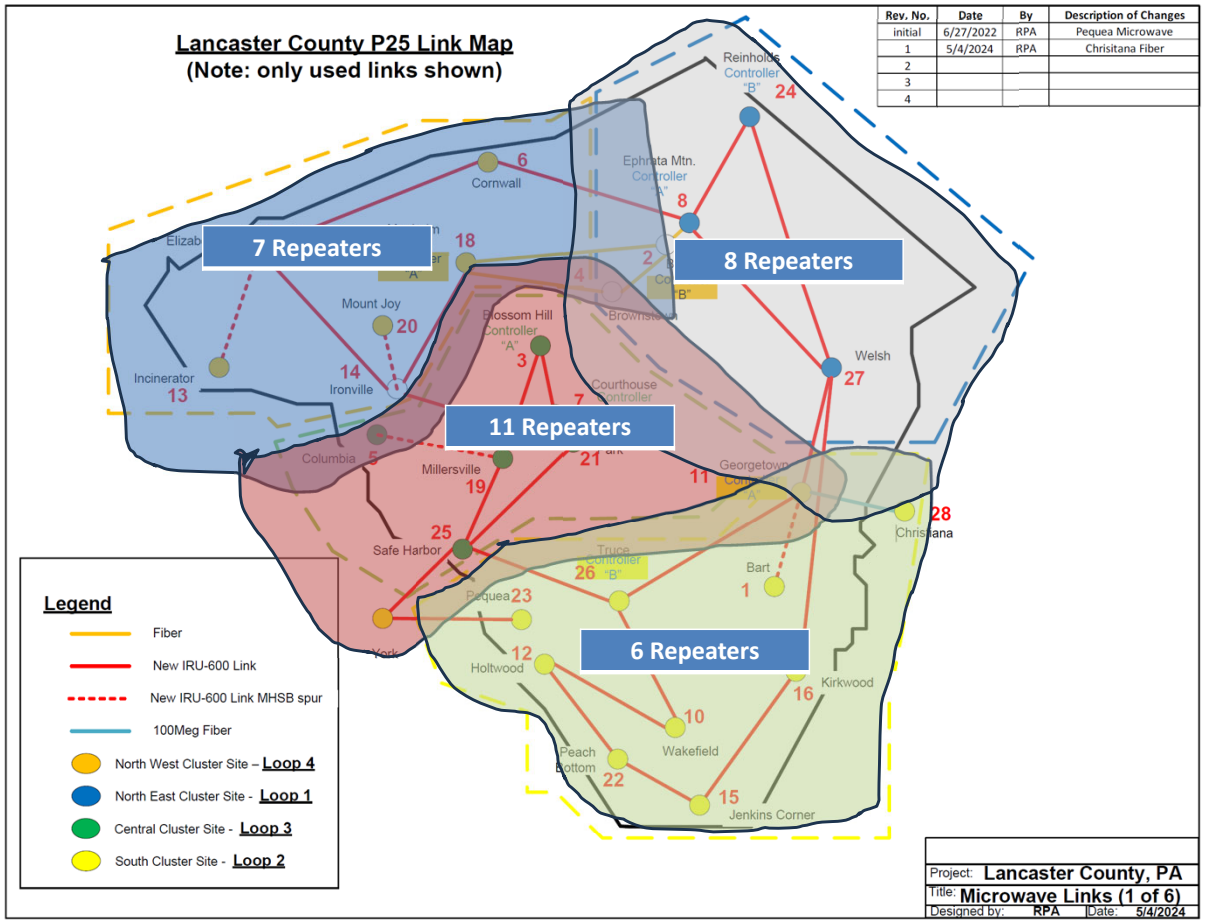
Report from Aug 2024

| Site Alias | PTTs | Total Call Time | Avg Call Time | "B" Queued | "B" Queued Time | "A" Queued | "A" Queued Time |
|---|---|---|---|---|---|---|---|
| 01-Central | 513197 | 605:23:08 | 0:00:04 | 0 | 0:00:00 | 0 | 0:00:00 |
| 02-NorthEast | 452015 | 525:05:15 | 0:00:04 | 0 | 0:00:00 | 0 | 0:00:00 |
| 03-NorthWest | 446254 | 520:07:37 | 0:00:04 | 11 | 0:00:11 | 17 | 0:00:14 |
| 04-South | 425051 | 477:30:10 | 0:00:04 | 341 | 0:06:08 | 31 | 0:00:12 |

# Cluster System Busy

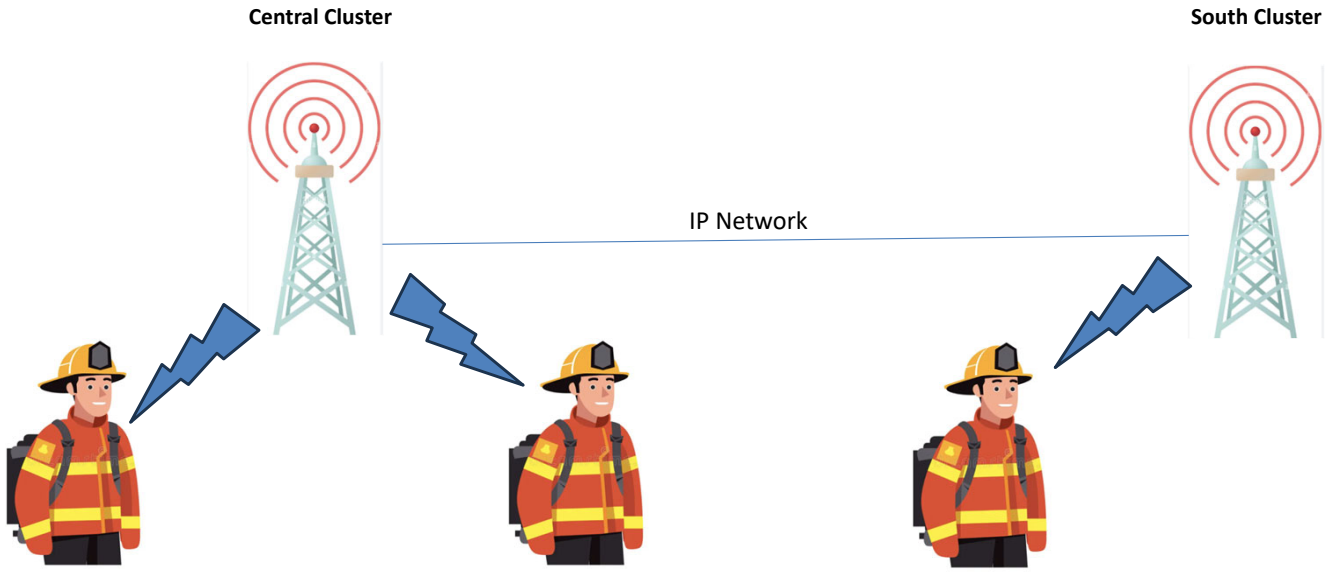


# System Busy


Lancaster County P25 Link Map
(Note: only used links shown)
Rev. No. | Date | By | Description of Changes
initial | 6/27/2022 | RPA | Pequea Microwave
1 | 5/4/2024 | RPA | Chrisitana Fiber
2
3
4
7 Repeaters
8 Repeaters
11 Repeaters
6 Repeaters
Reinholds Controller "B"
24
Ephrata Mtn. Controller "A"
8
Cornwall
6
Elizab
18
Mount Joy
20
Blossom Hill Controller "A"
3
Brownstone
2
Welsh
27
Incinerator
13
14
Ironville
Courthouse Controller
7
Columbia
5
Millersville
19
21
Georgetown
11
Safe Harbor
25
Christiana
28
Truce Controller "B"
26
Bart
1
Pequea
23
Holtwood
12
Kirkwood
16
10
Wakefield
Peach Bottom
22
15
Jenkins Corner
Legend
Fiber
New IRU-600 Link
New IRU-600 Link MHSB spur
100Meg Fiber
North West Cluster Site – Loop 4
North East Cluster Site - Loop 1
Central Cluster Site - Loop 3
South Cluster Site - Loop 2
Project: Lancaster County, PA
Title: Microwave Links (1 of 6)
Designed by: RPA
Date: 5/4/2024

# System Busy

| Central |
| --- |
| CCH |
| Talk Ch |
| Talk Ch |
| Talk Ch |
| Talk Ch |
| Talk Ch |
| Talk Ch |
| Talk Ch |
| Talk/Data Ch |
| Talk Ch |
| Talk Ch |




| South |
| --- |
| CCH |
| Talk Ch |
| Talk Ch |
| Talk Ch |
| Talk Ch/Data Ch |
| Talk Ch |

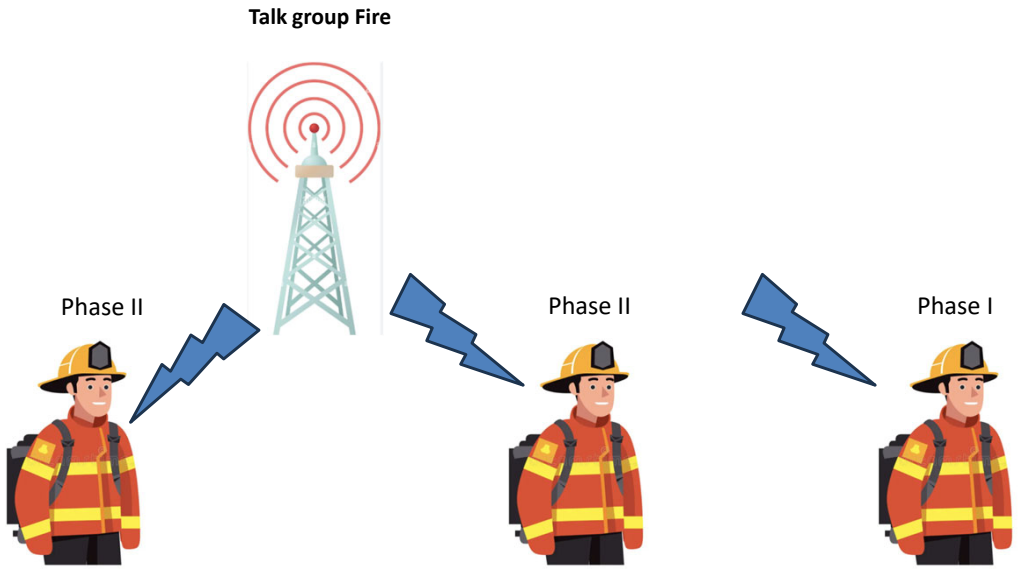
# Phase 1 vs. Phase 2

Phase 2 is more spectrally efficient than Phase 1, providing two effective channels per 12.5 kilohertz bandwidth. In P25 Phase 2, each physical base station provides two effective voice channels. It does this by using TDMA, or Time Division Multiple Access, where two independent conversations share the same channel.

| P25 Channels – Physical vs. Logical Channels | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model | Repeater 1/CCH | Repeater 2 | | Repeater 3 | | Repeater 4 | | Repeater 5 | | Repeater 6 | |
| Phase 1 | TB9100 | 1 | 2 | | 3 | | 4 | | 5 | | 6 | |
| Phase 2 | TB9400 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

| Phase | Talk paths |
|---|---|
| Phase 1 | 5 Talk paths |
| Phase 2 | 10 Talk paths |

# Phase II – Phase I Subscriber




| P25 Channels – Physical vs. Logical Channels | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| Phase 1 | TB9400 | 1 | 2 | | 3 | | 4 | | 5 | | 6 | |
| Phase 2 | TB9400 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

# C4FM vs LSM

## Continuous Four Frequency Modulation (C4FM) – System Currently Configured

- Frequency Shift Keying

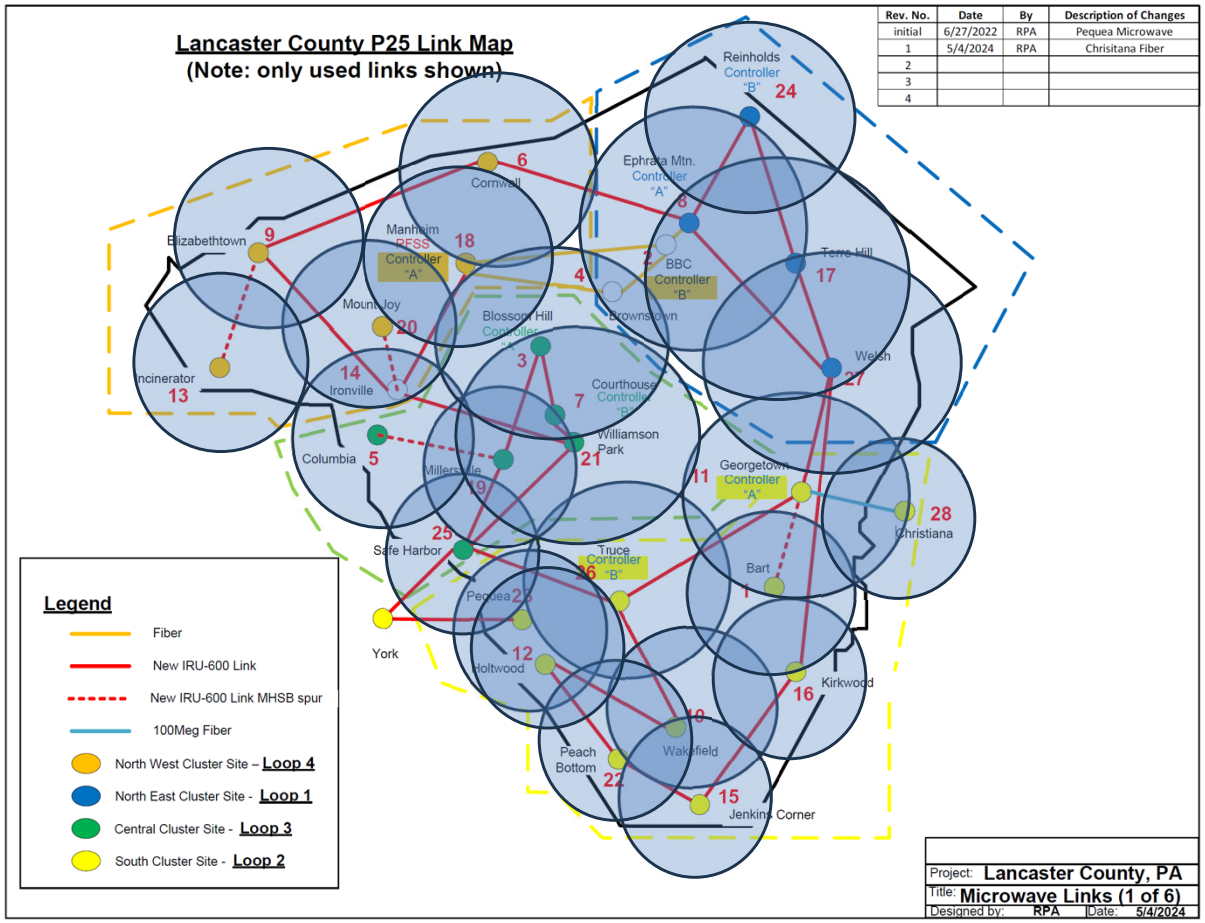
## Linear Simulcast Modulation (LSM)

- Phase Shift Keying

**Benefits of LSM**

- Require **fewer sites** compared to non-LSM (the usual P25 C4FM).
- **Better audio quality** in crossover areas using existing sites compared to C4FM on the same sites. (TDI)
- **Easier to do coverage planning/launch time calculations** as there is more margin for error.

# C4FM TDI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Ephrata Mtn. Controller "A" 8
Cornwall 6
Elizabethtown 9
Manheim PFSS Controller "A" 18
BBC Controller "B" 2
Terre Hill 17
Brownstown 4
Mount Joy 20
Blossom Hill Controller "A" 3
Welsh 27
Incinerator 13
Ironville 14
Courthouse Controller "B" 7
Williamson Park 21
Columbia 5
Millersville 9
Georgetown Controller "A" 11
Christiana 28
Safe Harbor 25
Truce Controller "B" 26
Bart 1
Pequea 23
York
Holtwood 12
Kirkwood 16
Peach Bottom 22
Wakefield 10
Jenkins Corner 15
Legend
Fiber
New IRU-600 Link
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# LSM (Linear Simulcast Modulation)

- Benefits of LSM
  - Better Audio Quality
  - Removes TDI (inter-cluster site interference)
  - Require fewer sites compared to non-LSM (C4FM)

# AVL

In the latest update, AVL was introduced. It allows units configured with GPS to send their location in the event the emergency button is pressed.

Packet data/AVL always uses Phase 1.

The Tait Core uses designated Data/Voice Channels to transmit data/AVL through the P25 System to a dedicated server that displays the location.

# Recap

Based on usage data, the amount of subscribers and usage has increased.

**The recent upgrade allows the county:**

- Move LSM - which will help with coverage and provide better audio quality.
- Phase 2 – Increase the capacity of the system (reduce denied radio calls)