



**FirstNet**®



# Quality of Service Priority and Preemption

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# What are Quality of Service, Priority and Preemption (QPP)?

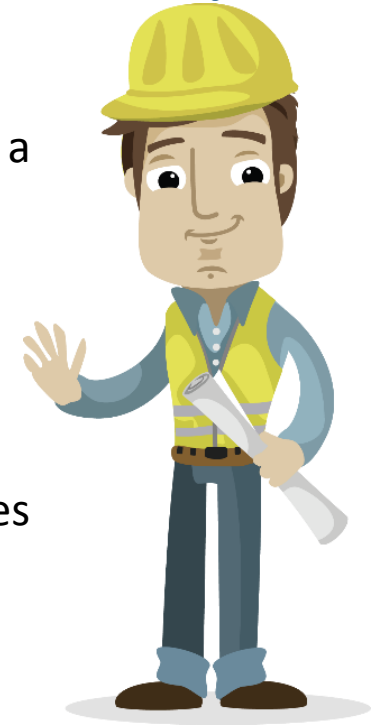


Hi, I'm  
Fred!



- **Quality of Service** – Quality of Service is the overall performance of a telephony or data network, particularly as seen by the users of the network. To measure quality of service quantitatively, several related aspects of the network service are often considered, such as error rates, bandwidth, throughput, transmission delay, availability and jitter.
- **Priority** – Priority is a network capability that enables a user's application or usage of the network to take precedence over another user's application or usage of the network.
- **Preemption** – A network capability that permits authorized high priority traffic, e.g., coming from public safety or first responders, to take over resources assigned to lower priority traffic, e.g., private traffic.

Hi, I'm  
Sam!



# Yeah I know That, But What Does This Mean?



- Quality of Service, Priority and Preemption are very broad terms for a very large set of 3GPP features and functionality that FirstNet and its partner will utilize to ensure that the first responders have priority access to Band 14 when they need it and if the situation requires it, prioritization among first responders.

**Dedicated  
Bearer**

**Best Effort**

**Default  
Bearer**

**Guaranteed  
Bit Rate**

**ARP**

**QCI**

**UE MBR**



# We Speak Different Languages

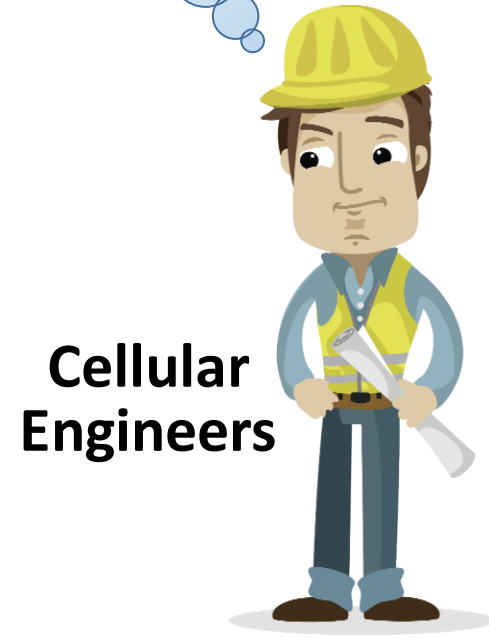


Does It Work When I Need It?

I Must Have  
Priority  
Man-Down  
Must Work  
Operations



Guaranteed Bit Rate  
Best Effort  
UE MBR Jitter  
Throughput  
Dedicated Bearer  
Default Bearer  
ARP Delay QCI



# We Speak Different Languages



Does It Work When I Need It?

I Must Have  
Priority

Man-Down  
Must Work

Operations

Guaranteed Bit Rate

UE MBR Jitter

Best Effort

Throughput

Dedicated Bearer

Default Bearer

ARP

Delay

QCI

Preemption = lower UE MBR  
Priority = ARP and ...  
Quality of Service = QCI and GBR



Public  
Safety

We Need  
A Rosetta  
Stone



Cellular  
Engineers



# The FirstNet Network



Imagine a 6 Lane Highway (Only one direction shown here)

Every ~5 Miles of Highway Supports:

- 300-400 Active Users
- 1000's of Idle Users

Does Your Department Have Enough Rolling Stock to Fill Up a Six Lane Highway?

Exit

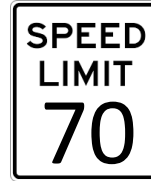
Entrance



# Quality of Service



Quality of Service = Setting Cruise Control at 70 Miles Per Hour and driving 70 Miles Per Hour



Quality of Service = Setting Cruise Control at 70 Miles Per Hour and driving 70 Miles Per Hour



Exit

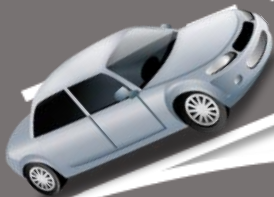
Entrance

# Priority

**Priority** = This Lane  
is Yours, everyone  
else move over

ILLEGAL  
TO CROSS  
DOUBLE  
WHITE  
LINE

*Priority = This Lane is Yours, everyone else move over*



Exit

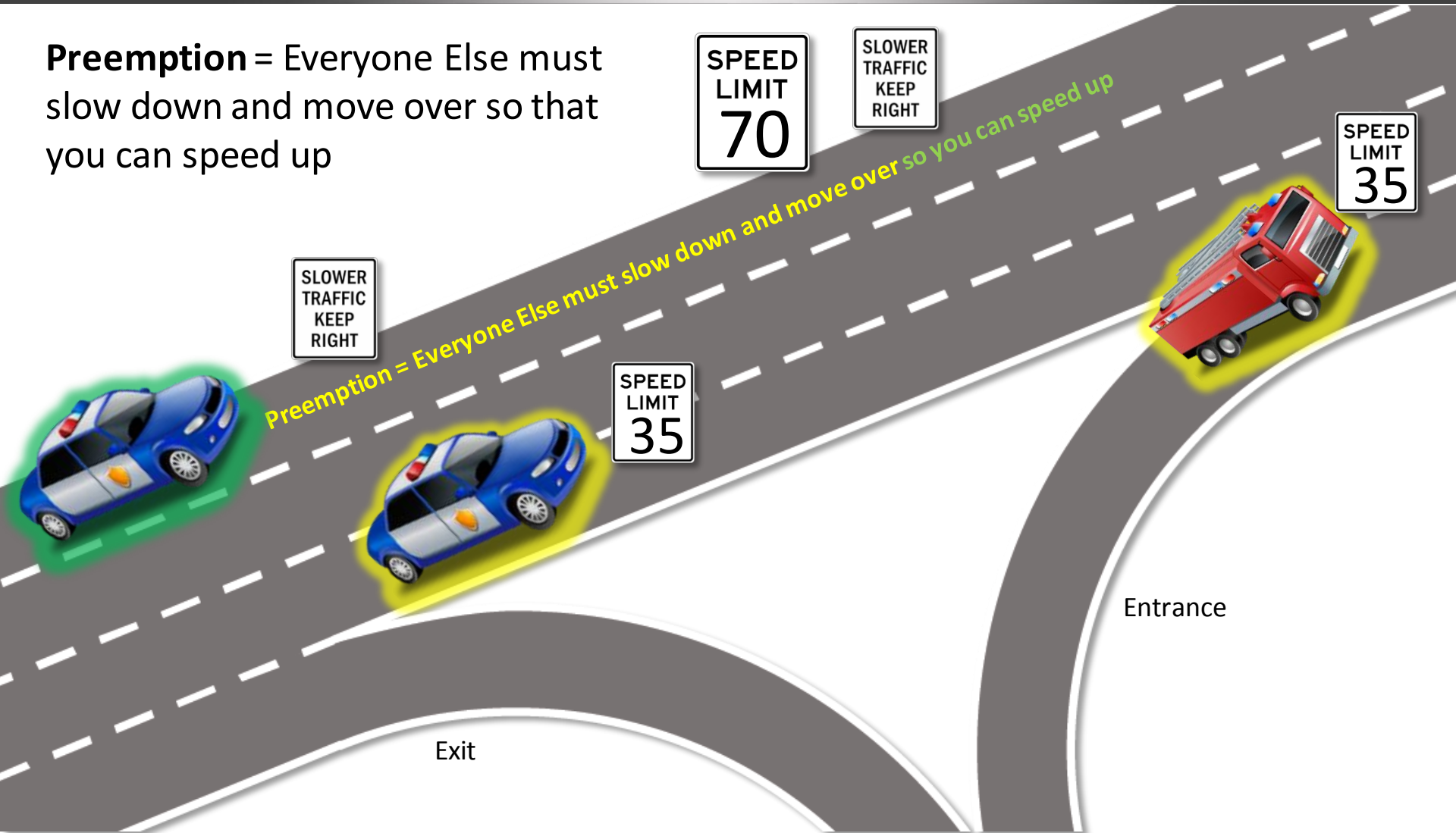
Entrance



# Preemption: Among First Responders



**Preemption** = Everyone Else must slow down and move over so that you can speed up

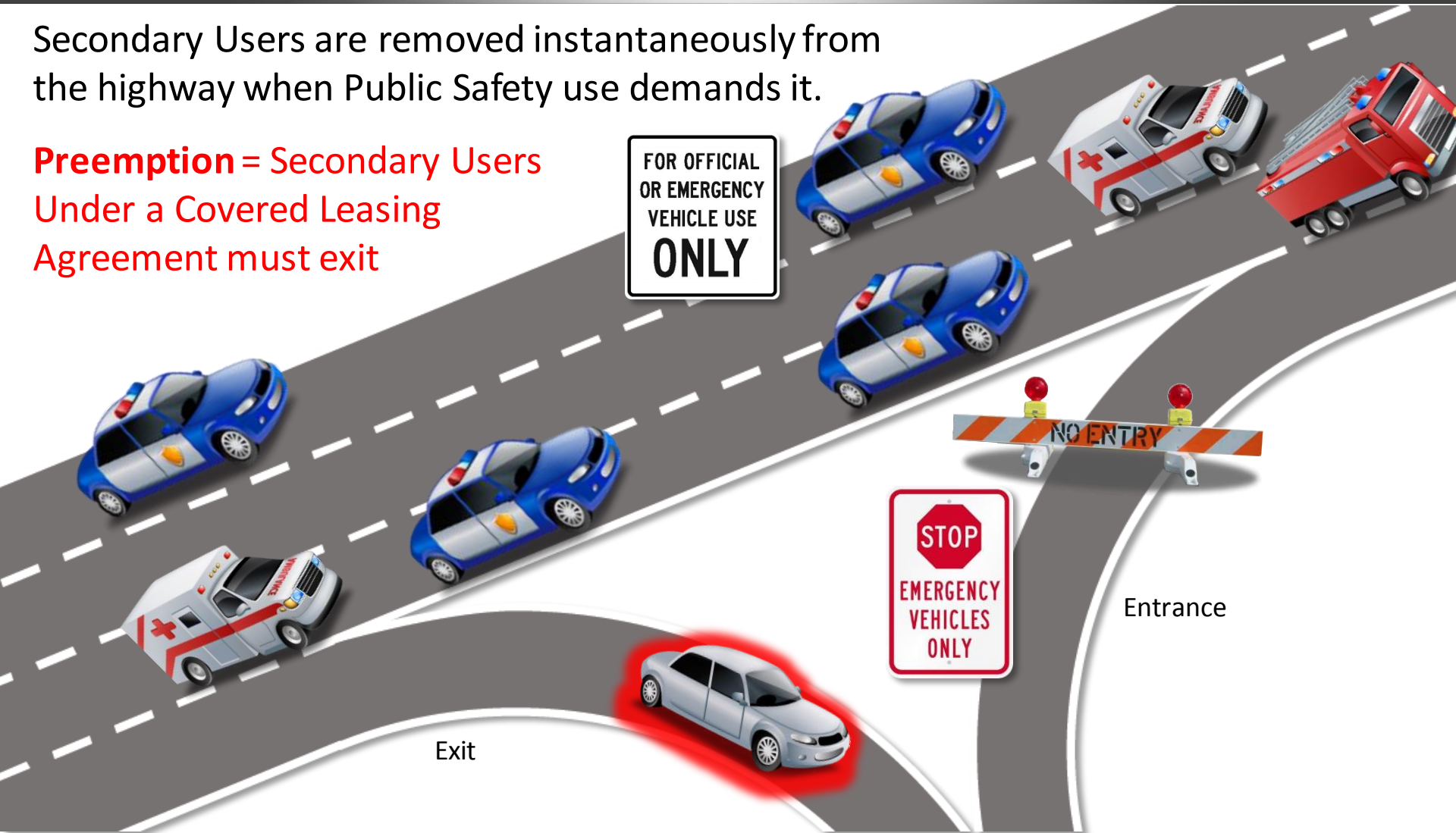


# Preemption: Between Primary Users and Secondary Users Under a CLA

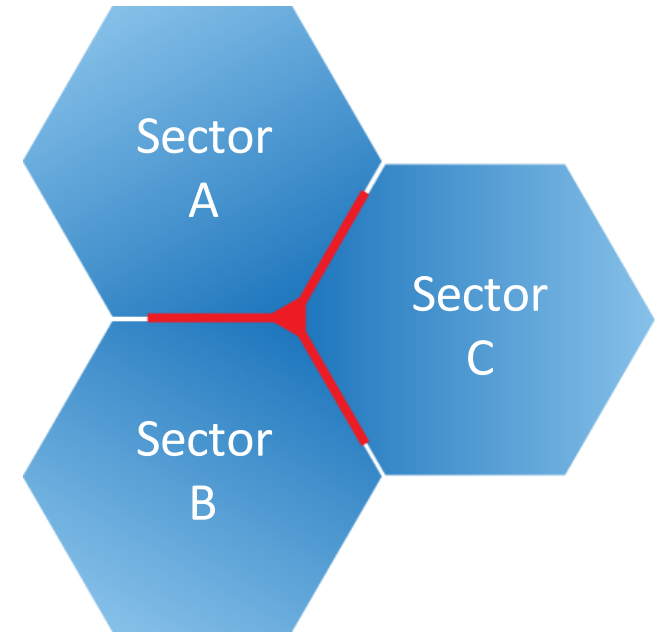
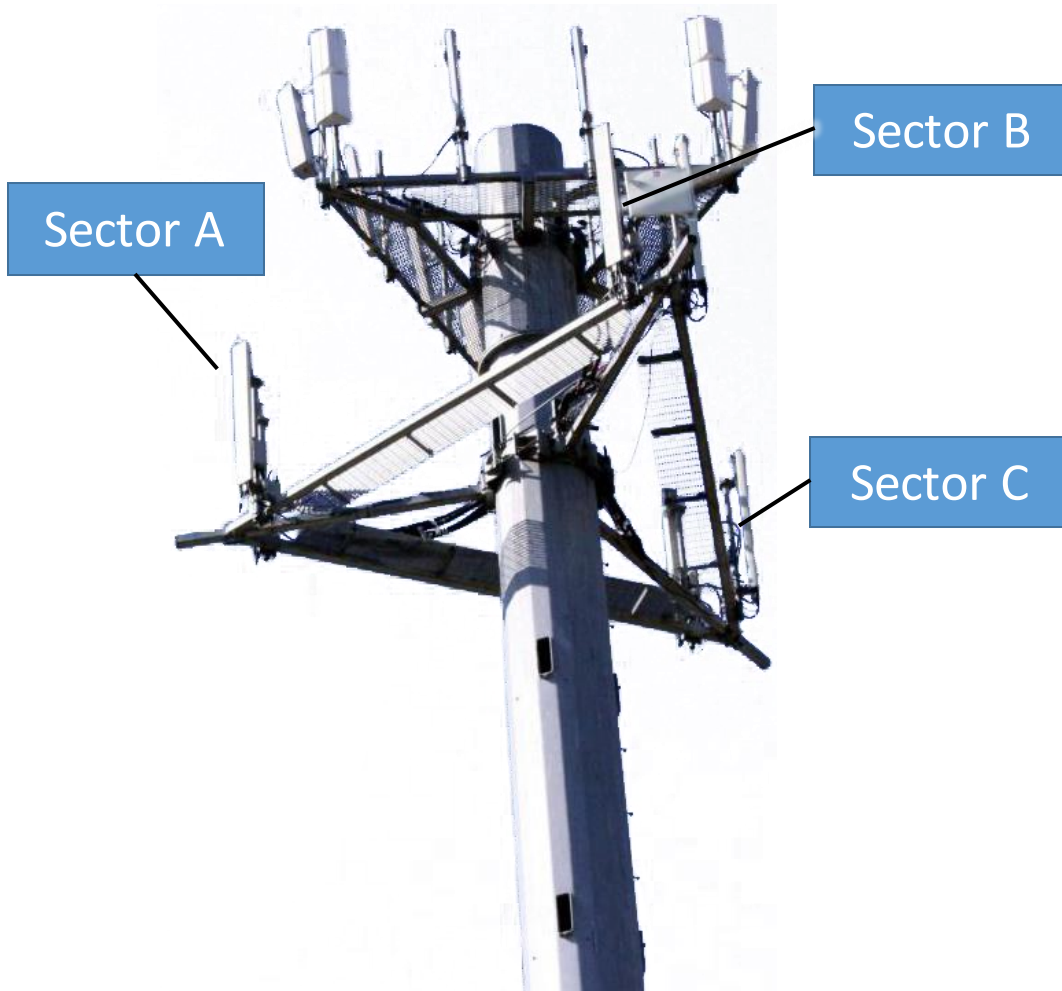


Secondary Users are removed instantaneously from the highway when Public Safety use demands it.

**Preemption = Secondary Users Under a Covered Leasing Agreement must exit**



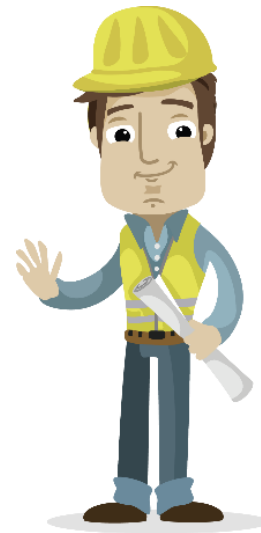
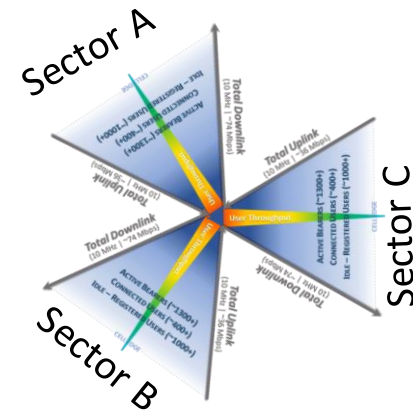
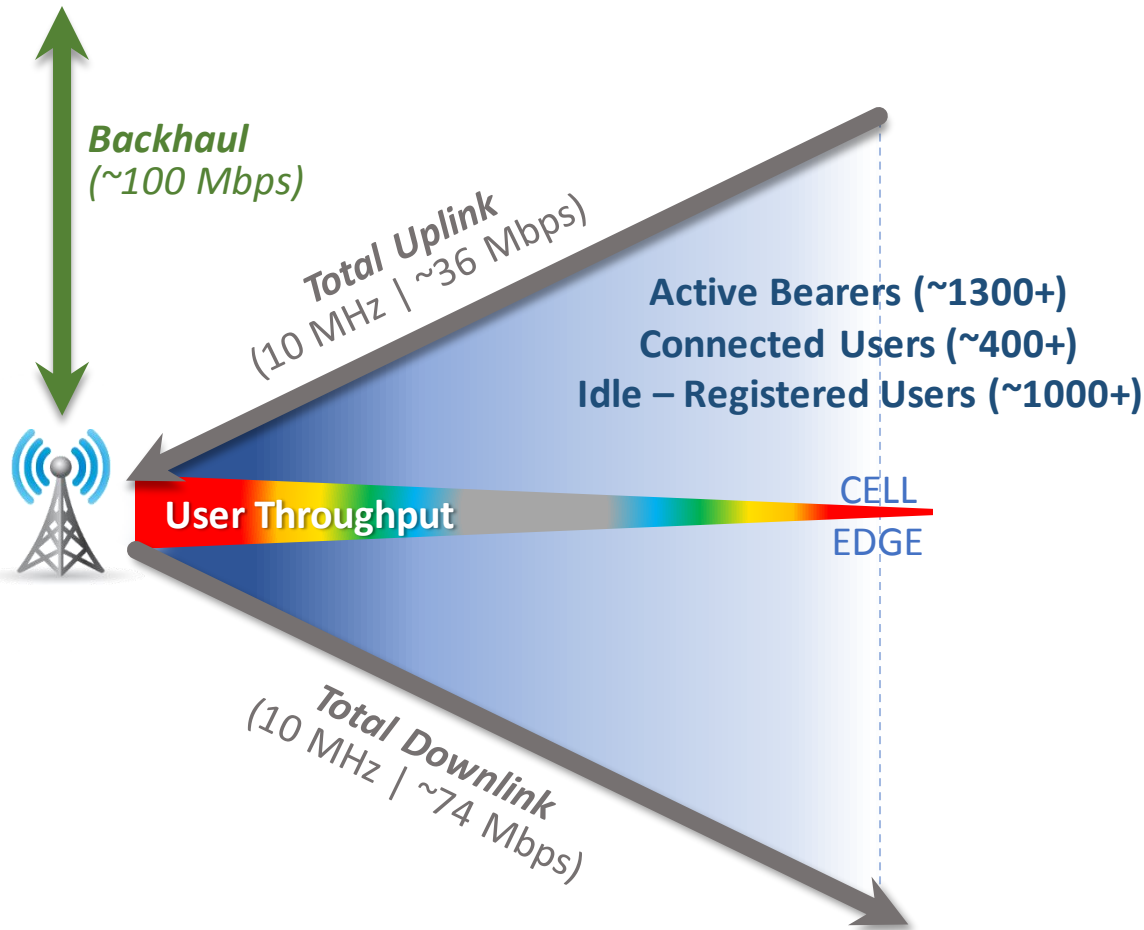
# LTE is a “Cellular” Technology



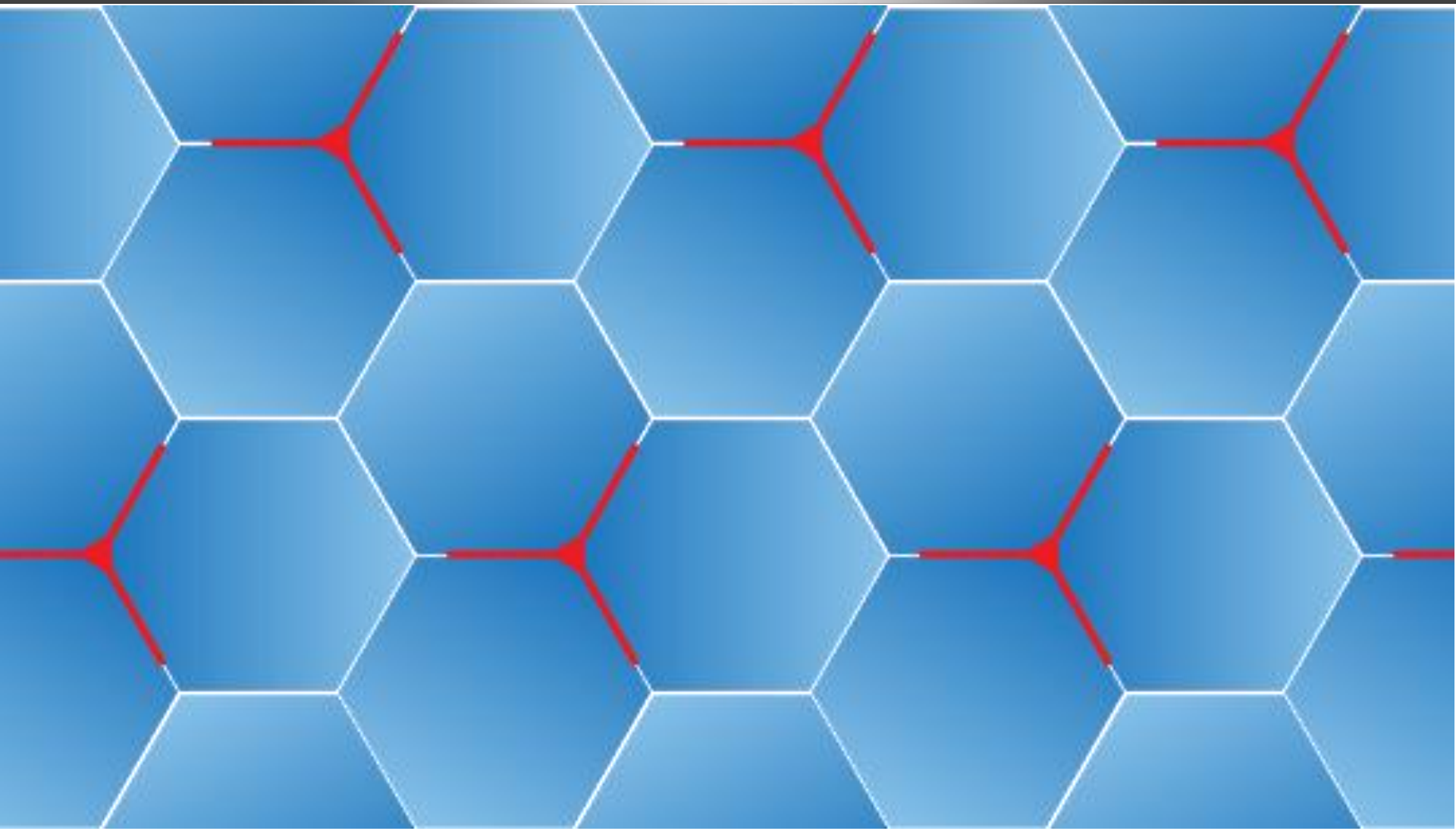
One “Cell” Site  
With 3 Sectors



# Cell-Sector Capacity

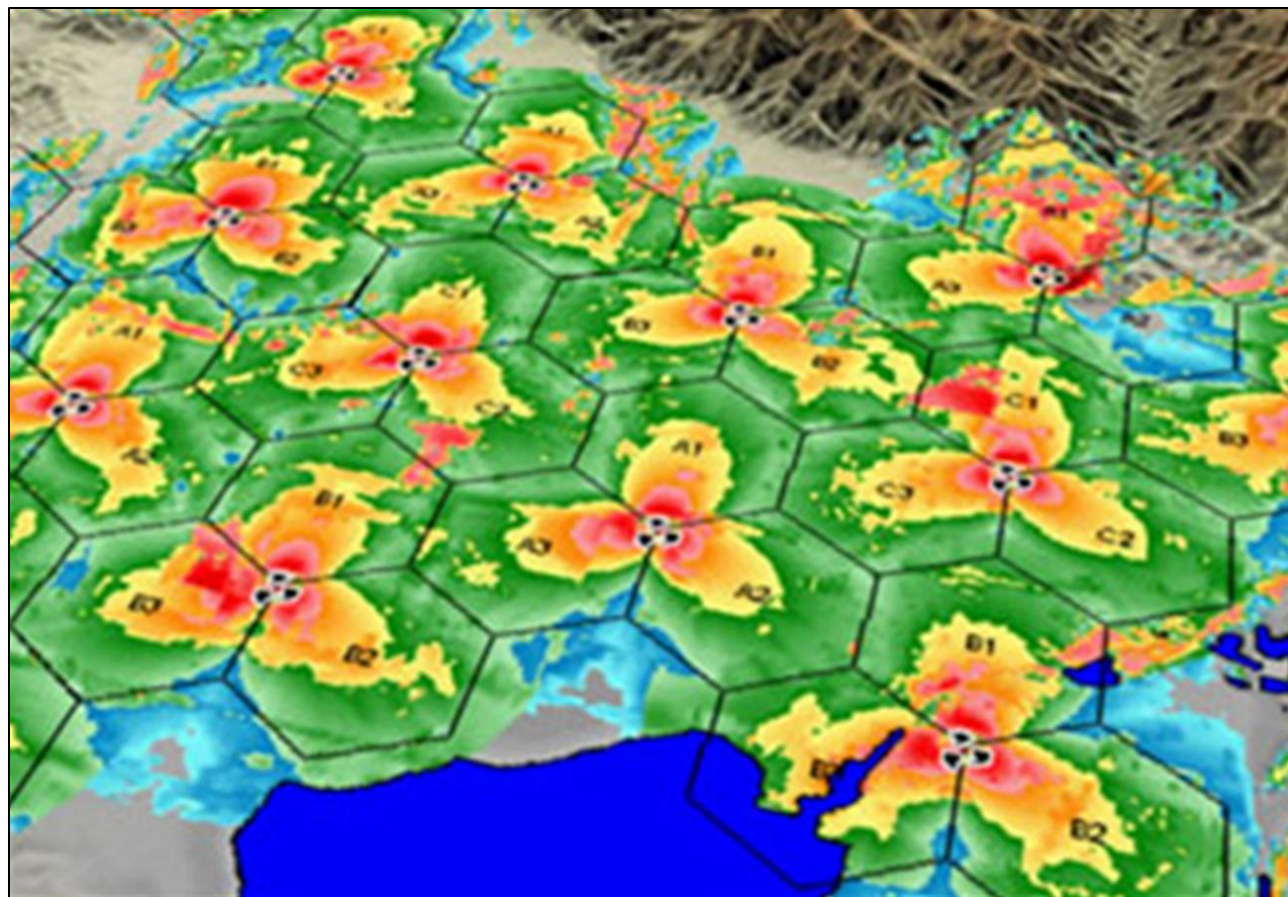


# An Ideal Coverage Map





# A Realistic Coverage Map



Excellent Signal



Very Good Signal



Good Signal



Acceptable Signal



Poor Signal



No Signal





# Each Sector Can Be Independently Managed

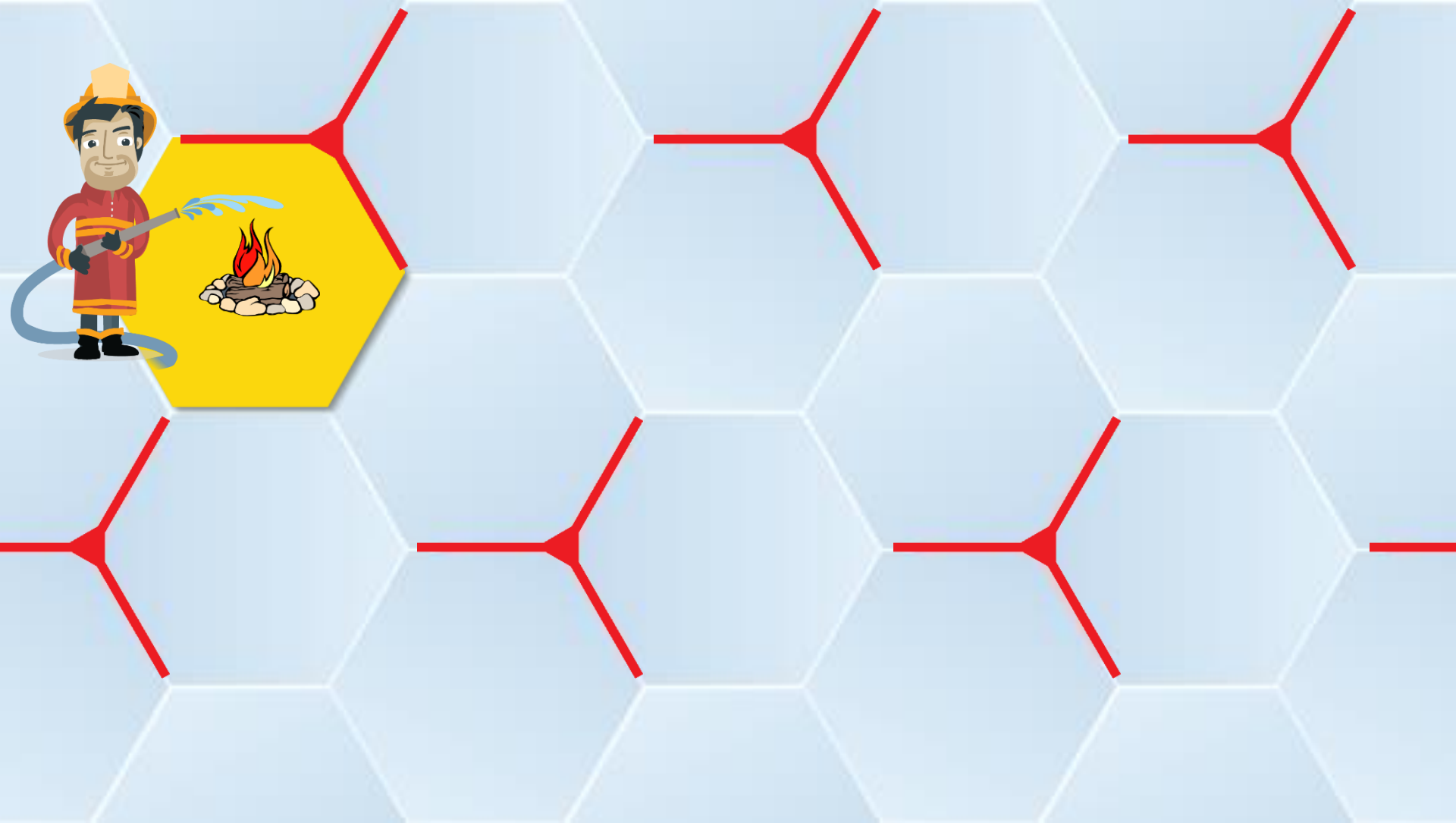


Sector A  
Load = 70%

Sector C  
Load = 10%

Sector B  
Load = 50%

# QPP Control – Single Sector



# QPP Control – Two Adjoining Sectors



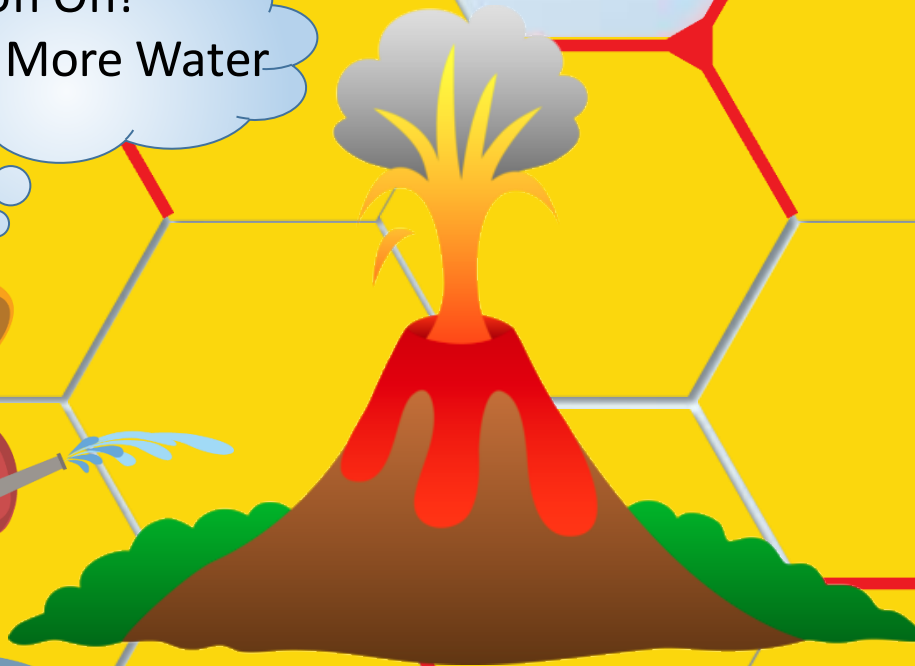


# QPP Control – Three Adjoining Sectors



# QPP Control – Multiple Cell Sites

Uh Oh!  
I need More Water



# QPP Control – Multiple Incidents Independently





# QPP Control – Now What to Do?

Uh Oh!  
I need More Water



Can I  
Help?



# Rosetta Stone – The QPP Framework



- The QPP Framework is a construct that
  - Allows engineers and first responders to talk about QPP without diving too deeply into each other area of expertise
  - Enables a way to describe network functionality
  - Describes what the network needs to know in order to make decisions in the rare cases that the network become overloaded with first responder traffic



# The QPP Framework – At a High Level



- Every Cell Sector Across the Nation will be in one of three states
  - **Static** – The network will automatically apply QPP based on what has been pre-configured when provisioned
  - **Dynamic** – The network will accept input from First Responders to help mitigate congestion between First Responders.
  - **Controlled** – The network must have input to reduce congestion between First Responders.
- The network can also handle a man down or responder emergency situation at the same time
- When needed, the network will take resources from secondary users to give to first responders