April 12, 2010

Marlene H. Dortch, Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Washington, DC 20554

Re: WT Docket 06-150
PS Docket 06-229

Dear Ms. Dortch:

Pursuant to Section 1.1206(b)(2) of the Commission's Rules, this is to notify you that on April 9, 2010, Stu Overby, Mark Krizik, Brad Hiben, Paul Steinberg, Rick Keith, Mario DeRango, Trent Miller and I, all with Motorola, met with Julius Knapp, Chief of the Office of Engineering and Technology, Jennifer Manner and Behzad Ghaffari of the Public Safety and Homeland Security Bureau, Stagg Newman, Chief Technologist Jon Peha and Ziad Sleem, Peter Trachtenberg, Tom Peters, Won Kim, Jennifer Salhus, and Jordan Usdan of the Wireless Telecommunications Bureau, regarding the above captioned proceedings.

During the meeting we discussed the information in the attached slides related to deployment of a nationwide public safety broadband network. Topics included capacity requirements for public safety applications and the overall network, the impact of interference between D-block and a system deployed using the spectrum licensed to the Public Safety Spectrum Trust, and issues related to roaming and priority preemption. As described it the presentation, reallocation of D-block to public safety significantly improves the ability for public safety to deploy a network capable of meeting its requirements.

Pursuant to the Commission's Rules, one copy of this notice is being filed electronically with the Commission. If you require any additional information please contact the undersigned at (202) 371-6953.

Sincerely,

/s/ Steve B. Sharkey

Steve B. Sharkey
Senior Director, Regulatory and Spectrum Policy

Attachment

Cc:	Julius Knapp	Ziad Sleem
	Jennifer Manner	Peter Trachtenberg
	Behzad Ghaffari	Tom Peters
	Stagg Newman	Won Kim
	Jon Peha	Jennifer Salhus
	Jordan Usdan	

Motorola, Inc., Global Government Affairs
1455 Pennsylvania Ave., Suite 900, Washington, DC 20004 T: (202) 371-6900

Motorola – FCC Meeting
April 9, 2010

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Summary

- Public safety requires guaranteed communications capacity, control and coverage to support prevention and response activities for which it is held accountable
- The broadband plan must be analyzed based on public safety operational requirements, not just commercial requirements.
- Engineering analysis combined with knowledge of public safety operations shows the plan falls short in several ways:
  - Guaranteeing only 10 MHz of capacity is insufficient to meet public safety needs; waiting later to add capacity from another band as FCC has implied exacerbates interoperability and raises costs.
  - Separating the D and PSST blocks will create interference and coverage holes for public safety similar to the $4B 800 MHz band problem.
  - Both analysis and experience shows that commercial grade priority access is insufficient to meet public safety needs. LTE technology does not solve this problem. Ruthless pre-emption is required, but is not a viable result for consumers or carriers.
- Reallocating the D block and joining it with the PSST spectrum to dedicate 20 MHz for public safety broadband will resolve these problems.
- The extra 10 MHz from the D block doubles the spectrum for public safety but is only 2% of the 500 MHz FCC has committed to provide for commercial use

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Topics

- ***Public Safety Capacity Requirements Analysis***
- ***Analysis of D-block Interference to Public Safety Broadband***
- ***Analysis of Roaming to Commercial Carriers to Serve Public Safety's Extra Capacity Needs***
- ***Overall Conclusions/Recommendations***

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Public Safety Capacity Requirements Analysis

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Severity of the Incident

Public Safety utilization of broadband resources will vary based on the nature and intensity of the incident

Day-to-Day Operations

Traffic Stops, EMS Incidents, Car Fires, Patrol, Inspections

Applications

- Data Dispatch
- Automatic Vehicle Location
- Records Lookup
- Traffic Citations
- Resource Tracking
- Real-Time Field Supervision
- Operational Video
- Machine-to-Machine
- Patient Care Reporting
- Incident Reporting

Incident & Event Management

Demonstrations,
Special Events,
Hazardous Materials Incidents

Applications

- Tactical Video
- Analytics
- Perimeter Control
- Hazardous Materials Queries
- Data Dispatch
- Automatic Vehicle Location
- Records Lookup
- Traffic Citations
- Resource Tracking
- Real-Time Field Supervision
- Asset Management
- Machine-to-Machine

Catastrophic Incident

Hurricane,
Bridge Collapse,
Major Fire

Applications

- Fixed, Deployed, Enterprise, Vehicular Video
- Remote State, Fed Database Lookups
- Remote Applications
- Fixed, Deployed Sensors
- Detection of CBRNE Threats
- Personnel Information
- Automated Vehicle Locations
- Electronic Command Board
- Fireground Management
- Computer Aided Dispatch
- Triage Applications
- Telemetry
- Internet Access
- VoIP Communications
- Mobile Data
- Asset Management
- Evacuee Tracking

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Voice of the Customer Feedback
Amoco Refinery Fire
York County, VA

The York County Department of Fire and Life Safety protects an Amoco refinery within their response area. They've been there for numerous incidents, some lasting for days

Amoco has video cameras throughout the refinery, but at one particular incident, they needed video at the command post to determine where to direct the water to extinguish the fire

They could not get the video fed from the surveillance cameras to the command post, so they posted an officer at the security office and he communicated verbally with command

They say it would "absolutely" have been a benefit if they could have piped wireless video from around the "hot zone" to the mobile command post, freeing up their personnel and putting the fire out sooner

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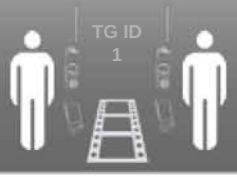
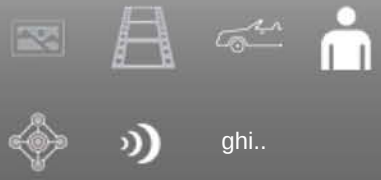
Integrated Command Center

Group Video Communications



Disparate Media Stream Correlation



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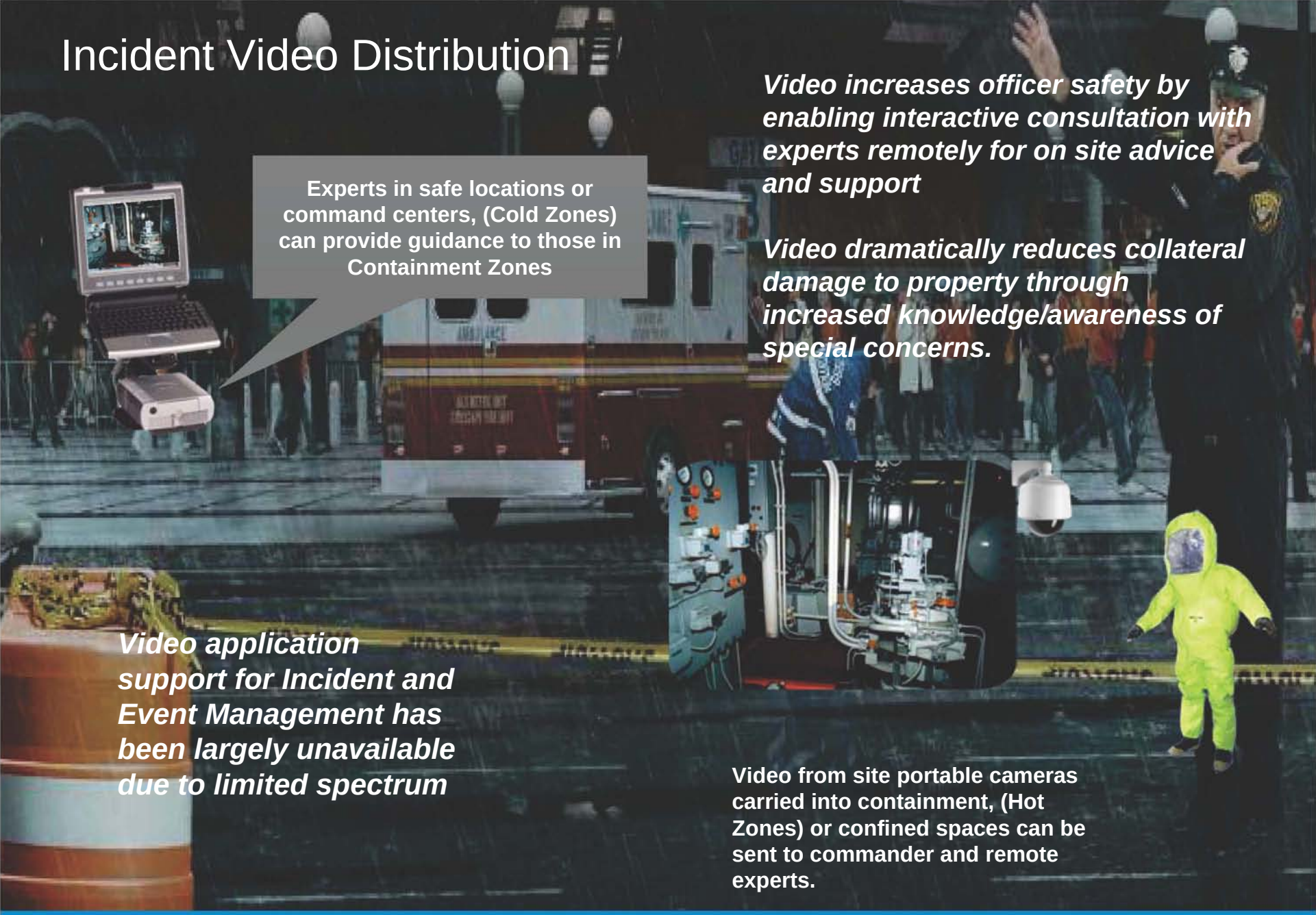
Incident Video Distribution



Experts in safe locations or command centers, (Cold Zones) can provide guidance to those in Containment Zones

Video increases officer safety by enabling interactive consultation with experts remotely for on site advice and support

Video dramatically reduces collateral damage to property through increased knowledge/awareness of special concerns.

Video application support for Incident and Event Management has been largely unavailable due to limited spectrum

Video from site portable cameras carried into containment, (Hot Zones) or confined spaces can be sent to commander and remote experts.

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Video Quality Tiering

The utility and value of the received video from a wide-angle view of an incident scene increases with encoded resolution and bit rate

NY DoITT required 1.2 Mbps (D1) cameras for fixed & mobile, LAPD required3 Mbps cameras for fixed.

V1: 128 kb/s

"Scanning"

- **Remotely monitor multiple cameras looking for gross anomalies** (e.g. a bridge collapse)

SQVGA: 160x120

V2: 384 kb/s

"Situational Awareness"

- **Asses magnitude of incident to determine appropriate response**
- Identify number of people and vehicles involved

QVGA: 320x240

V3: 1.2 mb/s

"Tactical Decision-Enabling"

- **Manage on-scene resources**, capture BOLO images, identify near-field license plates and vehicles
- Approaching fixed surveillance video quality

VGA: 640x480

V4: 3.5 mb/s

"Strategic Decision-Enabling"

- **Direct real-time response team**, positively identify suspects, assess injuries
- Approaching evidentiary (transparent) video quality
- Receiver-driven digital PTZ

1.2 MP: 1280x960

Original

1.2 MP: 1280x960

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video samples prepared using x264, with a real-time profile, @ 30 frames/sec, using content typical of a public safety incident scene

Incident Box Card

DEPARTMENT NAME:	BOX ALARM TYPE:	EFFECTIVE DATE:	MABAS DIVISION:
POSEN	HAZARDOUS MATERIALS	10/01/08	22
BOX ALARM #:	LOCATION OR AREA:	AUTHORIZED SIGNATURE:	
2889	POSEN- ENTIRE DISTRICT	CHIEF KEVIN SZEWCZYK	

MABAS BOX ALARM:

ALARM LEVEL	ENGINES	TRUCKS	SQUADS	EMS	HAZ-MAT TECH/TEAMS	CHIEFS	SPECIAL EQUIPMENT	CHANGE OF QUARTERS (STA #)
LEVEL I	POSEN MIDLOTHIAN	POSEN BLUE ISLAND	POSEN	POSEN DIXMOOR	SWHMRT ADVISORS POSEN TECHS	POSEN MIDLOTHIAN BLUE ISLAND		
LEVEL II	CALUMET PARK CRESTWOOD		FRANKFORT	ALSIP	SWHMRT FULL RESPONSE	ALSIP PALOS	MABAS 22 & 19 DECON OAK FOREST 951 ORLAND 6108	GARDEN HOMES (ENGINE) OAK FOREST (AMB)
LEVEL III	GARDEN HOMES (FROM POSEN) ROBBINS	HARVEY	HOMEWOD	OAK FOREST (FROM POSEN) PALOS HTS	MABAS 24 HAZMAT TEAM	MOKENA		PALOS (ENGINE) COUNTRY CLUB HILLS (AMB)
LEVEL IV	PALOS (FROM POSN) MERRIONETTE PK			COUNTRY CLUB HILLS(FRM POSN) CALUMET CITY	MABAS 21 HAZMAT TEAM			RIVERDALE (ENGINE) FLOSSMOOR (AMB)
LEVEL V	RIVERDALE (FROM POSN) DOLTON			CHICAGO RIDGE HOMER	MABAS 10 HAZMAT TEAM			HAZEL CREST (ENGINE) MATTESON (AMB)
INTERDIVISIONAL REQUEST		1ST CHOICE		2ND CHOICE		3RD CHOICE		

INFORMATION:

POSEN FIRE STATION LOCATED AT 2440 WALTER ZIMNY DRIVE. 147TH STREET TO CLEVELAND AVE. (2700 WEST) NORTH ON CLEVELAND 150' TO WALTER ZIMNY DRIVE

Posen is a small suburb south of Chicago with a population of approximately 5,500 people spanning one square mile.

The entire state of Illinois, as well as cities that border Illinois including Iowa, Wisconsin and Indiana belong to MABAS – Mutual Aid Box Alarm System.

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Multi-Agency Operations

Public Safety requires multi-agency coordination…

Alongside police, fire & EMS, priority can be needed for state & federal agencies as well as municipal organizations to shut down gas, electric, or to clean a dangerous spill

Incident Scene Operations Police, Fire, EMS

Mobile Command Posts
Emergency Service Units
Technical Advisory Response Units
Counter Terrorism Command Vehicles
Counter Terrorism Support Vehicles
Portable Sensors
Patrol Division Mobile Commands
Intel Division Mobile Support Vehicles
Police Fleet Services Towing Services
Fire Command Tactical Vehicles
Police Field Communications
Fire Heavy Rescue
Fire Emergency Medical Command Post
Fire Mobile Triage Vehicles
Fire Ambulances
Emergency Management Mobile Operations Center
Emergency Management Temporary Field Operations
Transp. Authority Field Comm's Emergency Services

Government & Civilian Organizations

Office of Emergency Management & Communication
Streets & Sanitation
Water Management
Department of Transportation
Bridge & Tunnel Authority
Metropolitan Transit Authority
Port Authority
Water Transport & Terminals
Department of Health
Department of Buildings
Environmental Protection Services
Office of the Mayor
Animal Care and Control
Aviation
Buildings
Elementary & Secondary Education
Higher Education
Department of Construction and Permits
Hospitals
Parks & Recreation
Water Supply
Electric Supply
Gas Supply

State & Federal Agencies

Department of Homeland Security
United States Coast Guard
United States Secret Service
Bureau of Customs and Border Protection
Federal Emergency Management Agency
Transportation Security Agency

Machine to Machine

Call Boxes
Sensors
Fleet Management
Bus Locator
Traffic Monitoring
Traffic Signal
Digital Signage

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Severity of the Incident

DEPARTMENT NAME:	BOX ALARM TYPE:	EFFECTIVE DATE:	MABAS DIVISION:
POSEN	HAZARDOUS MATERIALS	10/01/08	22
BOX ALARM #:	LOCATION OR AREA:	AUTHORIZED SIGNATURE:	
2889	POSEN- ENTIRE DISTRICT	CHIEF KEVIN SZEWCZYK	

MABAS BOX ALARM:

ALARM LEVEL	ENGINES	TRUCKS	SQUADS	EMS	HAZ-MAT TECH/TEAMS	CHIEFS	SPECIAL EQUIPMENT	CHANGE OF QUARTERS (STA #)
LEVEL I	POSEN MIDLOTHIAN	POSEN BLUE ISLAND	POSEN	POSEN DIXMOOR	SWHMRT ADVISORS POSEN TECHS	POSEN MIDLOTHIAN BLUE ISLAND		
LEVEL II	CALUMET PARK CRESTWOOD		FRANKFORT	ALSIP	SWHMRT FULL RESPONSE	ALSIP PALOS	MABAS 22 & 15 DECON OAK FOREST 951 ORLAND 6108	GARDEN HOMES (ENGINE) OAK FOREST (AMB)
LEVEL III	GARDEN HOMES (FROM POSEN) BOBBINS	HARVEY	HOMEWOD	OAK FOREST (FROM POSEN) PALOS HTS	MABAS 24 HAZMAT TEAM	MOKENA		PALOS (ENGINE) COUNTRY CLUB HILLS (AMB)
LEVEL IV	PALOS (FROM POSN) MERRIONETTE PK			COUNTRY CLUB HILLS(FRM POSN) CALUMET CITY	MABAS 21 HAZMAT TEAM			RIVERDALE (ENGINE) FLOSSMOOR (AMB)
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INTERDIVISIONAL REQUEST		1st CHOICE		2nd CHOICE		3rd CHOICE		

INFORMATION:
POSEN FIRE STATION LOCATED AT 2440 WALTER ZIMNY DRIVE. 147th STREET TO CLEVELAND AVE. (2700 WEST) NORTH ON CLEVELAND 150' TO WALTER ZIMNY DRIVE

Hazardous Materials

Incident Box Cards

Coordinated mutual aid response

Resource counts of personnel based on National Fire Protection Association (NFPA) minimum standards for company response

	Level 1 Gas Tanker Spill			Level 2 Clandestine Lab			Level 3 Refinery Explosion		
	Individuals	Vehicles	Command Vehicle	Individuals	Vehicles	Command Vehicle	Individuals	Vehicles	Command Vehicle
Incident Command	3	3	0	4	4	0	5	5	0
Command Asst.	0	0	0	4	0	0	5	0	0
Fire Engines	8	2	0	16	4	0	24	6	0
Fire Trucks	15	3	0	15	3	0	20	4	0
Fire Squads	5	1	0	10	2	0	15	3	0
EMS - Responders	4	2	0	6	3	0	10	5	0
EMS - Life Safety	10	5	0	18	9	0	18	9	0
Haz Mat Tech Teams	8	2	0	8	2	0	16	4	0
Mobile Command	0	0	0	4	0	4	4	0	4
Police Blue Team	5	5	0	15	15	0	25	25	0
State Police	2	2	0	2	2	0	2	2	0
State EPA	2	2	0	2	2	0	2	2	0
Federal	0	0	0	6	2	0	0	0	0
Total	**62**	**29**	**0**	**110**	**48**	**4**	**146**	**65**	**4**

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Incident Broadband Utilization

Low Video Quality

- **Medium severity incidents even at a Level 1 Alarm Level exceed the capacity of a 5+5 MHz channel**
- Multi-agency applications involve essential data & video services
  - Data dispatch functions, location & mapping, incident & status
  - Records & database lookups, manuals, building plans, image downloads
  - Tactical video from select vehicles, personnel, and hot zone deployable

Personal Camera
400 kbps

In-Car & Hot Zone Camera
1.2 Mbps

Public Safety Broadband Utilization

Hazardous Materials Coordinated Mutual Aid

Uplink

20 (10+10) MHz Uplink
8.0 Mbps up

10 (5+5) MHz Uplink
3.5 Mbps up

Level 1	Level 2	Level 3
3.9 Mbps	6.6 Mbps	12.2 Mbps

Downlink

20 (10+10) MHz Downlink
16.7 Mbps

10 (5+5) MHz Downlink
8.4 Mbps

Level 1	Level 2	Level 3
6.3 Mbps	11.1 Mbps	15.9 Mbps

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Incident Broadband Utilization

Acceptable Video Quality

- **Medium severity incidents even at a Level 1 Alarm Level exceed the capacity of a 5+5 MHz channel**
- Multi-agency applications involve essential data & video services
  - Data dispatch functions, location & mapping, incident & status
  - Records & database lookups, manuals, building plans, image downloads
  - Tactical video from select vehicles, personnel, and hot zone deployable

Personal Camera
& Hot Zone Camera
1.2 Mbps

In-Car
3.5 Mbps

Public Safety Broadband Utilization

Hazardous Materials Coordinated Mutual Aid

Uplink

20 (10+10) MHz Uplink
8.0 Mbps up

10 (5+5) MHz Uplink
3.5 Mbps up

Level 1	Level 2	Level 3
7.0 Mbps	12.0 Mbps	23.0 Mbps

Downlink

20 (10+10) MHz Downlink
16.7 Mbps

10 (5+5) MHz Downlink
8.4 Mbps

Level 1	Level 2	Level 3
7.1 Mbps	11.1 Mbps	22.1 Mbps

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Interference Analysis

- ***To make the auction attractive, D-block auction winner(s) will not be required to partner with regional public safety entities on their LTE network deployments***
  - D-block LTE site deployments, therefore, could be completely independent, and not coordinated with Public Safety LTE site deployments

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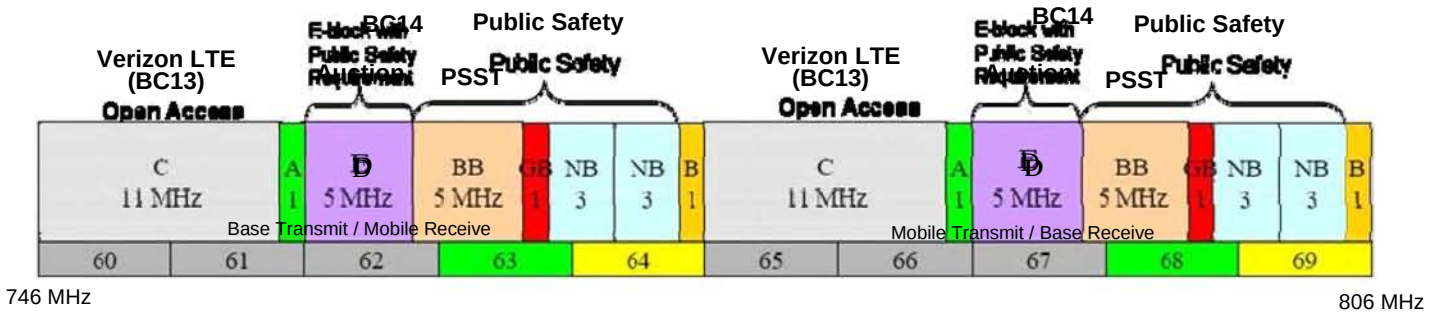
Primary Interference Scenarios Examined

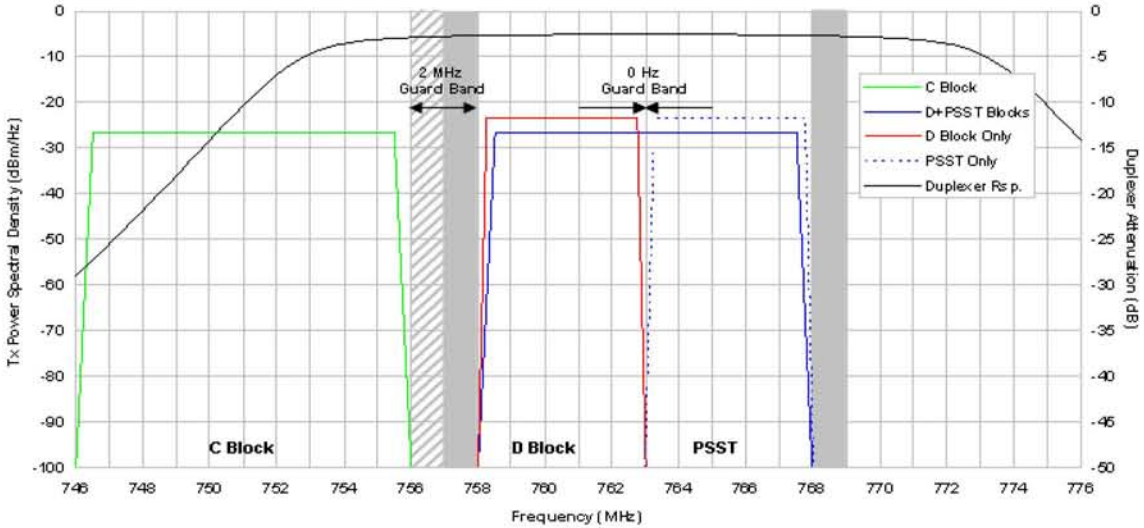


1 **D-Block Base Tx to Public Safety UE Rx in PSST (No Guard Band)**

2 **2nd Harmonics of D-Block Mobile (UE) Tx to GPS Rx @ 1575.42 MHz**

UE Receiver Selectivity In upper 700MHz

Shows how the selectivity of practical UE duplexers are too wide to reject the D-block signals from entering a PSST receiver in interference case 1



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Interference Analysis Method

- ***Simulation used 3GPP TR 36.942 model for commercial LTE coexistence studies***
  - Provides a baseline assessment, but likely underestimates actual interference
  - Modified to provide outage areas rather than throughout degradation
  - Simulation parameters used
    - BS Antenna height of 30m
    - 5MHz D-Block BS Tx power = 43dBm
    - UE Antenna gain= -10 dB
    - Cell size: D-Block = 500m, PSST= 500m, 866m
    - BS Out of Band emission and UE Adjacent Channel Selectivity
- ***Analyzed throughput and outage impact of interference as a function of effective guard band and cell density ratio between interfering networks***

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Simulation Results- D-Block to PSST Interference

(No Guard Band, Base Sites not co-located, Different cell sizes)

Average Sector-wide Impact	Coverage Hole Area Impact
Throughput Loss: 7.9%	**Throughput Loss: 55%**
Coverage Outage Increase: 2.4% (from 3.4 to 5.8%)	**Coverage Outage Increase: 22% (from 8 to 30%)**

- Distances between sites of D block and PSST: 0m, 201m, 348m, 402m, 457m, 549m, 672m, 696m

- Coverage Hole Areas defined as being within 80m radius from commercial sites that are 500m or greater from a PSST site, as holes are more prevalent in proximity to D-block sites that are distant from the PSST sites

= D-Block Sites **= Outage due to D-block**

= Public Safety Sites

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Simulation Results- D-Block to PSST Interference

(No Guard Band, Base Sites not co-located, Same cell sizes)

Average Sector-wide Impact	Coverage Hole Area Impact
Throughput Loss: 1%	**Throughput Loss: 10%**
Coverage Outage Increase: 0.2% (from 2.7 to 2.9%)	**Coverage Outage Increase: 3% (from 5 to 8%)**

- Distance between sites of D block and PSST is 433m.

= D-Block Sites **= Outage due to D-block**

= Public Safety Sites

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Impact of Microcells/Picocells not covered in TR 36.942

- ***Commercial Microcells & Picocells are used extensively in urban areas***
  - They add coverage and capacity within airports, train stations and other large buildings
  - They are also used to increase capacity in dense urban environments
- ***They are more likely to cause interference than macro sites***
  - Lower power but very low antenna height
  - Very small spacing possible between interfering base and Public Safety UE
- ***Public safety could be forced to add microcells and picocells to fill the coverage holes caused by D-block microcells and picocells***

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TR 36.942 is Too Simplified for Mission Critical Assurance

- ***These 36.942 interference results are only baseline, as reality is actually more complex and with often more severe results***
- ***36.942 presents an ideal environment:***
  - Uniform site spacing
  - All base stations have the same HAAT (27 meters/88.5 feet)
  - All UEs at ground level on a flat earth
- ***36.942 uses simplified models***
  - Section 4.5.2 Note 3: "*This [propagation] model is mainly for distance from few hundred meters to kilometers. This model is not very accurate for short distances.*"
  - Minimum base-to-mobile coupling loss of 70 dB
- ***36.942 is carrier-centric versus public safety-centric***
  - Output is capacity loss rather than coverage loss; Section 5.1.1.9: "*Simulation results for E-UTRA shall be presented in terms of throughput reduction in percent relative to the reference throughput without external interference…*"
  - Loss is evaluated on a cell-wide basis

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Interference Concerns Are a Result of Experience

- ***Commercial network interference to public safety has been a problem in the past***
  - Led to the ongoing multi-year, multi-billion dollar rebanding of the 800 MHz LMR band due to Public Safety radios being interfered with by Nextel base site transmissions

- ***That experience offers insight into how interference impacts public safety***
  - Loss of coverage
  - Depends on where, not what percent of area is lost
  - Incidents cannot be planned around coverage holes

- ***Cellular operators view interference differently***
  - Loss of throughput
  - Not concerned about where throughput is lost, just how much
  - Evidenced by the 3GPP modeling approach detailed in TR 36.942

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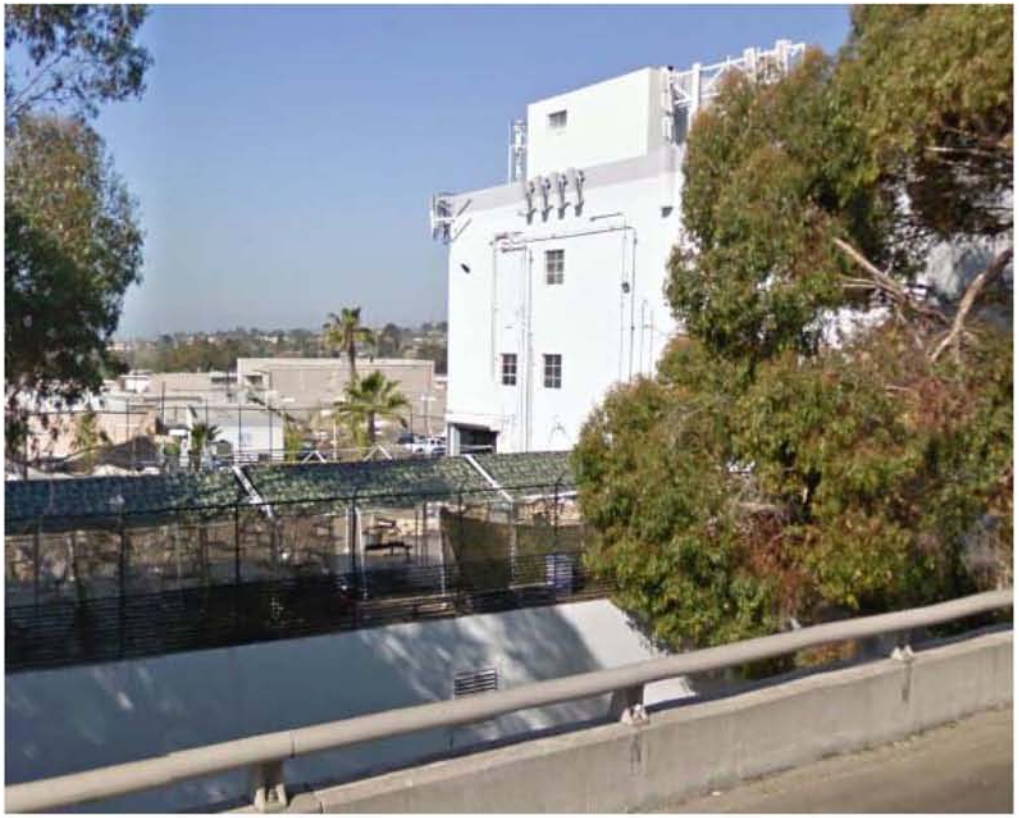
Actual Interference Scenarios – San Diego, CA



- ***Three-story building next to a storage facility***
- ***Storage facility is on a hill, reducing the height of the antennas above the ground***
- ***Measured -10.3 dBm signal strength in the yard of the storage facility (only 51.8 dB coupling loss, compared to assumed 70dB minimum coupling loss in 36.492)***

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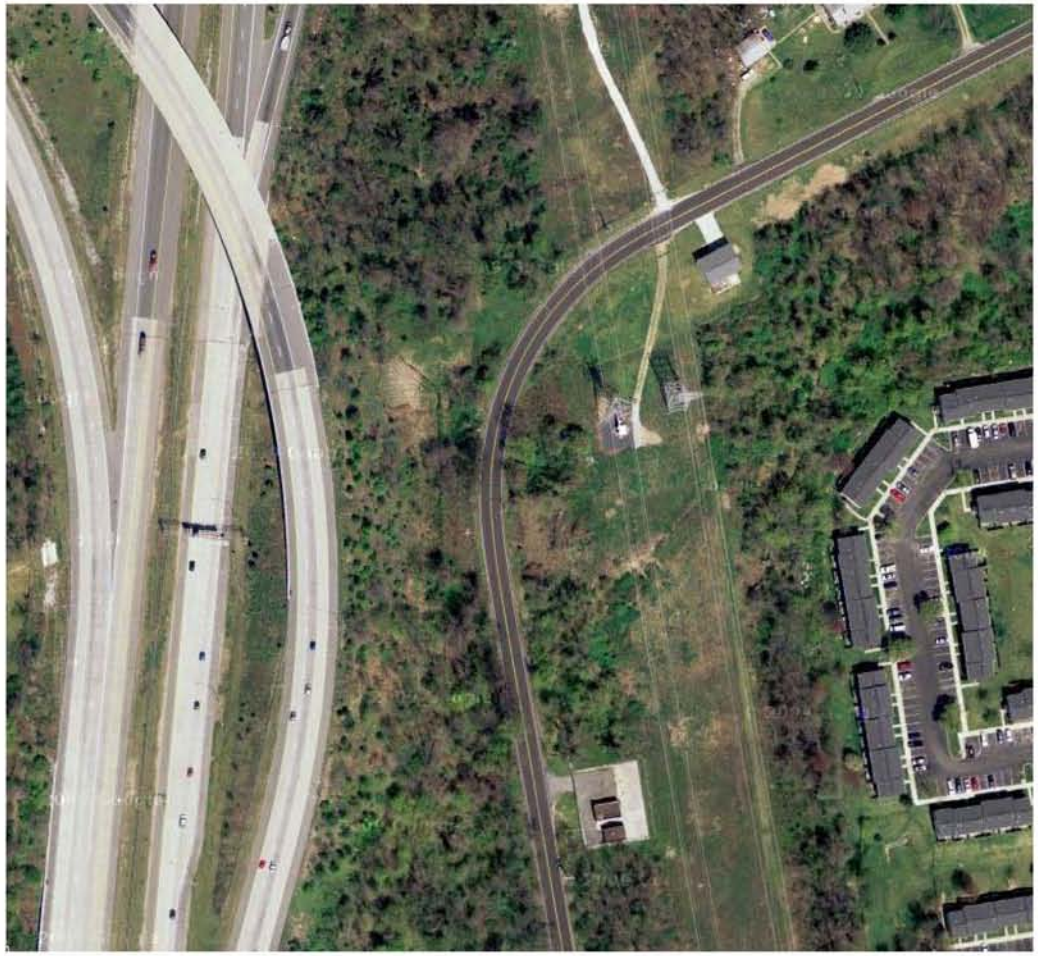
Actual Interference Scenarios– Anne Arundel Co, MD



- ***Cellular antennas on a high-voltage transmission line pylon***
- ***Approximately 160' from the highway***
- ***Bridge about the same height as the cellular antennas***
- ***-16.2 dBm measured on bridge (only 49.8 dB coupling loss, compared to assumed 70dB minimum coupling loss in 36.492)***

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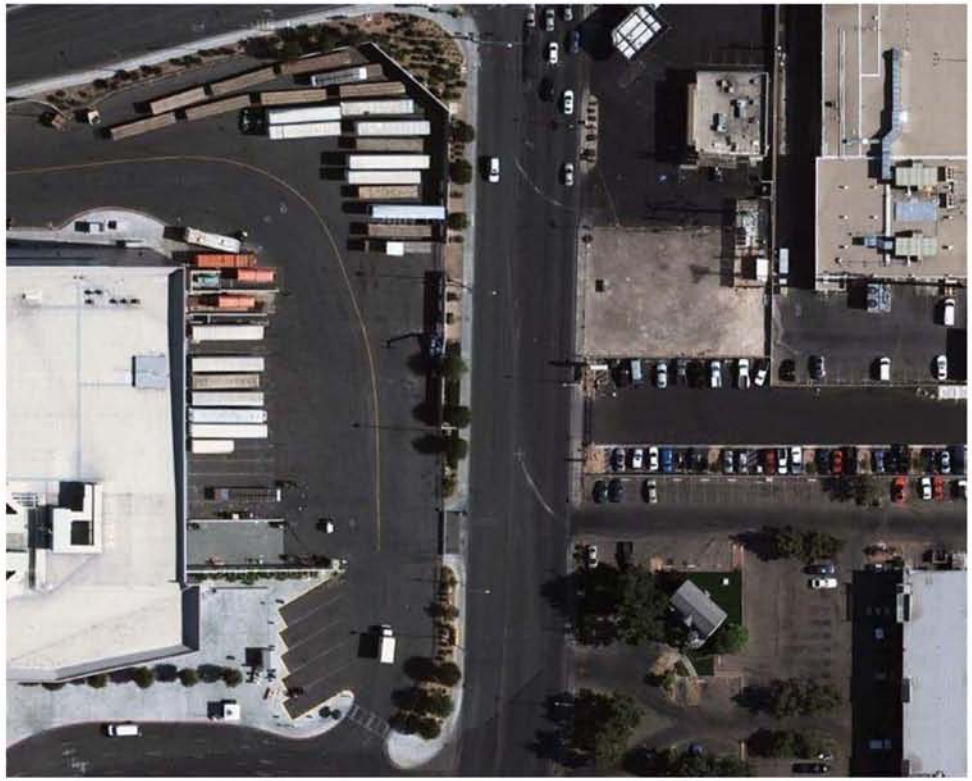
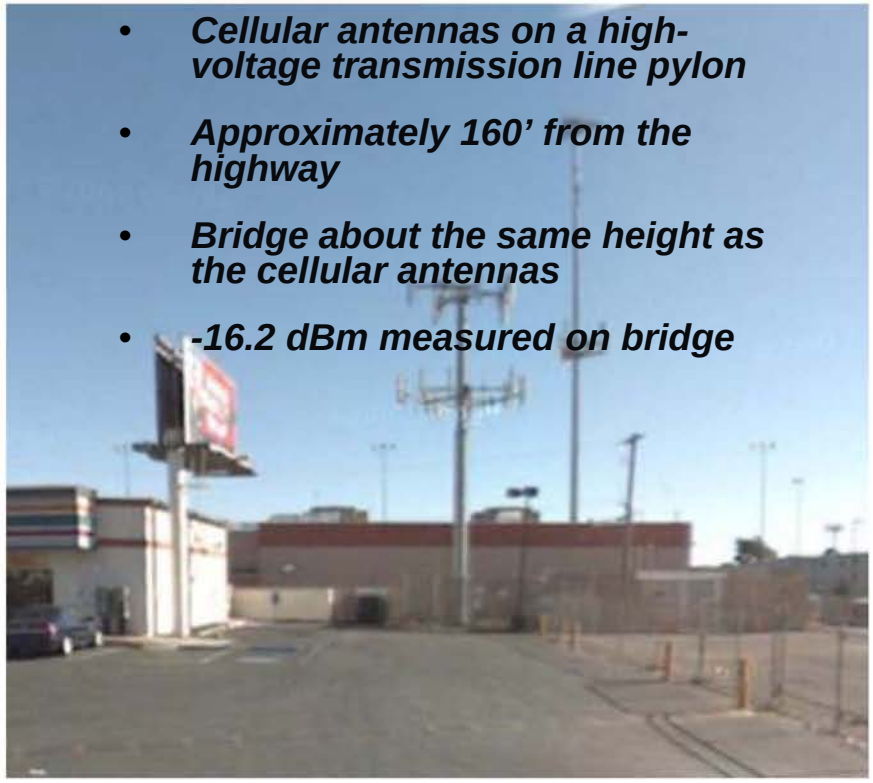
Actual Interference Scenarios – Las Vegas Convention Center





- ***Cellular antennas on a high-voltage transmission line pylon***
- ***Approximately 160' from the highway***
- ***Bridge about the same height as the cellular antennas***
- ***-16.2 dBm measured on bridge***

- ***Several operators across the street***
- ***Some using very high power with low antenna height to penetrate the convention center***
- ***-12.1 dBm measured in the parking lot (only 55.3 dB coupling loss, compared to assumed 70dB minimum coupling loss in 36.492)***

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Interference Case 2: D-Block Tx to GPS Rx

- ***GPS receivers are common in today's smartphones to provide device location fixes, for various location services, including E911 calls***
- ***The second harmonic component from lower end of D block Mobile Device (UE) Tx (around 788 – 788.21 MHz) would fall into GPS receive band, potentially causing interference to GPS location fixes***
  - GPS receiver center frequency is 1575.42 MHz and typical Rx bandwidth for a commercial GPS receiver is about 2 MHz (1574.42-1576.42 MHz).
  - An LTE mobile device is likely to have a GPS receiver and this co-existence issue is more problematic than interference from LTE UE to GPS receivers in other near-by devices due to larger coupling loss between the devices.
- ***Occupied bandwidth of a combined D-block and PSST-block (10 +10 MHz) network would be 250kHz further away from the 2nd harmonic region and would thus present less interference into the GPS Rx band***

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Mitigating/Eliminating D-Block Interference to Public Safety

- ***Congress reallocates D-block to Public Safety***
  - A combined D-block and PSST-block obviously eliminates D-block interference issue
  - This solution also alleviates interference issue that will plague D-block devices with GPS receivers because the occupied bandwidth shifts 250 kHz away from 2nd harmonic region.
- ***If reallocation does not occur, then the only other options are:***
- ***Insert 2MHz guard band between D-block and PSST block***
  - Least sensible as this either destroys value of D-block, or both blocks
- ***Force D-block auction winner to partner with Public Safety to share sites***
  - Co-siting base equipment would be required to mitigate coverage outages due to interference from adjacent channel
  - Eliminates Public Safety's option to seek competitive offers from other 700 MHz carriers for site sharing – gives D-block operator a monopoly position
- ***Public Safety would also need to match and co-site all micro/picocell and cell splitting that is done by D-block carrier***
  - Not practical for Public Safety to be in lockstep with completely independent D-block deployments
- ***Do nothing and potentially face another costly rebanding effort in the future***

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Commercial Roaming/ Priority/ Preemption Analysis

- ***Motorola fully supports Public Safety's recommendation to pursue LTE technology for broadband operation***

- ***Commercial Mobile Radio Service Providers will be required to give public safety users the ability to roam onto their networks with priority access, both in areas where public safety networks aren't available and when additional capacity is required beyond that provided by an operating public safety network.***

- ***As with any commercial technology, there are elements in the LTE standard that are not defined based on public safety operations***

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Architecture for Enabling PS Control of Policies When Roaming

Agency 1

Agency Applications

. . .

Agency N

Agency Applications

Regional Public Safety "Upper Core"

Network Elements:
HSS, PCRF, PGW (opt)

Common Functions:
Consistent subscription, authorization, QoS and policy

Regional Applications

S6a/S5

S6a/S8

Standard LTE Roaming interfaces

S6a/S8

Internet "pipe"

Regional PS "Lower Core"

Carrier 1

Carrier 2

Network Elements:
SGW, MME
Functions:
LTE Mobility, Auth

Network Elements:
SGW, MME

Network Elements:
SGW, MME

Satellite

PSST Spectrum

Commercial Spectrum

Commercial Spectrum

PS devices

Roaming

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Challenges with Priority Roaming to Carrier

Issues That Require Further Standards Work - 1

- ***Limited protection of the LTE control channel during a "dense incident"***
  - **Issue**: At an incident scene, a flood of commercial and public safety devices can prevent a responder from accessing the system. LTE provides "access class barring" which is intended to order certain classes of device to "back off" the control channel, however this is manually activated by the operator
  - **Responder Experience**: Will not provide guaranteed access for public safety users to the commercial network during heavy traffic loads
  - **Resolution Alternatives**: No current standards work to address this issue

- ***No mechanism for equitably balancing resources among responding agencies (fire, police, etc.) at a single cell***
  - **Issue**: Standard doesn't support bandwidth guarantees for agencies
  - **Responder Experience**: Certain users would not be able to exchange traffic with the LTE network
  - **Resolution Alternatives**: No current standards work to address this issue

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Challenges with Priority Roaming to Carrier

Issues That Require Further Standards Work - 2

- ***No public safety specific situational prioritization***
  - **Issue**: There is no standardized means to support situational public safety priority. LTE only provides policy for devices and applications. Is a 4-alarm fire the same as a cat in a tree?– and yet both incidents are dispatched by the same CAD application to potentially the same user devices in different situations.
  - **Responder Experience**: Cannot allocate appropriate QoS treatments based on incident type within the LTE network at various priority incident scenes
  - **Resolution Alternatives**: No current standards work to address this issue

- ***Inter-PLMN Standards Maturation Required***
  - **Issue**: Seamless handover between LTE networks not fully supported
  - **Responder Experience**: After access has been achieved, may have to drop all existing session and reestablish those session whenever a roam occurs
  - **Resolution Alternatives**: Standards work in progress, but even R10 proposed features are insufficient for public safety. No current standards work to define complete solution.

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Challenges with Priority Roaming to Carrier

Problems That Require Further Analysis

- ***No device visibility into the status of roaming networks with out detaching***
  - **Issue**: A device must detach from PS network to attempt to obtain more bandwidth or coverage from from a commercial network only to discover carrier network sites are down in an incident
  - **Responder Experience**: Increased device out-of-service times as it cycles trying to find available networks
  - **Resolution Alternatives**: No solution to a downed network. One possibility to avoid prolonged device outage is to include multiple transceivers in the same device, but self-interference within the device could result

- ***Unclear how to avoid excessive roaming charges without requiring slower, manually activated roaming***
  - **Issue**: When a PS device loses coverage with the PS network or lacks available bandwidth for a desired application or service, it is highly desirable that roaming be automatic to avoid disrupting the responder
  - **Responder Experience**: public safety agencies can accumulate extraordinary roaming charges even during day to day incident responses, particularly on cell edges.
  - **Resolution Alternatives**: require unique support for slower, manually activated roaming, but lose the seamlessness and increase the potential for operator error

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Challenges with Priority Roaming to Carrier

Problems That Require New Policies to Be Established

- ***Priority without preemption isn't good enough for public safety***
  - Priority access would be sufficient if all commercial traffic was non-GBR (guaranteed bit-rate)
  - However, commercial users will likely use more real-time streaming applications with GBR service in an major incident, and then eNodeB bandwidth can become saturated with "dedicated bearers" (i.e. no non-GBR data bearers to slow down)
  - Commercial users are smart enough to not release their service in times of incidents and high congestion and so Public Safety users can remain at head of queue due to priority, but still waiting indefinitely for bandwidth to free up
  - Only preemptive access using ARP (allocation and retention priority) mechanisms can force drops in current commercial user services to free up bandwidth for public safety access
  - Ruthless preemption would be a public safety operational requirement, but is unacceptable for commercial users

- ***No guarantee of consistent policy enforcement across carriers and their equipment vendors since standards aren't specific***
  - **Issue**: Lack of a common public safety policy (that is accepted by all carriers and equipment vendors) that can be derived for and enforced across all 700MHz LTE carrier networks (e.g. QCI, ARP, priority access, instant access, pre-emption)
  - **Responder Experience**: inconsistent operation across carriers including (1) disruptive drop and reconnect of existing sessions when roaming, (2) random loss of packet flows, (3) choppy/dropped video
  - **Resolution Alternatives**: Development of a national public safety policy mandate that must be enforced across all LTE providers

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Roaming Analysis Conclusions

- ***To ensure a consistent roaming experience for responders, public safety must have its own "upper core" (LTE H-PLMN)***
  - Consistent provisioning, authorization, policy, and applications while roaming
- ***LTE today does not support all of public safety's operational requirements, particularly in roaming***
  - No current standards work in place to address these issues
  - No assurance that 3GPP will accept these requirements for standardization or when the standards would be complete
- ***Some LTE issues are difficult to solve, even with standards changes. More work is needed on these***
- ***Public Safety Specific Policies Need to Be Established Around Public/Private Interworking***
  - Preemptive, not priority access, would be needed by Public Safety on commercial networks
  - A Public Safety "profile" is needed in several areas (QoS, Preemption, Roaming, etc.) and must be supported by both commercial carriers and equipment vendors

Relying on roaming to commercial networks for extra capacity is not currently a viable solution for public safety mission critical traffic

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Overall Conclusions/ Recommendations

- ***A Congressional reallocation of D-block to Public Safety Solves These Problems***
  - Provides public safety with an appropriate amount of dedicated capacity
  - Eliminates D-block interference issue
  - Alleviates interference issue that will plague D-block devices with GPS receivers
  - Lessens any dependency on carrier roaming to support public safety's capacity needs
  - Mitigates any excessive roaming charges

- ***Reallocating the 10 MHz of D-block would double public safety's dedicated broadband spectrum, while only imposing a 2% reduction in the 500MHz that the FCC has committed to commercial operators.***

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