March 15, 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
GN Docket 09-51

Dear Ms. Dortch:

Pursuant to Section 1.1206(b)(2) of the Commission's Rules, this is to notify you that on Friday March 12, 2010 Peggy Matson, Jeff Anderson, Jim Krammen, Rob Kubik and I, all with Motorola, met with Stagg Newman, Walter Johnston, Jon Peha, Pat Amodio, Behzad Ghaffari, Ziad Sleem, Ahmed Lahjouji, Kurian Jacob, Yoon Chang and Jerry Stanshine of the Commission staff regarding the above captioned proceedings.

During the meeting we discussed the attached slides related to public safety requirements for a broadband network and a comparison of the capacity of a network deployed with a total of 10 megahertz of spectrum compared to a network with a total of 20 megahertz of spectrum. As shown in the attached slides, a network deployed using a total of 20 megahertz of spectrum is necessary to support video of sufficient quality to meet the tactical requirements of public safety. A network using a total of 10 megahertz has limited ability to support even low quality video, particularly toward cell edge.

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: Stagg Newman
Walter Johnston
Jon Peha
Pat Amodio
Behzad Ghaffari
Ziad Sleem
Kurian Jacob
Yoon Chang
Jerry Stanshine
Ahmed Lahjouji

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Capacity Requirements
For
Public Safety Incident Scene Video

There Are Many Advantages Of A 10+10 Block Of Spectrum (e.g. PSST Block + D Block), As Compared to 5+5 Only

* Increases:
  - cell and system capacity (more than 2X)
  - available bit rate per user
  - # of users supported on the system

OR

* Reduces # of sites for same coverage

OR

* Reduces interference

1. Enables immediate transmission of video from an incident scene.
2. Reduces cost of system deployments.
3. Better performance.
4. Eliminates need for guardband between PSST block and D block.

Note: Assuming LTE system technology.

Enabling Video Is All About Capacity

We review two “incident location” scenarios:

- Incident at the edge
- Incident where capacity is at the average of a cell’s throughput

We make the comparison between two LTE system scenarios:

- 5+5 MHz (e.g. PSST Block Only)
- 10+10 MHz (e.g. PSST Block and D Block)

The capacity constraint is in the uplink. We look only at the uplink.

The immediacy of video transmissions is critical.

- As documented in reports on the Minneapolis Bridge Collapse, and numerous other less-infamous incidents (e.g. burning building).
- Immediate video transmission requires a fixed (wired or point-to-point wireless) camera solution (not possible for most incidents) or transmission on a pre-deployed Public Safety network.

Design For The Worst Case, Not Just For Day-To-Day

Scenario #1: Incident with Video Near The Cell's Edge

Scenario Assumptions:

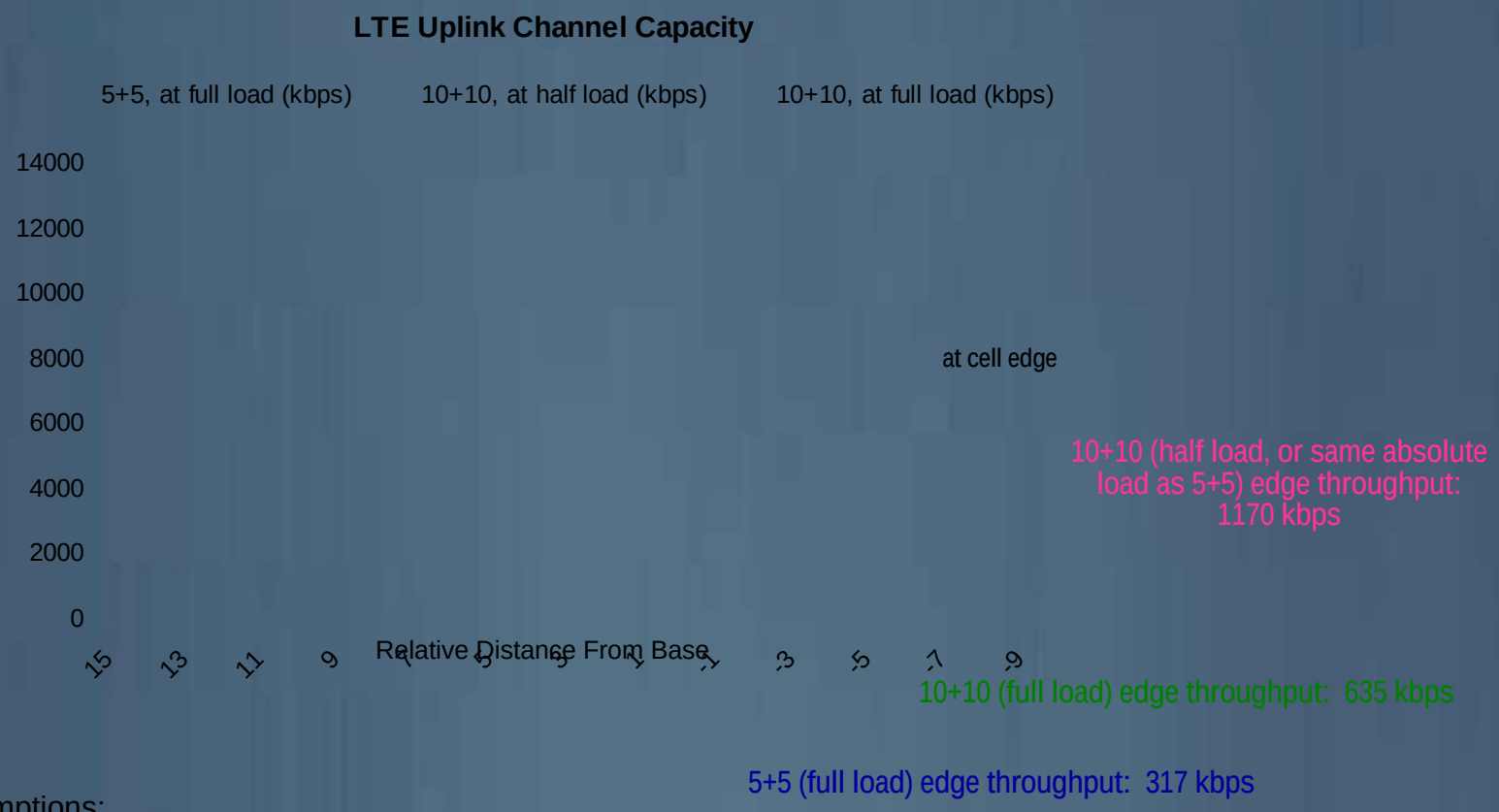
- Public Safety LTE system.
- Incident is contained within a single cell, and is near the cell edge.

User/traffic Assumptions:

- Immediate transmission of incident scene video back to EOC and incident command is required.
- 20% of the cell's capacity is consumed with non-video P.S. traffic.
- Note: These are conservative assumptions on traffic. Substantial non-P.S. government application traffic and/or VoIP traffic would take away more of the available bandwidth.

Incident within a single cell,
near the cell's edge

Cell Edge Throughput Defined



Definitions and Assumptions:

- ❖Cell edge is based on the 3GPP definition of cell edge… any point in the cell whose SNR (signal-to-noise ratio) is worse than 95% of the other points in the cell. 5+5 full load cell edge is at -7 dB SNR.
- ❖Site count is the same whether 5+5 or 10+10, for this analysis.
- ❖Assumes 6 dB IOT (Interference Over Thermal) on the uplink for 5+5 full load and 10+10 full load. Assumes 3 dB IOT on the uplink for 10+10 half load.
- ❖Assumes 2 antennas on every base. Assumes optional 64 QAM mode is not supported.
- ❖Uses 3GPP TR 36.942 Shannon channel capacity estimation.

Load: Video Cameras

Value:

- Very high value in immediate access to streaming incident video, particularly for EOC.

Minneapolis deployed 3 high-quality video streams on an expanded Muni-WiFi system.

Deputy Director of Emergency Preparedness, City of Minn.:

- *"The ability to see the I-35W bridge site from our EOC was unbelievable."*
- *"We would see something remotely that was a safety issue and we could point that out instantly."*
- *"The ability to prioritize equipment resources going forward, as we went into body recovery, was amazing. It helped us prioritize because we knew we wouldn't see this equipment… "*

Number of cameras:

- Minneapolis deployed 3.
- A burning building would typically call for 4.

Video Quality Tiering

V1: "Scanning"
Remotely monitor multiple cameras looking for gross anomalies

V2: "Situational Awareness"
Asses magnitude of incident to determine appropriate response

V3: "Tactical Decision-Enabling"
Manage on-scene resources

V4: "Strategic Decision-Enabling"
Direct real-time response team

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

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

Click to view a comparison video

For fixed surveillance, NYPD requiring 2 Mbps, LAPD required 3 Mbps

V1: 128 kb/s

"Scanning"

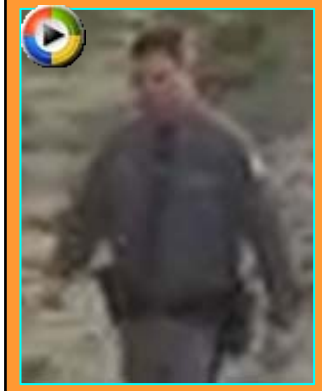
- **Remotely monitor multiple cameras looking for gross anomalies** (e.g. a bridge collapse)

SQVGA: 160x120

V2: 384 kb/s

"Situational Awareness"

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

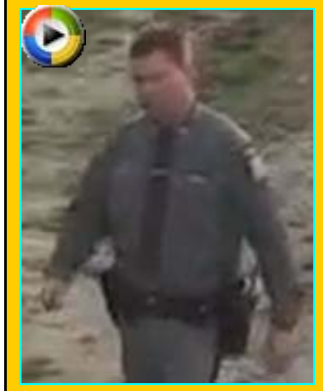


QVGA: 320x240

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

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

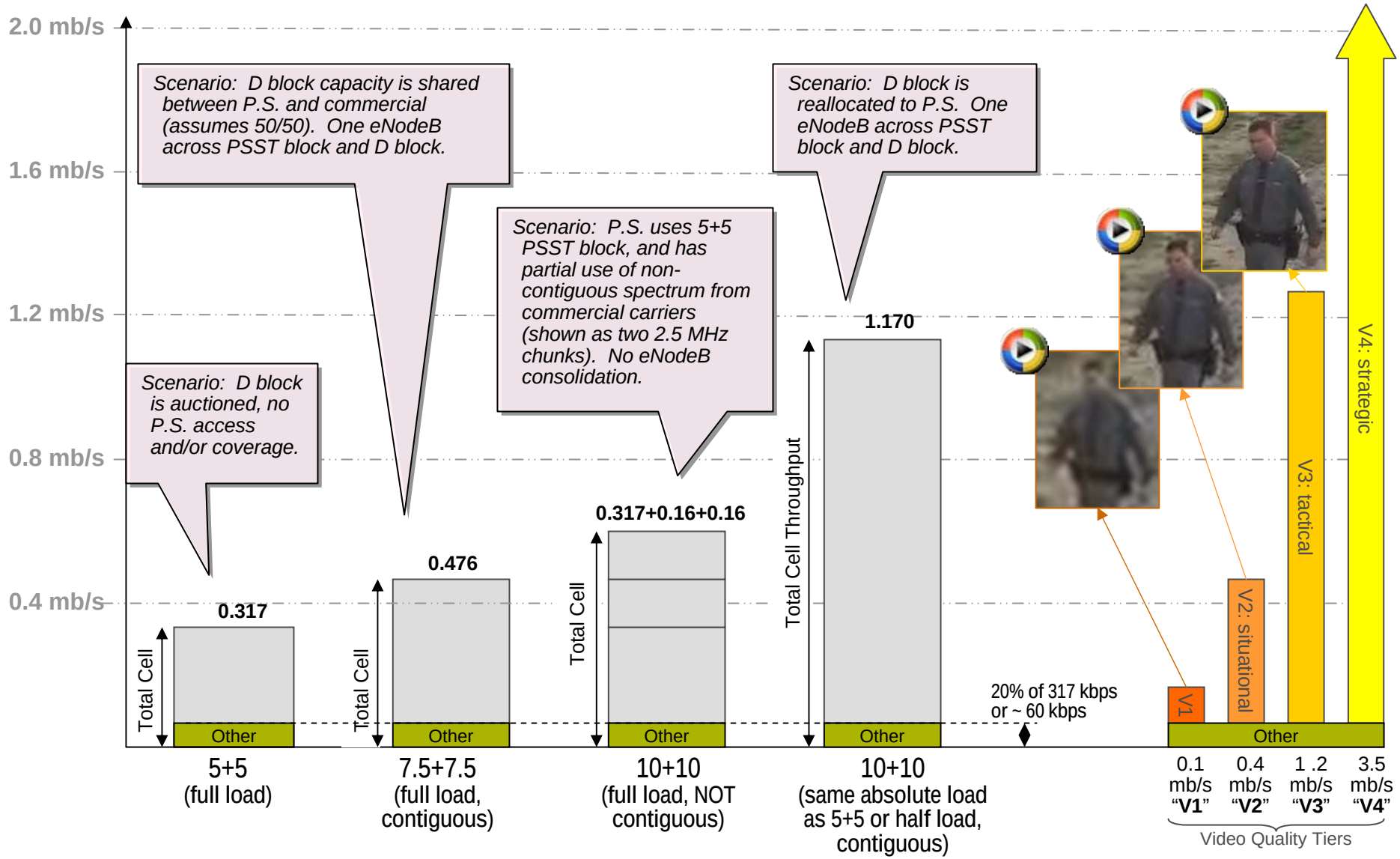
Video Tiering Key Take Aways

1. **If P.S. (e.g. the EOC) wants to do any remote decision-making, then V3 or V4 video streams are required.**

2. **V2 video streams can be useful, outside of decision-making (e.g. to identify activity).**

3. **The usefulness of V1 video streams from an incident is very limited.**

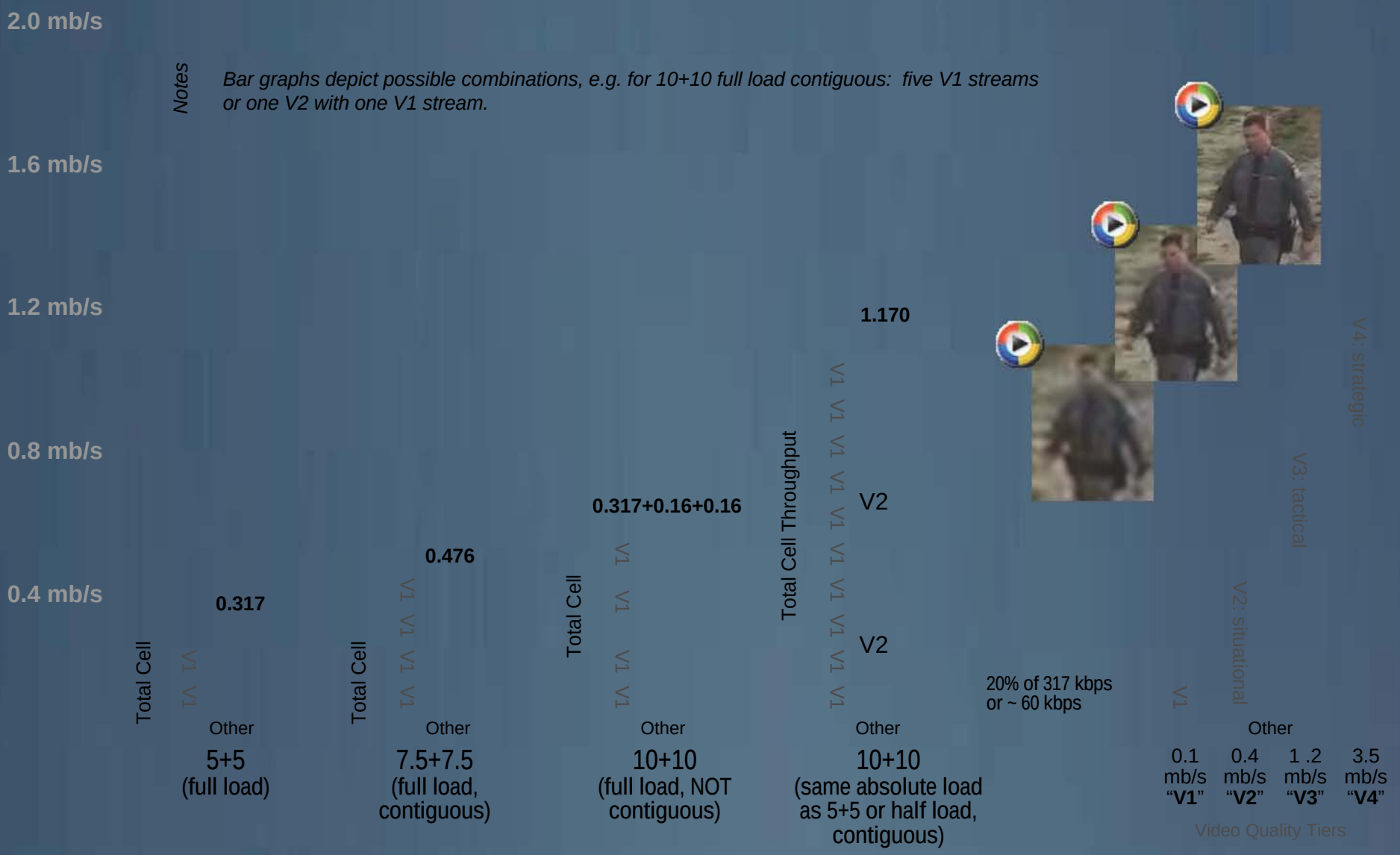
The Capacity At The Edge



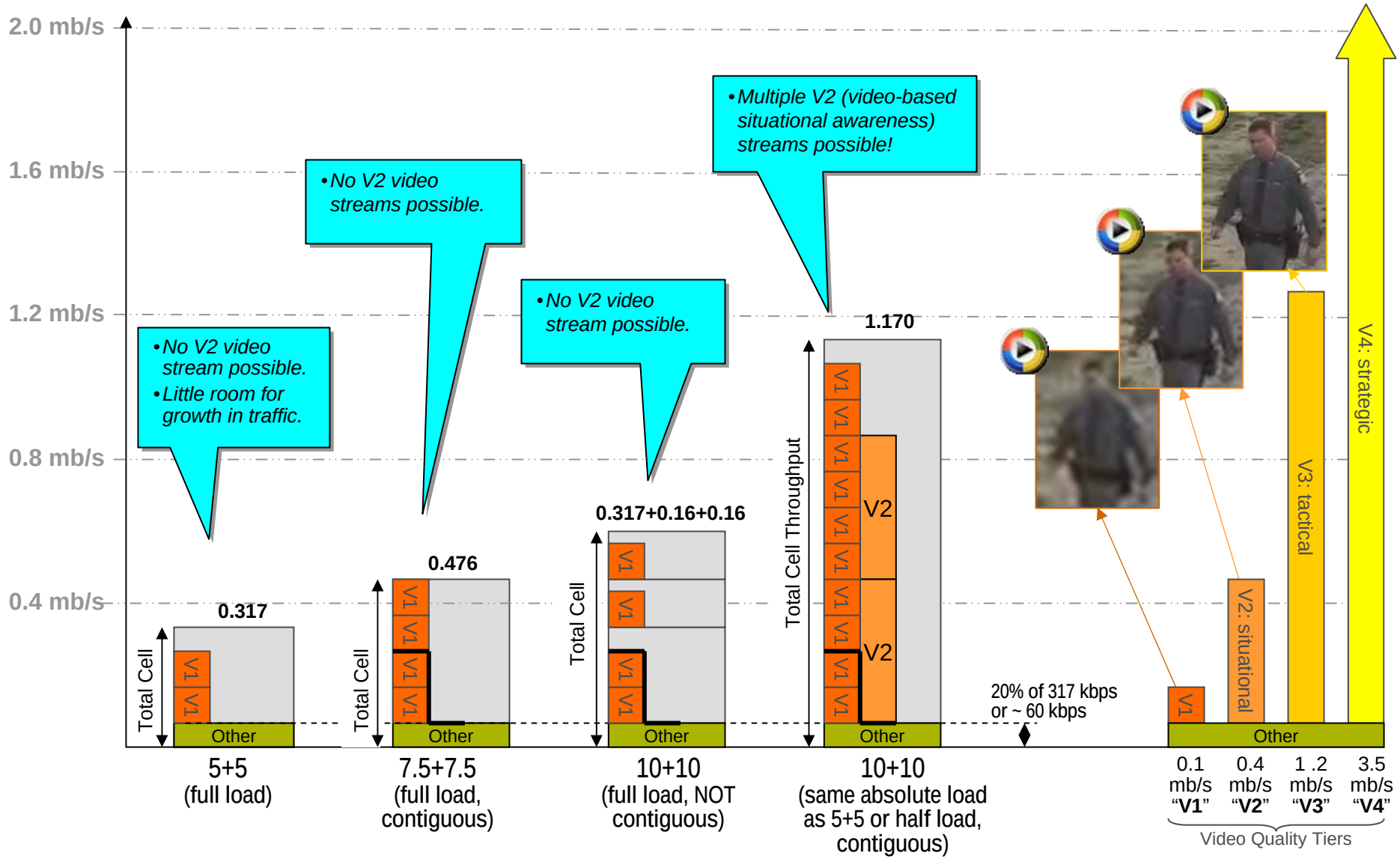
The Possibilities At The Edge

Notes

Bar graphs depict possible combinations, e.g. for 10+10 full load contiguous: five V1 streams or one V2 with one V1 stream.



V2 Situational Awareness Video ONLY Available With 10+10 Contiguous When At The Edge With Full Load



Scenario #2: Incident with Video But NOT On The Edge

LTE system:

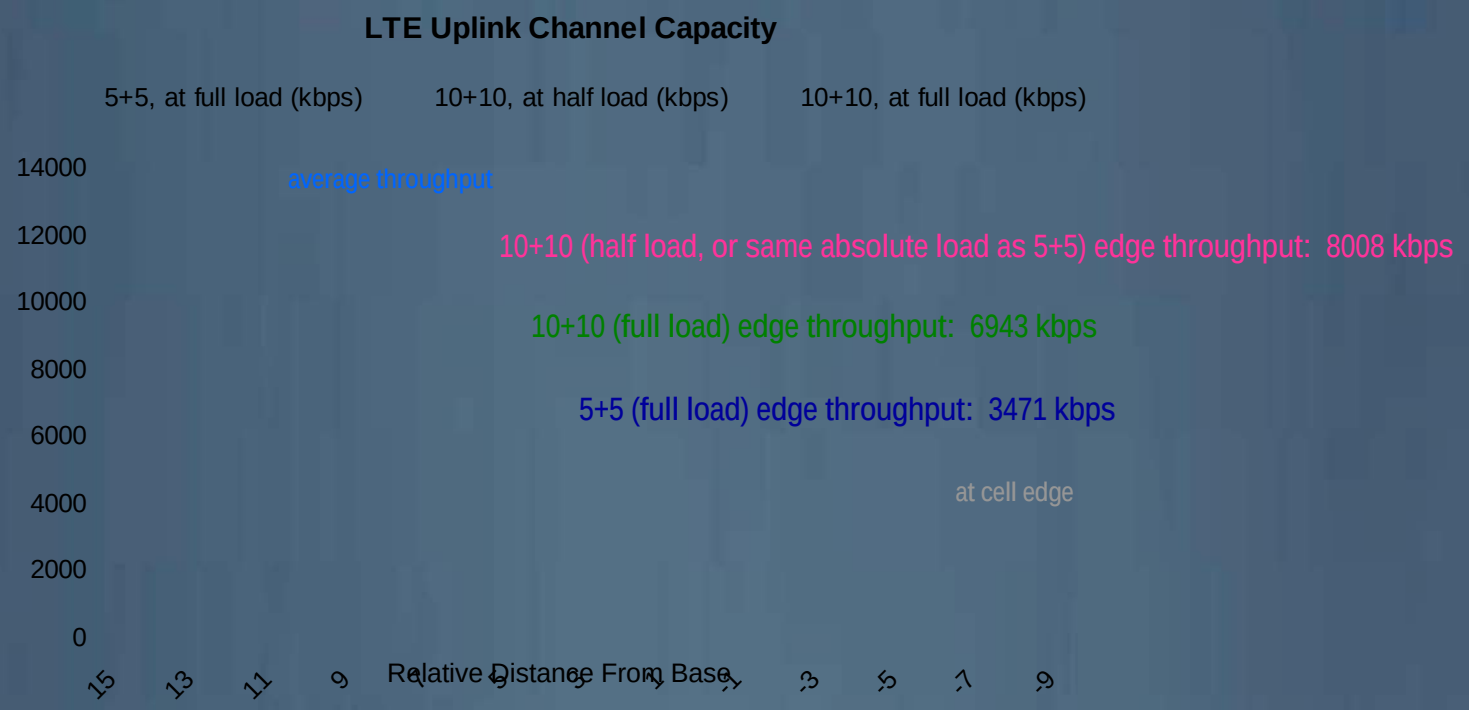
- Public Safety LTE system.
- Incident is contained within a single cell, and is NOT on the edge

User requirement (no change from edge scenario):

- Immediate transmission of incident scene video back to EOC and incident command.
- 20% of the cell's capacity is consumed with non-video P.S. traffic.
- Note: These are conservative assumptions on traffic. Substantial non-P.S. government application traffic and/or VoIP traffic would take away more of the available bandwidth.

Incident within a single cell,
NOT on the cell's edge

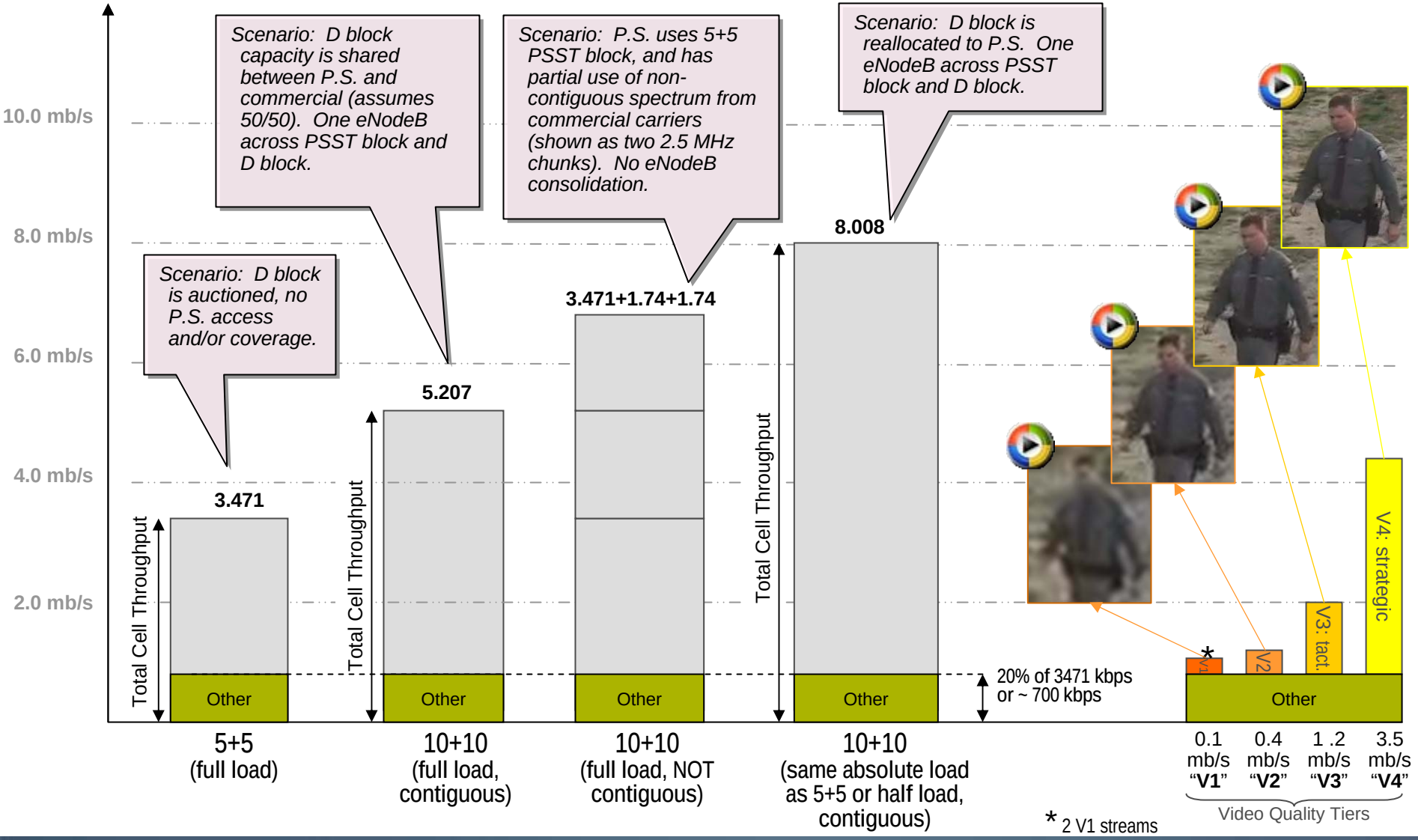
Cell Average Throughput Defined



Definitions and Assumptions:

- ❖Cell average (average throughput) comes from Motorola 3GPP submittals based on LTE simulations. We have estimated the 5+5 full load cell average to be at approximately 8 dB SNR.
- ❖Site count is the same whether 5+5 or 10+10, for this analysis.
- ❖Assumes 6 dB IOT (Interference Over Thermal) on the uplink for 5+5 full load and 10+10 full load. Assumes 3 dB IOT on the uplink for 10+10 half load.
- ❖Assumes 2 antennas on every base. Assumes optional 64 QAM mode is not supported.
- ❖Uses 3GPP TR 36.942 Shannon channel capacity estimation.

The Capacity At The "Average"

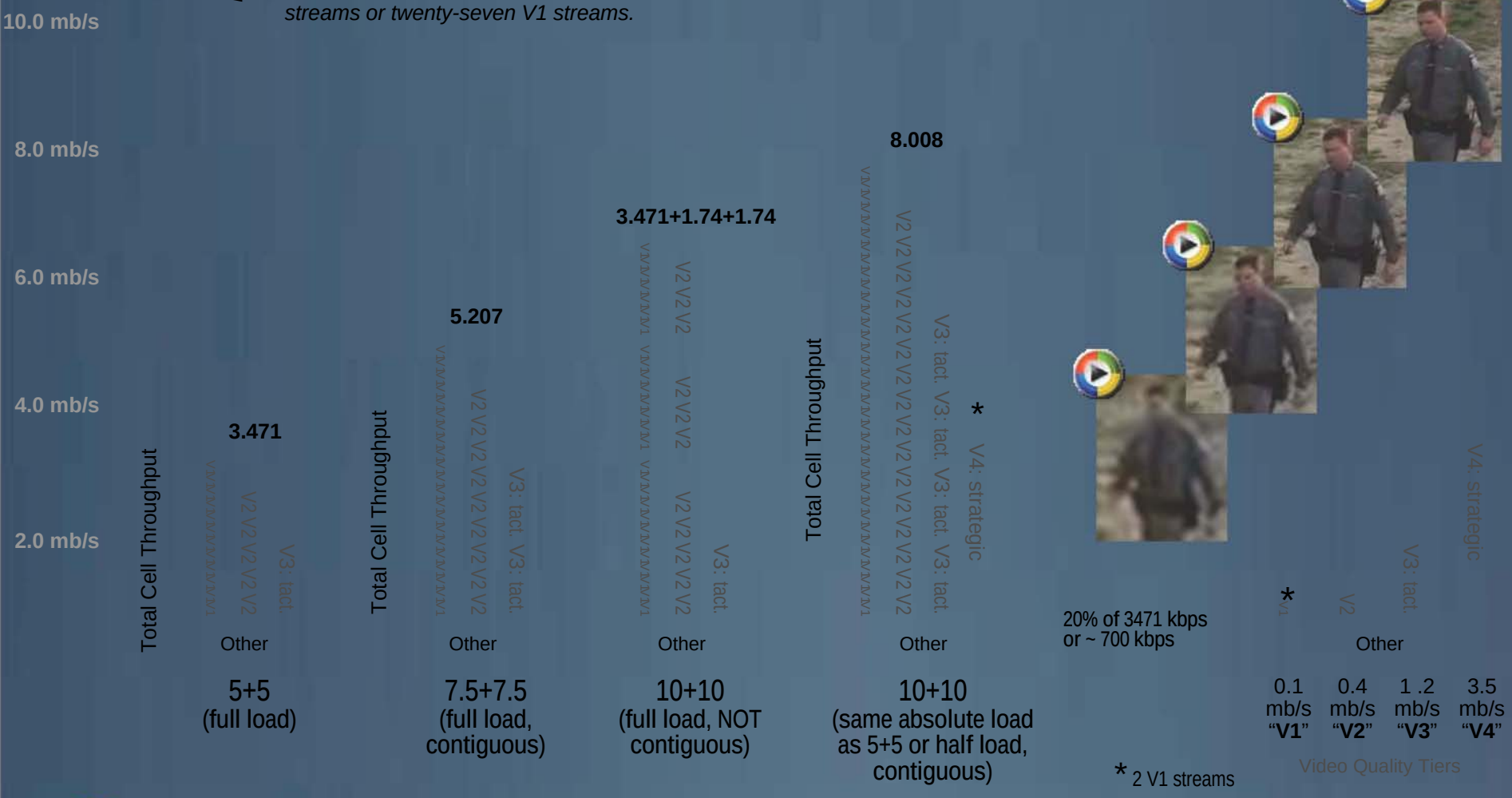


The Possibilities At The “Average”

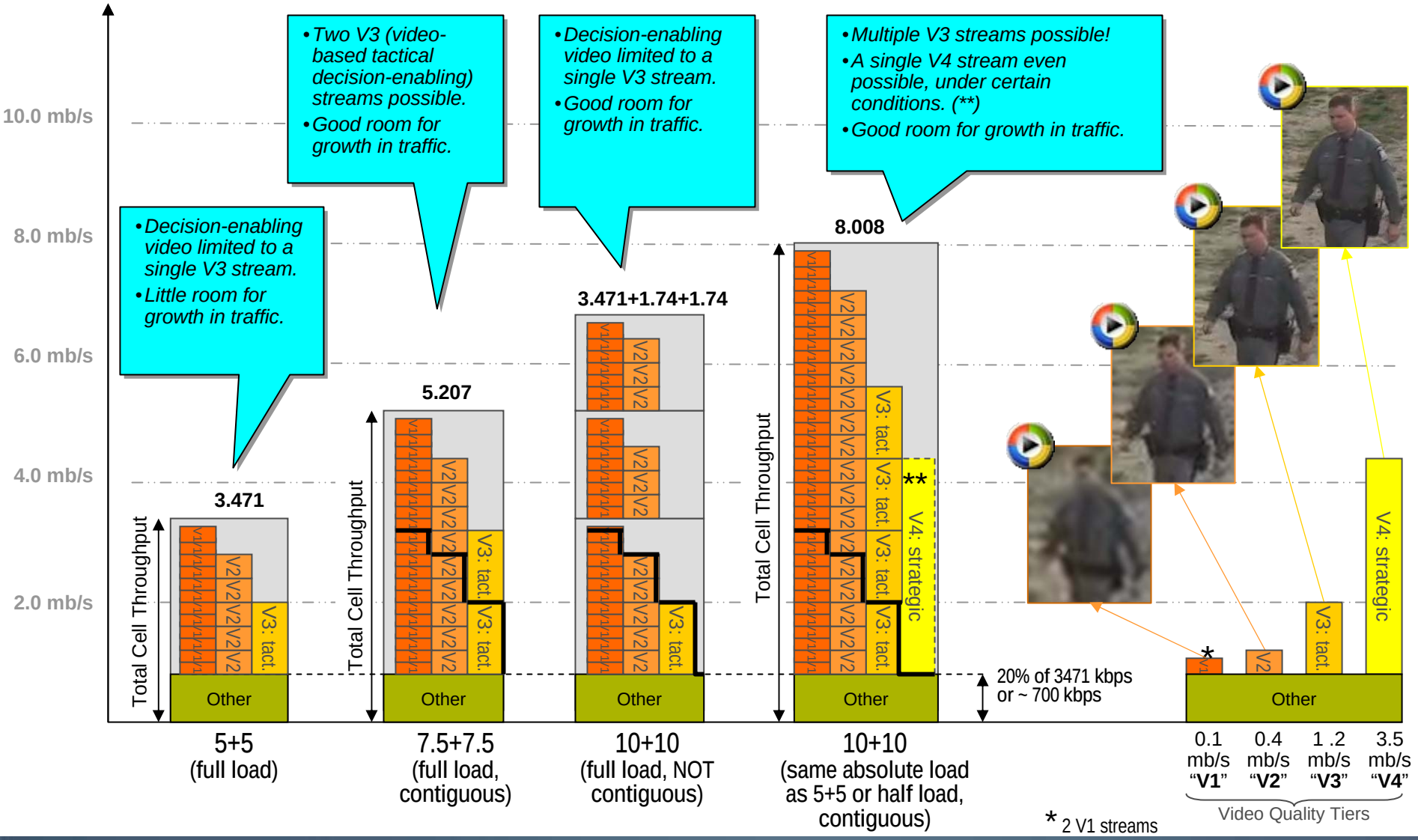
Notes:

Scheduled throughput reduces as size of individual loads go up, due to lack of multi-user diversity.

Bar graphs depict possible combinations, e.g. for 5+5: one V3 with two V2 streams, or five V2 streams or twenty-seven V1 streams.


10.0 mb/s
8.0 mb/s
6.0 mb/s
4.0 mb/s
2.0 mb/s
Total Cell Throughput
3.471
V3: tact.
V2 V2 V2 V2
V1 V1 V1 V1 V1 V1 V1 V1 V1 V1 V1 V1
Other
5+5
(full load)
Total Cell Throughput
5.207
V3: tact. V3: tact.
V2 V2 V2 V2 V2 V2 V2 V2
V1 V1 V1 V1 V1 V1 V1 V1 V1 V1 V1

Four V3 Video Streams Or A Single V4 Stream ONLY Available With 10+10 Contiguous When At The "Average"



Future Public Safety Demand Grows Faster than Future LTE Enhancements

Wireless data traffic projected to double every year through 2014.[1] Public Safety data usage will be driven by such applications as:

- **GPS / Computer Aided Dispatch / Database inquiries**
- **Ubiquitous availability of video and images**
- **Non-P.S. government data applications**
- **Low-bandwidth applications with many transmitters reporting data around the clock (e.g. telemetry, perimeter monitoring, environment sensing to detect tampering or accidental HazMat conditions, bio sensing of officers, crowd-sourcing)**
- **etc.**

Required Capacity For P.S. Applications

10+10 MHz

Public Safety Applications Will Continue to Grow

5+5MHz

Advanced LTE : 4G

2011

Time

[1] Source: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, (February 9, 2010)

Summary of Key Points

1) V3 and V4 video streams provide the most value at an incident scene. While V2 streams have some value for situational awareness, V1 streams have little to no value at an incident scene.

2) 5+5 is insufficient to support P.S. use of video for incident scene.

3) Contiguous 10+10 supports incident scene video well, with limited capability all the way out to the edge.

Back Up

About The Video Clips

The original video clip:

- Acquired from the Pond5 Stock Video Footage archive: http://www.pond5.com/stock-footage/361778/overturned-car-accident-scene-on-highway-with-fire-trucks-and-police.html
- Purchased royalty-free license from Pond5.
- Original has a color space of YUV4:2:0, a resolution of 1920x1080i (interlaced), and a frame rate of 29.97 FPS (frames per second).

Subsequent V1/V2/V3/V4 video clips:

- Resolution (original was deinterlaced to 1920x1080p, then scaled to the following target resolutions using a Lanczos filter):
  - V1 (100 kbps): 160 x 120 (SQVGA) pixels
  - V2 (400 kbps): 320 x 240 (QVGA) pixels
  - V3 (1.2 Mbps): 640 x 480 (VGA) pixels
  - V4 (3.5 Mbps): 1280 x 960 (1.2 MP) pixels
- Encoding and Compression:
  - All streams were encoded with H.264 Baseline Profile in a real-time configuration (e.g. no multi-pass, no b-frames, etc.). (Better compression can be obtained using a non-real-time encoder configuration, but this would not be representative of a live video use case.)
  - Actual encoder used was x264 (a well respected open source implementation of H.264).

Note: 3X bit rate increments between tiers

Standards:

- No quantitative video quality standard for Public Safety incident scene exists today.
- The DHS Project VQiPS (Video Quality in Public Safety) is currently identifying target use cases and missions for video in public safety, and aims to define respective quantitative quality standards.
- Motorola is represented in VQiPS.