Big Data Visualizations to Support Operations and Planning

Enabling Decision Making & Effective Communication
What is Big Data?

Extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.
- Google

Big Data is a loosely defined term used to describe data sets so large and complex that they become awkward to work with using standard statistical software.
- International Journal of Internet Science

Big Data is defined by the three V’s:
- Volume
- Velocity
- Variety
- Principles of Big Data (Morgan Kaufmann)

Fourth V:
- Value
- Extracting Value from Chaos (J. Gantz and D. Reinsel)

Fifth (and sixth and seventh etc.) Vs:
- Veracity
- Variability
- Etc.
- The Internet
Why did this term become so popular?
Where is it going?

In 1992 global internet traffic amounted to 100 GB per day.

In 2019 global internet traffic will be \(~52,000\) GB per second!

Source: Cisco VNI, 2015
Highlights from Cisco Visual Networking Index (VNI) Document

• Global Internet traffic in 2019 will be equivalent to 66 times the volume of the entire global Internet in 2005.

• Traffic from wireless devices will exceed traffic from wired devices by 2016.

• 2/3 of all IP traffic will originate with non-PC devices by 2019.

• The number of devices connected to IP networks will be more than 3 times the global population by 2019.

Source: Cisco VNI, 2015
“We want to know what every product in the world is. We want to know who every person in the world is. And we want to have the ability to connect them together in a transaction.”

- Walmart’s CEO on global e-commerce in 2013.
What does all this have to do with transportation?
RITIS Today

Traffic events: 70,000 records per day (0.002 GB/day)
Traffic detectors: 35,000,000 records per day (5 GB/day)
Probe vehicles: 5,200,000,000 records per day (550 GB/day)
Transit, CCTV, weather, radio, etc.: XX,XXX,XXX,XXX,XXX records per day (??? TB/day)
V2X & Automation: X,XXX,XXX,XXX,XXX records per day (??? ?B/day)

Connected vehicle will generate 25 GB of data per hour.
- Hitachi, Ltd.
Big Data at the CATT Lab
Situational Awareness – Nationally
Situational Awareness – Locally
Major Event Impacts
Off Peak Conditions
Morning Rush
Snow Storm
How much did this cost?

| Time  | 12 AM | 1 AM | 2 AM | 3 AM | 4 AM | 5 AM | 6 AM | 7 AM | 8 AM | 9 AM | 10 AM | 11 AM | 12 PM | 1 PM | 2 PM | 3 PM | 4 PM | 5 PM | 6 PM | 7 PM | 8 PM | 9 PM | 10 PM | 11 PM | Daily Total |
|-------|-------|------|------|------|------|------|------|------|------|------|-------|-------|-------|------|------|------|------|------|------|------|------|-------|-------|----------|
| 1/01/15 | $0.4K | $0.4K | $0.7K | $0.2K | $0.6K | $1.8K | $4.4K | $4.2K | $1.6K | $5.5K | $0.3K | $0.7K | $0.8K | $0.1K | $0.6K | $0.2K | $1.3K | $1.9K | $2.5K | $1.0K | $2.2K | $1.0K | $1.3K | $1.1K | $38.4K |
| 1/02/15 | $0.4K | $0.4K | $0.3K | $0.3K | $0.1K | $0.1K | $0.2K | $0.3K | $0.2K | $0.5K | $0.3K | $0.2K | $0.6K | $0.2K | $2.2K | $1.3K | $2.7K | $7.3K | $14.6K | $10.4K | $1.2K | $0.6K | $0.2K | $1.2K | $1.2K | $49.4K |
| 1/03/15 | $0.6K | $0.6K | $0.3K | $0.3K | $0.2K | $0.6K | $1.1K | $1K | $1K | $1.5K | $0.3K | $0.3K | $4K | $3.3K | $17.6K | $9.5K | $65.4K | $39.3K | $19.1K | $6.2K | $14.2K | $13.3K | $9.0K | $5.2K | $1.1K | $256.5K |
| 1/04/15 | $0.7K | $0.4K | $0.4K | $0.4K | $1.1K | $1.5K | $1K | $0.9K | $2.9K | $7.4K | $4K | $18.5K | $0.3K | $0.2K | $1.2K | $2.4K | $6K | $14.2K | $0.7K | $0.9K | $0.8K | $98.1K |
| 1/05/15 | $0.4K | $0.4K | $0.4K | $0.4K | $0.2K | $0.1K | $16.6K | $26.4K | $28.3K | $10.1K | $0.4K | $0.4K | $4.4K | $4.4K | $4.4K | $19.7K | $22.0K | $20.3K | $0.6K | $0.2K | $1.1K | $0.4K | $894.7K |
| 1/06/15 | $0.4K | $0.4K | $0.4K | $0.3K | $0.7K | $41.5K | $502.7K | $547.6K | $564.9K | $280.3K | $12.2K | $19.9K | $17.0K | $22.0K | $0.6K | $0.2K | $1.1K | $0.4K | $894.7K |

**Tuesday, January 6, 2015 8:00 AM**

**Delay cost:**
- Total: $654,890.63
- Per VMT: $1.07

**Hours of delay:**
- Person-hours: 2,9542h 55m 34s
- Vehicle-hours: 24116h 40m 27s

**Vehicle miles traveled (VMT):**
- Total: 535,199 miles
- Passenger: 481,675 miles
- Commercial: 53,520 miles
- Delay per VMT: 2.7037 mins / mile

**Data validity:** 100%

Click the table cell to see links to congestion scans.
Where is the worst congestion?
Congestion Scan
Congestion Scan
Customizable Performance Dashboards
Nikola Ivanov,
Deputy Director, CATT Laboratory
http://cattlab.umd.edu
ivanovn@umd.edu
(301) 405-3626