Cloud Based Traffic Management

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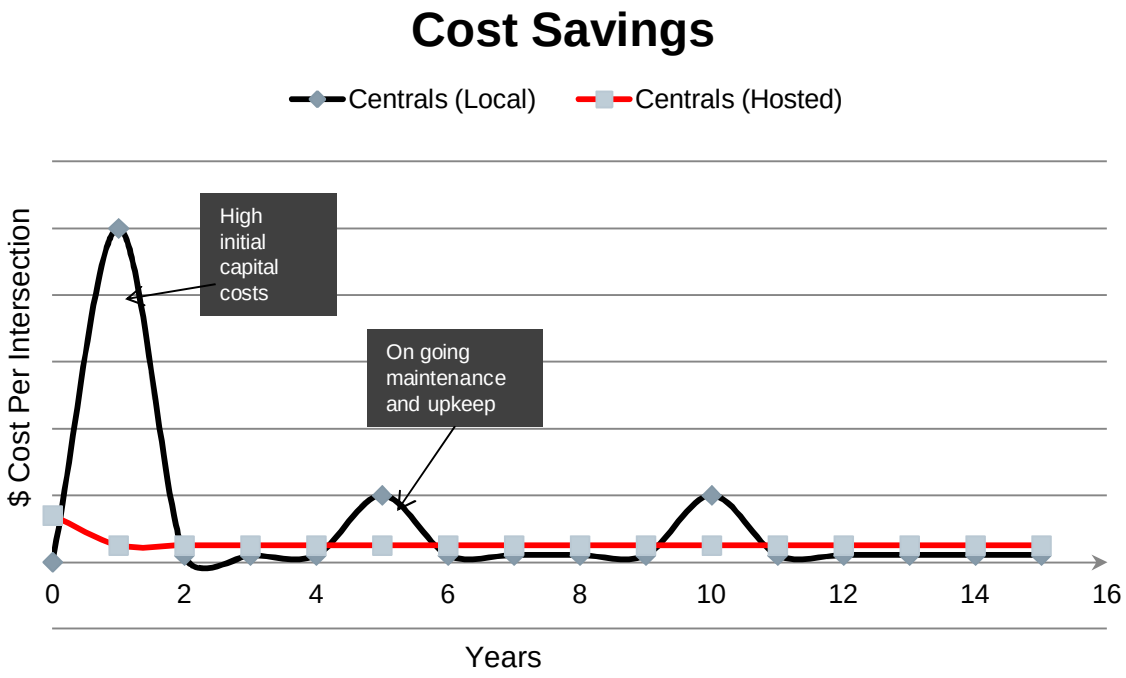
Why Cloud based Systems

-An agency obtains the same or improved performance and user experience when the hardware and software resources are located in a centralized data center.



- Reduces overall costs
- Eliminates IT needs
- Increases IT security
- Centralizes Upgrades
- Choice of hardware devices
- Anytime, Anywhere Availability

Agenda

- What is Cloud Based Traffic Management
- Why should agencies pay attention
- What are some procurement best-practices
- What are some of the operational challenges
- Case Studies
- Future

Efficiency is the core motivation for Innovation Technology & Human Development

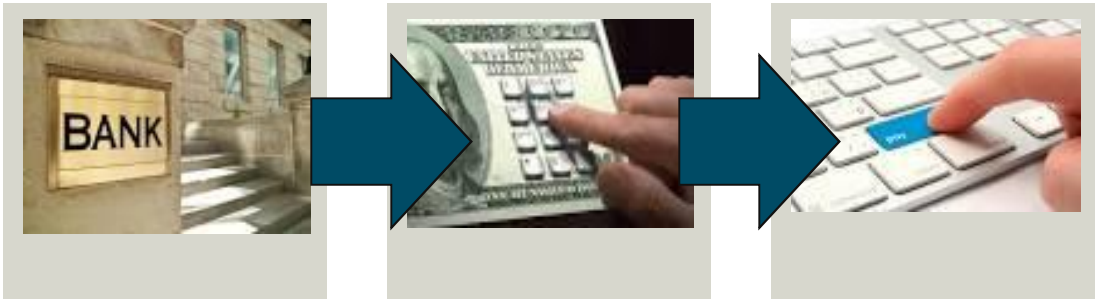
- Mobility
  - Distance per hour

1 20 500

- Computing
  - Instructions Per Second

1 10 Million 53 Million

- Banking
  - $Cost per Transaction



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Efficiency is the core motivation for Innovation Traffic Industry

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Metric

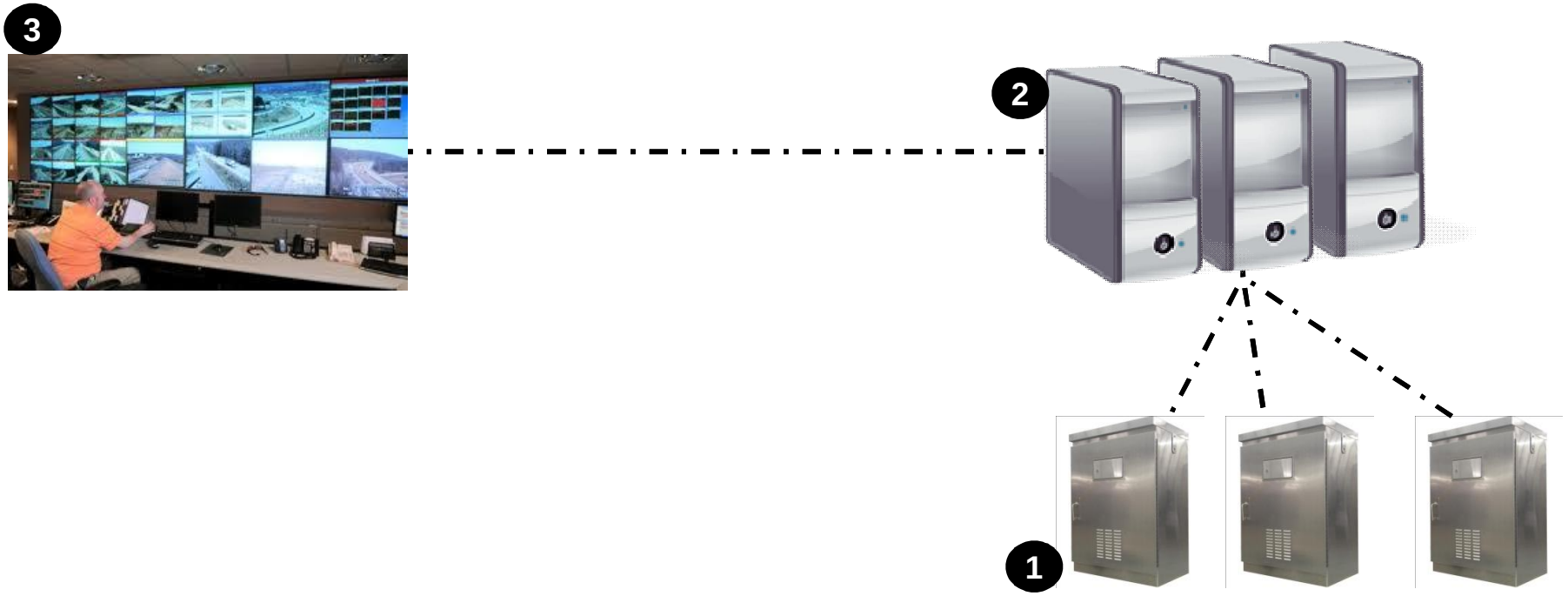
Lifetime Cost per intersection

Closed Loop Systems
- 3 Tiered system
- Low speed com
- Limited functions

ATMS
- 2 Tiered system
- High speed com
- Single App

Cloud
- 1 Tiered system
- High speed com
- Core function/App
- Multiple Apps

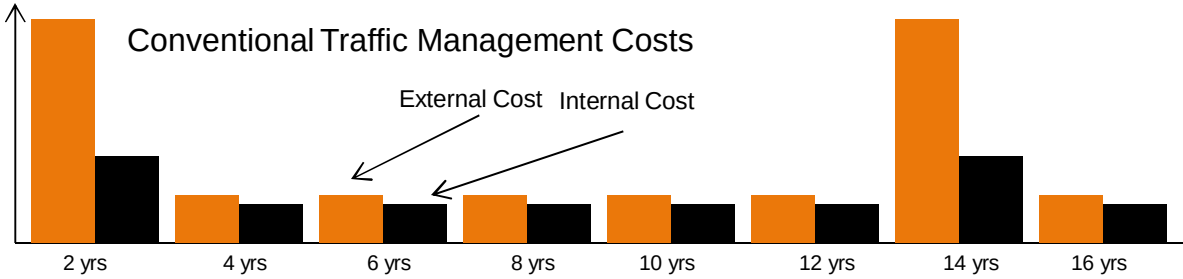
Conventional Traffic Management
Local Hosting



1. **Intersection equipment** is directly connected to the data center using standard communication.
2. **Servers** and IT equipment hosts the traffic management software.
3. **The Traffic Management Center** (TMC) accesses the servers.

Drawbacks of Conventional Traffic Management Systems (ATMS)

- Biggest IT Investment for a typical traffic operations center
  - High procurement costs
  - Only suitable for large agencies



- Requires high levels of IT engagement and competence
  - Adds up initial investments
  - Difficulty for mid to small sized cities and rural agencies

- Most agencies use only a handful of features
  - Increases training costs without return
  - Requires additional software support contracts

- Limited Portability
  - Requires clunky solutions for employees on the move

Cloud Based Traffic Management
Deployment Mode 1 (Full Hosting)

3

2

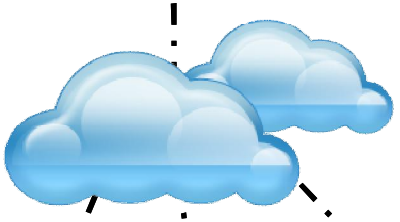
4

Advantages

- No hardware or software at the agency
- No maintenance or IT support required
- Minimal costs

Drawbacks

- Limited functionality
- IP communication infrastructure required



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1. Intersection equipment is directly connected to the data center using specialized secure communication. E.g IP communication or Cell modems
2. Specialized data centers hosts the central traffic management system.
3. The Traffic Management Center (TMC) accesses the agency specific information via secure communications.
4. Alternately, the same information is also available on mobile devices for technicians and engineers in the field.

Cloud Based Traffic Management Deployment Mode 2 (Semi Hosting)

4

3

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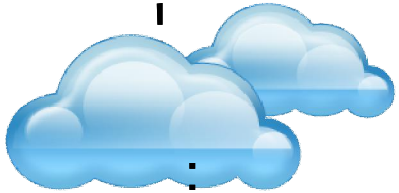

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Advantages

- Wide functionality with web capability
- Multiple TMC modes (fixed and virtual)

Drawbacks

- Increased costs
- IT competency and maintenance

1. Intersection equipment is directly connected to the local server that hosts a conventional traffic management system
2. Specialized data centers pulls the data
3. The Traffic Management Center (TMC) pushes data to specialized data centers via secure communications.
4. Alternately, the same information is also available on mobile devices for technicians and engineers in the field.

Key Differentiation
Cloud Versus Conventional Traffic Management

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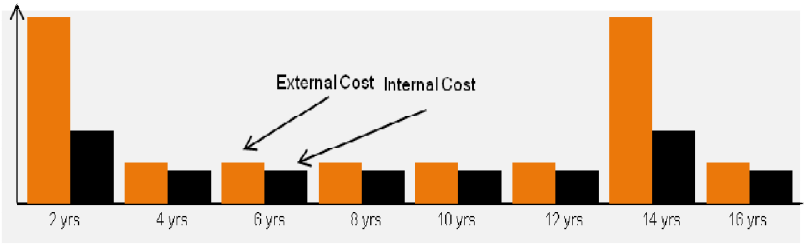
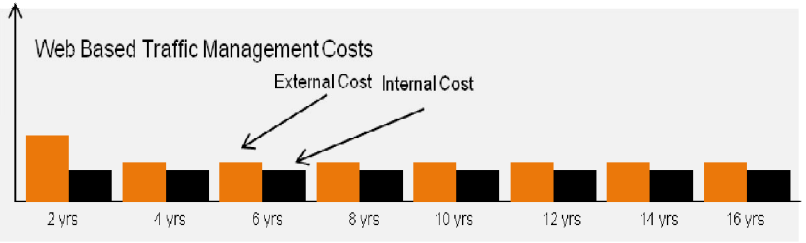
Conventional	Cloud Hosting
•Software installed at the Customer premises	•Software installed at the data center
• Hardware installed at Customer premises	• Shared hardware installed at the data center
• High levels of IT engagement and competence at the Customer	• Minimal or low levels of IT engagement and competence at the Customer
• Wider feature set	• Narrow feature set
• Strong vendor attachment	• Ease of switching vendors

Traffic Management as a Service
Why should agencies pay attention

Flexibility

- Test drive prior to purchase
- Easier to stop service
- Opportunity to tailor to an agency's needs
- Add and subtract devices
- Access to service wherever & whenevr
- Choice of devices
- Buy only what you need when you need it





Cost

- Reduced hardware costs
- Reduced TMaWS license costs
- Reduced IT staffing requirements
- Reduced training costs

Efficiency

- Faster response to complaints
- More time for traffic operations
- Less time on IT maintenance

Cloud Based Traffic Management
Key Components

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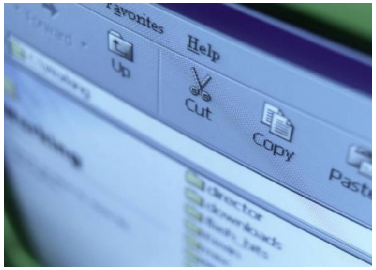
Data Center

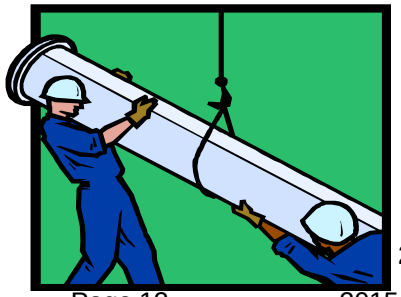
- Data center Tiers
- Data center types
- Privacy & Security
- Process Maturity

Application Software



- Features & Functions
- Ease of Use
- Privacy & Security
- Backwards compatibility

Deployment



- Flexible deployment options
- Flexible funding options
- Training & technical support
- Hardware support

Cloud Based Traffic Management Data Center

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- **Physical structure of data centers (Tiers)**
  - Tier 1
    - 99.671% uptime → 28.2 Hrs downtime per year.
    - No redundancy
  - Tier 2
    - 99.749% uptime → 22 Hrs downtime per year.
    - Partial redundancy
  - Tier 3
    - 99.982% uptime → 1.6 Hrs downtime per year
    - Good redundancy
  - Tier 4
    - 99.995% uptime → 2.4 Min downtime per year
    - Full redundancy

- **Operation model of data centers**
  - Corporate (Private Cloud)
    - Owned and operated by the same company.
    - Data center or web hosting may not be the core business
    - A secure, reliable and redundant data center is critical for their success
    - E.g Wall street firms, large corporations, government entities
  - Collocation (Public Cloud)
    - Data center focused companies renting out hardware and software to other companies
    - Companies pay a fee and remotely manage the servers
    - E.g Small to midsize companies, most web sites

-Important consideration for
-Cloud based traffic management
-Critical infrastructure

Cloud Based Traffic Management Procurement Best-Practices

- 'System' to 'Service'
  - Standard RFP may not suffice
- User device compatibility
  - HTML 5 Vs Apps Vs Hardware
  - Serial versus IP communication
- Carrier Neutrality
  - Ability to communicate with any telecom carrier
- Privacy & Security
  - Authentication Methods
  - Archival process for private information
- Data Center Standards
  - SAS 70, SSAE-16 (Audits)
- Data Center Maturity
  - Experience with handling critical infrastructure
  - Matured processes to manage complaints & outages
  - Physical location and redundancy
- Domain Experience
  - Experience with handling critical infrastructure
- Demo Capability
  - Agency should get an evaluation version
- Terms & Conditions
  - Payment terms
  - Warranty terms

→It's a Service not a System

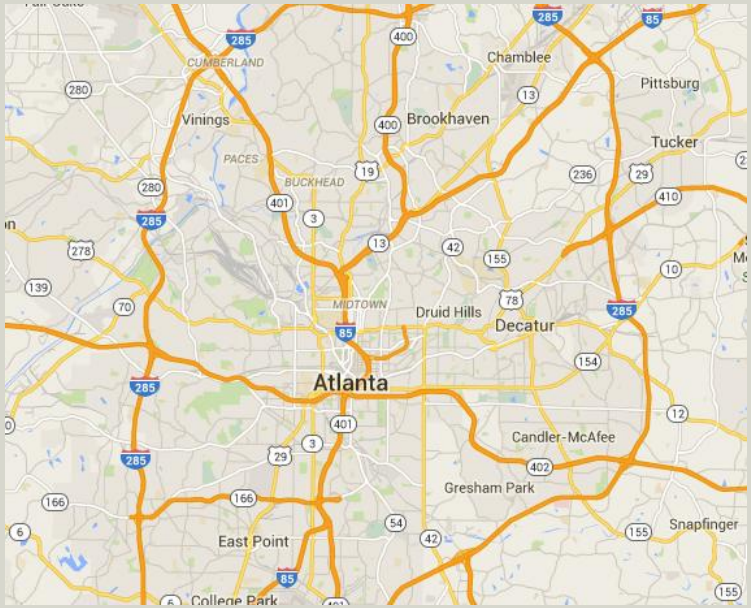
→Identify a Partner not a Vendor

Cloud Based Traffic Management
Operational Challenges

- Privacy & Security
  - New authentication processes
  - New security policies
- Communication & Connectivity
  - High grade IP connectivity is a must
  - Legacy communication hardware
- Operating Modes
  - New paradigms are possible
  - Virtual TMC is now a possibility

Cloud Based Traffic Management
Case Study- GDOT, Georgia

- Hosting Type
  - Full Hosting
- Number of Connected Intersections
  - 10
- System Name
  - TACTICS smartGuard
- Install Date
  - October 2014



Cloud Based Traffic Management
Case Study- Athens, Greece

- Hosting Type
  - Fully Hosted
- Population
  - 800,000
- Number of Connected Intersections
  - 132
- System Name
  - SITraffic smartGuard
- Install Date
  - January 2014

What we learned

- Cloud based traffic management was more interesting for rural agencies
  - Easy to monitor remote problem intersections
  - No need for specialized IT competency
  - Fits the budget
  - Communication infrastructure is not the bottleneck

Cloud Based Traffic Management
The Future

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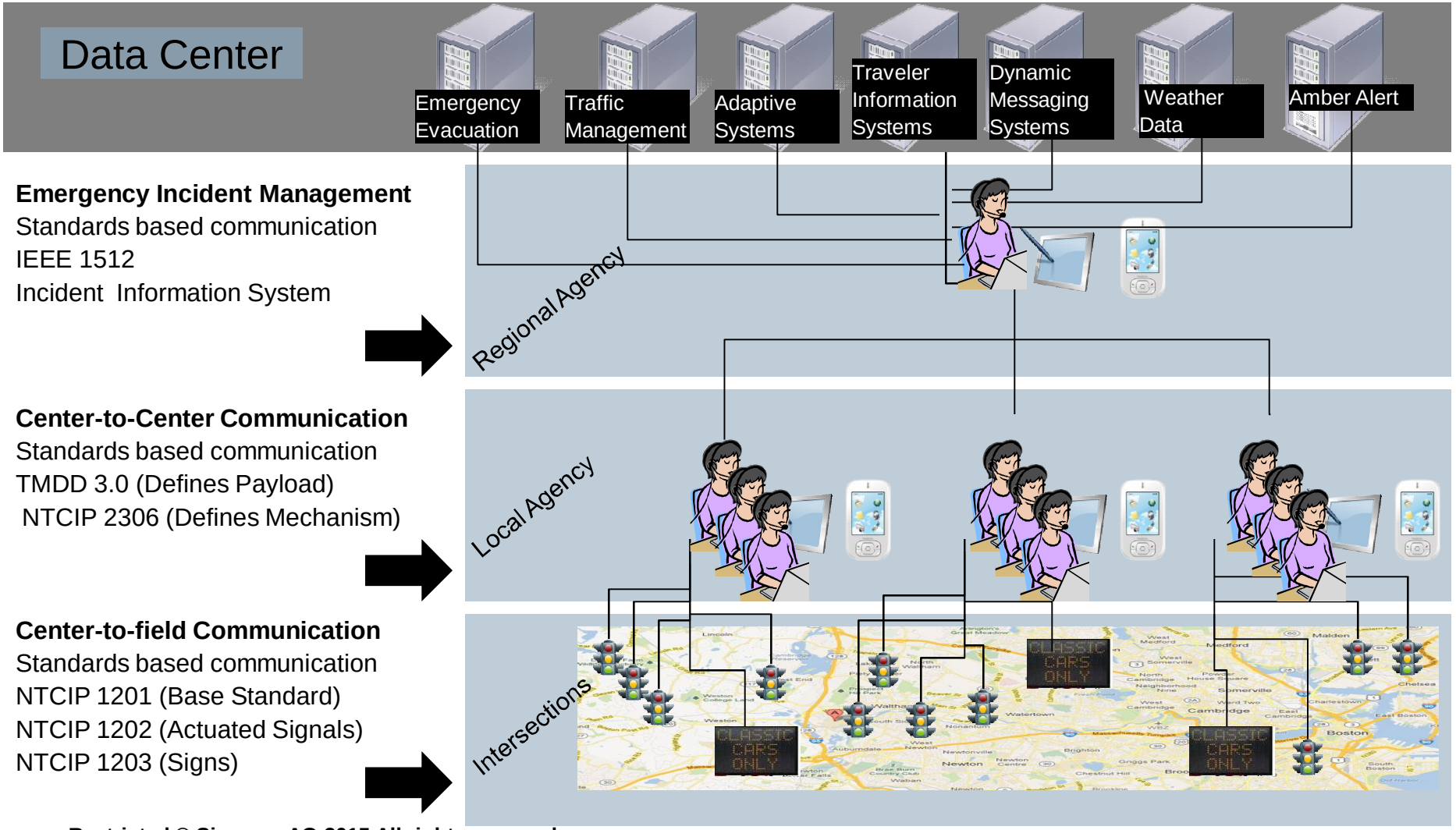

Emergency Incident Management
Standards based communication
IEEE 1512
Incident Information System

Center-to-Center Communication
Standards based communication
TMDD 3.0 (Defines Payload)
NTCIP 2306 (Defines Mechanism)

Center-to-field Communication
Standards based communication
NTCIP 1201 (Base Standard)
NTCIP 1202 (Actuated Signals)
NTCIP 1203 (Signs)

Cloud based Traffic Management Limitations

- Situations where a cloud based solution may not be suitable
  - Agencies with large serial communications infrastructure
  - Agencies with customized functionality
  - Agencies with Center-Centre (C2C) functionality