TRB Webinar: Cloud Computing for Next Generation Traffic Management Systems

October 25, 2023

3:00 – 4:30 PM

NOVEMBER 2022 UPDATE

PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at TRBwebinar@nas.edu

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ENGINEERING

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REGISTERED CONTINUING EDUCATION PROGRAM

AICP Credit Information

1.5 American Institute of Certified Planners Certification Maintenance Credits

You must attend the entire webinar

Log into the American Planning Association website to claim your credits

Contact AICP, not TRB, with questions

Purpose Statement

This webinar will share procurement, migration strategy, security, and new analytics and services related to cloud computing.
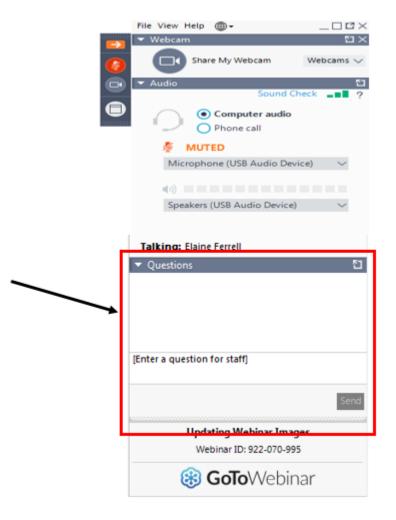
Learning Objectives

At the end of this webinar, you will be able to:

(1) Identify challenges, opportunities, and drivers to transition components of their traffic management system(s) to cloud services

(2) Identify different commercial cloud service providers and practitioners' experiences with each

(3) Understand new capabilities and analytics that are possible through cloud services

Questions and Answers

- Please type your questions into your webinar control panel

- We will read your questions out loud, and answer as many as time allows

Today's presenters

Vaishali Shah
vaishali.shah@aemcorp.com

Bob Fifer
Bob.Fifer@state.co.us

Athena Hutchins
ahutchins@nittec.org

Ed Fok
edward.fok@dot.gov

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Examples of Transportation Uses

- Transportation data archive and sharing
- Occasional computation intense task
- Reduce on-premise technologies
- Functions needing multiple remote or mobile access

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Common Cloud Functions

- Data Storage
- Virtualize a computer
  - Computer performance are scalable to meet operational demands
  - Hardware are insulated from lifecycle and maintenance issues
- Virtual machine run on a full virtualization environment
  - Virtual machine has its own guest operating system
  - Program and applications operates normally

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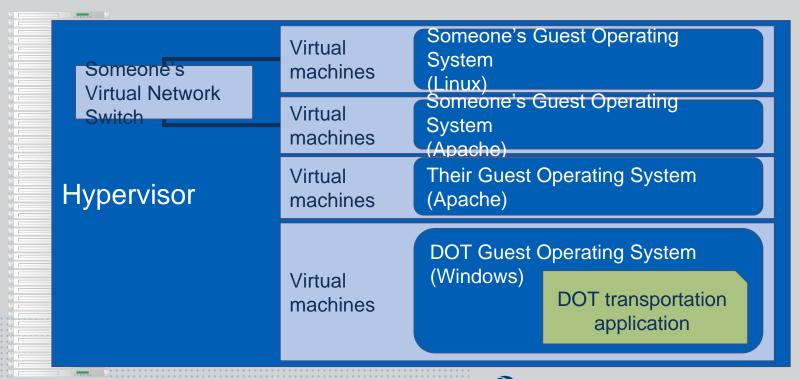
There's no free lunch...

- Day to Day
  - Rely on dependable connection to cloud services
  - Treat user security just like an on-premise device
  - Necessary software patches and malware defense
- When disasters strikes – how bad can it get?

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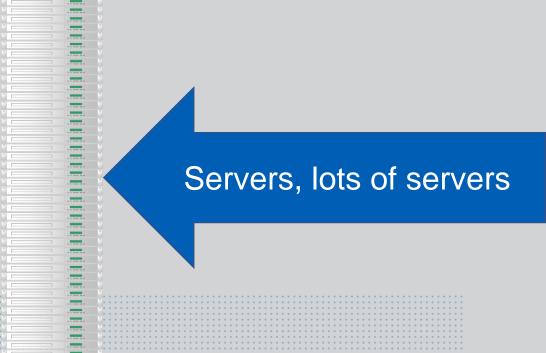Office of Innovation Implementation

Separation Anxieties (from the cloud)...

- Losing cloud connection at one or more points
  - Can we maintain control to field devices?
  - Can we still operate with our partners?
  - Can we still operate using cloud enhancements?
- Lost of physical facilities
  - How do we regain access to cloud-based enhancement and functions?
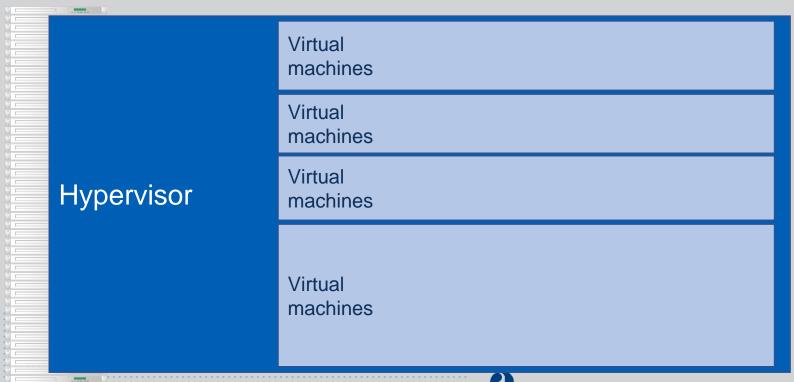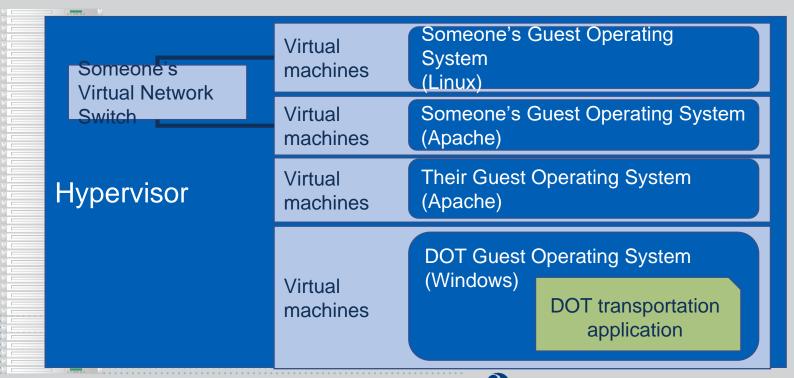- Plan for lost of connection – have a playbook ready

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How does the Cloud work?

Someone's Virtual Network Switch

Hypervisor

Virtual machines — Someone's Guest Operating System (Linux)

Virtual machines — Someone's Guest Operating System (Apache)

Virtual machines — Their Guest Operating System (Apache)

Virtual machines — DOT Guest Operating System (Windows)

DOT transportation application

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How does the Cloud work?

Servers, lots of servers

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How does the Cloud work?

Hypervisor

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How does the Cloud work?

Hypervisor

Virtual machines

Virtual machines

Virtual machines

Virtual machines

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How does the Cloud work?

Someone's Virtual Network Switch

Hypervisor

Virtual machines	Someone's Guest Operating System (Linux)	
Virtual machines	Someone's Guest Operating System (Apache)	
Virtual machines	Their Guest Operating System (Apache)	
Virtual machines	DOT Guest Operating System (Windows)	DOT transportation application

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Security Risks

- Virtual Machines share many of the same vulnerabilities
  - Software/Guest Operating System patch management and configuration
  - Our beautiful users and how their authentication and access controls are managed (or not…)
- Cloud Specific Risks (New)
  - Virtual Machine Escape
  - Virtual Network Switch Exploits
  - Hypervisor Protections

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Cloud Specific Risks

- Virtual Machine Escape
  - Unauthorized access to the hypervisor from within a virtual machine
- Virtual Network Switch Exploits
  - Unauthorized communication with the Hypervisor or other unauthorized virtual machine
- Hypervisor Vulnerabilities
  - Breach of Process Isolation
  - Breach of Network Isolation
  - Denial of Service

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Mitigating Cloud Risks

- Cloud Service Provider – know them well
  - What are their operation and maintenance process?
    - Patch management
    - Vulnerability mitigations
  - What are their security plans?

- Protect your own piece of the cloud like the machine you're watching this on

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Resources and References

- National Institute of Standards and Technology (NIST)
  - SP800-125 Guide to Security for Full Virtualization Technologies
  - SP800-125A Security Recommendations for Server-based Hypervisor Platforms
  - SP800-125B Secure Virtual Network Configuration for Virtual Machine (VM) Protection
  - SP800-145 The NIST Definition of Cloud Computing
  - National Vulnerability Database nvd.nist.gov

- Your Cloud Providers Contract and Service Agreements

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Questions?

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NITTEC COALITION

- Established in 1995 with a Federal Mobility Grant
- Regional Collaboration and Leadership
  - Technology Deployment
  - Operations
  - Incident Management
  - Traveler & Traffic Information
- Multi-Agency Transportation Operations Coalition
  - 5 Policy Members, 9 General Members, 28 Affiliate Members
    - Transportation Agencies
    - Public Safety and Border Enforcement
    - Emergency Services and Recovery
  - Only Bi-national Coalition of its kind in U.S. / Canada

Policy Members

General Members

Affiliate Members

REGIONAL OPERATIONS FUNCTIONS
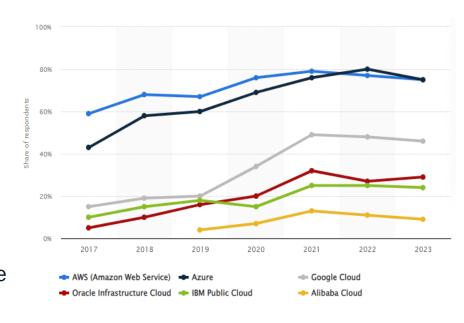
➤ Multi-agency Collaboration
   ➤ Centralized 24/7 operations and traffic management services for bi-national region
   ➤ Information Clearinghouse
   ➤ Standardized Operations
   ➤ Multi-Agency Event Planning and Operations
   ➤ Multi-Agency ITS Deployment
   ➤ Regional Messaging Standards
   ➤ Traffic Management Plans
➤ Traveler Information
➤ Border Traffic Management
➤ Incident & Emergency Management
➤ Construction Coordination
➤ Traffic and Congestion Management
➤ Weather System Monitoring
➤ Special Event Planning and Management
➤ Performance Measures Reporting

CLOUD GROWTH & ADOPTION

➢ Reports estimate +75% increase in cloud adoption in the last 6 years[1]

➢ Many industries are planning to migrate from legacy enterprise software to cloud-based tools (+33.4%), as well as migrating on-premises workloads to the cloud (+32.8%)[2]

➢ Cloud computing in the transportation management space is also increasing as more IT departments are being engaged in ITS projects

1: Current enterprise public cloud adoption worldwide from 2017 to 2023, by service, Statista,
https://www.statista.com/statistics/511508/worldwide-survey-public-coud-services-running-applications-enterprises/
2: Google Cloud Brand Pulse Survey, Q4 2022. Learn more about how decision-makers are preparing for uncertainty.

CLOUD BENEFITS FOR ITS & TRANSPORTATION

➢ Scalability of data storage to support growing data needs of Transportation Agencies
  ➢ Connected vehicle data
  ➢ Disparate system integrations for Integrated Corridor Management projects
  ➢ Historical traffic data collection & data forecasting requirements

➢ Secure & resilient compute and infrastructure
  ➢ Scalable cloud compute services such as Virtual Machines, databases, application gateways, etc.
  ➢ Geographically separate regions & zones support high uptime and disaster recovery
  ➢ Shared responsibility models for security with many resources available via the cloud provider to secure assets

➢ Software & Infrastructure as a Service
  ➢ Cloud software tools available that provide platform for Artificial Intelligence, Machine Learning, Computer Vision, Generative AI
  ➢ Reduce cost and burden of developing products that leverage these services in support of agency missions & goals

ICM & BORDER CROSSING USE CASES

➢ Integrated Regional Data Hub
  ➢ Leverage cloud services, such as a managed Data Lake, as an integration platform for disparate systems, connected together to provide regional traffic operations
  ➢ Connectors to various data sources such as Customs & Border Patrol, Bridge Authorities, State Police, transit and partner agency ITS systems to ingest raw and processed data
  ➢ Scalable data storage, aggregation, extract-transform-load (ETL) enabling a fused data picture of the region
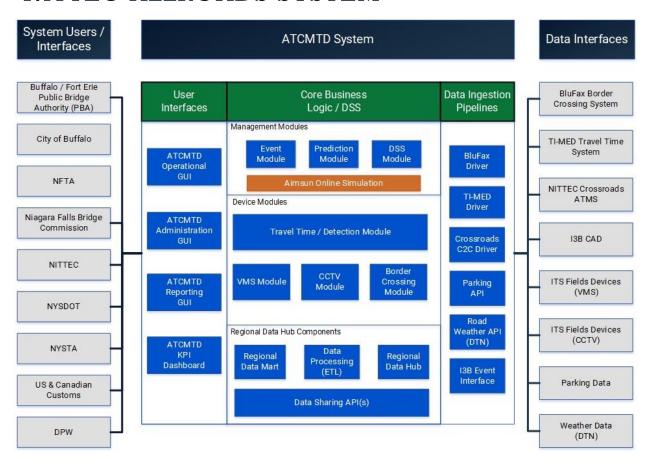
➢ Data Sharing via Data Mart
  ➢ Processed data shared via Application Programming Interfaces (APIs) running on native cloud services
  ➢ Reduces burden on agency ISPs as external consumers utilize cloud endpoints for data consumption
  ➢ Control over data access via API keys (and other mechanisms) to track who can access the data
  ➢ Provides a data platform for new innovations using the regional data sets

➢ ATCMTD Algorithms & AI
  ➢ Utilize traffic models & simulation on the fused data to run real-time simulations, generating traffic predictions and response plan evaluation for the region
  ➢ Combining traffic demand predictions with historical border crossing data enables advanced actions to be taken before border delays cause upstream problems for surrounding jurisdictions
  ➢ Predictive weather, traffic and road condition data enables better planning for winter weather operations
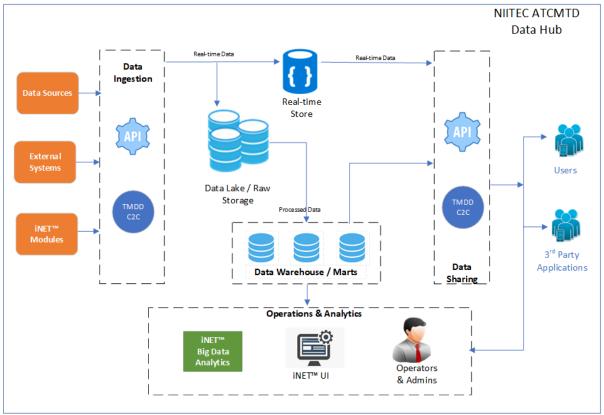
NITTEC ALLROADS SYSTEM

Cloud-based ATCMTD that Manages Key Operational Areas:
- Border Crossing
- Truck Traveler Information
- Regional Smart Mobility
- Incident Management
- Winter Operations
- Transit Operations
- Traveler Information

ALLROADS REGIONAL DATA HUB

Cloud services power ingestion, storage, processing and sharing of data

EMERGING CLOUD-BASED TECHNOLOGIES

➢ Advancements in generative AI, such as OpenAI/ChatGPT, unlocks new avenues for innovation in the transportation space

➢ Asking questions to your system about your data, using natural language, will result in insights and actionable responses

    ➢ Example: "Show me the days last year where border crossing delays were more than 20% out of normal bounds"

        "Overlay travel volumes of the main feeder routes to the border crossings"

        "Enact bridge authority notification plan when volumes reach 75% of the volumes above"

➢ Computer Vision / AI will give accurate information on queuing, truck staging area capacity, parking availability, winter road conditions, and many others

➢ AI-based cluster analysis will give insights into infrastructure and asset health, allowing prioritized maintenance of critical ITS devices

➢ Cloud providers are investing in these technologies and as agencies we should look to adopt these capabilities to improve our overall operations

FOR MORE INFORMATION:

ATHENA M. HUTCHINS, P.E., F.ASCE

NITTEC EXECUTIVE DIRECTOR

AHUTCHINS@NITTEC.ORG

Today's presenters

Vaishali Shah
vaishali.shah@aemcorp.com

Bob Fifer
Bob.Fifer@state.co.us

Athena Hutchins
ahutchins@nittec.org

Ed Fok
edward.fok@dot.gov

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