FEBRUARY 5 - 6 • LOS ANGELES, CA

SMART PORTS
(INFORMATION TECHNOLOGY)
The port of tomorrow is part of a digital community
Connected Transportation Sectors

- Connected Maritime
- Connected Roadways
- Connected Vehicle
- Connected Freight and Logistics
- Connected Aviation
- Connected Mass Transit
- Connected Rail
<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex Integration</td>
<td>56%</td>
<td>Prefer fully integrated and validated solution over separate best-of-breed vendors</td>
</tr>
<tr>
<td>Need to Automate Extraction of Insights and Resulting Actions</td>
<td>42%</td>
<td>Pick analytics tools as most important enabler</td>
</tr>
<tr>
<td>Data Overload</td>
<td>40%</td>
<td>Cite data management as #1 capability they need to improve</td>
</tr>
<tr>
<td>Expanded Security Vulnerability</td>
<td>76%</td>
<td>Cite security is an important element of IoT implementation</td>
</tr>
<tr>
<td>Siloed Networks</td>
<td>25%</td>
<td>Have experienced increased network strain when implementing IoT initiatives</td>
</tr>
</tbody>
</table>
Port of Rotterdam

https://youtu.be/PECbWmx3x0U
The industry is changing
Bigger problems, need larger solutions
Container Terminal / Intermodal Operations

- Telemetry/Safety IO
- Cameras on RTGs and Straddle Carriers for remote operations
- AGV Vehicle Connectivity for full automation
- Reduce Costs by Removing Fiber Spools on Cranes
- Facilitate moving cranes between blocks
- Backbone network for WiFi APs for mobile workforce/handheld devices
Port of Hamburg

- One of the largest ports in Europe
  Over 140 million tons total turnover per year
- Biggest railway port in Europe
  200 freight trains with 5000 wagons per day
- 1900 employees
- 10,000 ships per year
- Connected to 900 harbors in 174 countries around the globe
- Strong growth in cruise ship tourism
Port of Hamburg – Legacy Issues

- 4 isolated control centers for
  - River
  - Railways
  - Roads
  - movable infrastructure

- About 300 traffic sensors

- 270 km of fiber optics

- First Hot Spots (WiFi)
Hidden cost of siloed services
Port of Hamburg – Deployed Port Traffic Center
Port of Hamburg – Example Sensors
Port of Hamburg – Sensor Integration

**Structural: strain gauges**
Measuring the strain and stress on structural steel members.

**Structural: tiltmeters**
Settlements and relative displacements, tilt of piers and abutments.

**Environment: air quality**
Pollution level: NO, NO2, SO2, CO and PM10.

**Environment: weather**
Rainfall, relative humidity, air temperature, wind speed/direction.
Transportation: The Top Priority for Cities

Need for investment over the next 5-10 years by infrastructure area

<table>
<thead>
<tr>
<th>Infrastructure Area</th>
<th>Needing Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Services</td>
<td>64</td>
</tr>
<tr>
<td>Energy</td>
<td>67</td>
</tr>
<tr>
<td>Public Housing</td>
<td>69</td>
</tr>
<tr>
<td>Water</td>
<td>70</td>
</tr>
<tr>
<td>Waste Mgt</td>
<td>71</td>
</tr>
<tr>
<td>Public Safety</td>
<td>71</td>
</tr>
<tr>
<td>Health Care</td>
<td>74</td>
</tr>
<tr>
<td>Education</td>
<td>77</td>
</tr>
<tr>
<td>Environment</td>
<td>77</td>
</tr>
<tr>
<td>Transportation</td>
<td>84</td>
</tr>
</tbody>
</table>

Infrastructure area most important in attracting economic investment

Survey of public & private sector stakeholders across world’s top 25 cities
Connected Transportation Examples
# Fog Computing Example

## Dynamic message sign automation

Real-time information on weather, traffic accidents, lane closures, work zones, and more via digital signage

<table>
<thead>
<tr>
<th>Industry drivers</th>
<th>Business needs</th>
<th>Capabilities</th>
<th>Business outcomes</th>
<th>Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Smart transportation and connected communities increasingly requiring dissemination of real-time information</td>
<td>• Legacy device integration—make use of existing signage to better communicate with travelers</td>
<td>• Automate vehicle-as-sensor information, and provide notifications for all travelers</td>
<td>• Fatality and crash reduction</td>
<td>• Traffic operators at DOT, City, and County</td>
</tr>
<tr>
<td>• Dynamic message signs can share data from vehicles, sensors, and legacy devices to make roadways safer and more efficient for all travelers</td>
<td>• Connected vehicle applications—utilize dynamic messages signs to share data from vehicles-as-sensors e.g. DSRC</td>
<td>• Collect and disseminate real-time data streams including information on weather, queues, incidents, lane closures, and work zones</td>
<td>• Prevention of secondary crashes</td>
<td>• Chief Engineer, District Engineer, Chief of Operations/Intelligent Transportation Systems</td>
</tr>
<tr>
<td>• Automation enables more efficient traffic operations and operator safety</td>
<td></td>
<td>• Notify drivers, pedestrians, and operators in real-time</td>
<td>• Improved emergency response</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Improved operations and system efficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• A digital foundation ready for connected and automated vehicles</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Improved traveler communications</td>
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Automated and connected vehicle notifications

Data collection that increases the safety of drivers and pedestrians in real time

Industry drivers
- Smart transportation and connected communities incorporating vehicle-as-a-sensor e.g. DSRC technologies
- AASHTO SPaT Challenge for DSRC in all states by 2020
- Toyota and GM deploying DSRC on new vehicles
- Planning for automated vehicles

Business needs
- Data collection for real-time and predictive analytics
- Improve roadways and traffic signals today for future connected and automated vehicle applications
- Provide data to connected vehicle applications

Capabilities
- Collect and evaluate vehicle data in real-time
- Relay connected vehicle to infrastructure data for vehicles in real-time
- Visualize data on mapping applications and in existing traffic management centers
- Identify emergency needs in real time

Business outcomes
- Improve traveler notifications and reduce crashes
- Identify emergencies and respond to vehicles in real time
- Improve access and mobility
- Lower total costs for data collection, analysis, and predictive applications
- A digital foundation ready for connected and automated vehicles

Stakeholders
- Traffic operators at DOT, City, and County; potentially emergency responders and police departments
- Chief Engineer, District Engineers, Chief of Operations/Intelligent Transportation Systems
Fog Computing Example

Automation of roadway infrastructure

Integrated and normalized data across multiple sensors that delivers real-time traveler information

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<td>• Trends of connected and automated vehicles, changing mobility needs, and need for better traveler information</td>
<td>• Need to identify and report road weather changes in real-time</td>
<td>• Notify drivers, pedestrians, and operators of changing weather conditions in real-time</td>
<td>• Maximize system efficiency, safety, and throughput</td>
<td>• Traffic operators at DOT, City, and County</td>
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<td>• Traffic fatalities on the rise since 2014</td>
<td>• Ability to utilize existing sensor technology to enhance traffic operations</td>
<td>• “Single click” for operator intervention</td>
<td>• A digital foundation ready for connected and automated vehicles</td>
<td>• Chief Engineer, District Engineers, Chief of Operations/Intelligent Transportation Systems</td>
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<td>• Legacy ITS systems, roadways, and operations centers</td>
<td>• Advanced data collection and analysis</td>
<td>• Automate responses and system changes based on real-time conditions</td>
<td>• Improved incident response</td>
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<td>• Planning for future automation and legacy sensor integration</td>
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Fog Computing Example

Dynamic monitoring, metering and pricing

An efficient and effective means to maximizing traffic throughput and reducing roadway accidents

Industry drivers
- System efficiency and air quality standards
- System operations as a priority
- Need for traffic calming and queue smoothing

Business needs
- Need to manage recurring and non-recurring congestion based on real-time and predictive information
- Ability to change system operations including lane control, lane reversals, and speed limits

Capabilities
- Control the rate at which vehicles enter the freeway
- Monitor arterial traffic conditions and queueing
- Dynamically allocate lane access, lane merge control, and reversible lanes
- Enable hard shoulder running
- Support queue warning
- Enable active traffic management and dynamic speed limits

Business outcomes
- Maximize system efficiency and throughput
- Improved safety
- Queue reduction

Stakeholders
- Traffic operators at DOT, City, and County
- Chief Engineer, District Engineers, Chief of Operations/Intelligent Transportation Systems
Cisco’s Integrated Port Architecture

Centralized Dashboard and Vertical Applications

Centralized Platform and Business Intelligence

Secure Digital Network Architecture for Port

Sensor technologies supported: Wired, Wi-Fi, LoRa, Cellular...

Various Port Sensors and Devices

Container Tracking
Vessel Tracking
Crane Operations
Water Level Sensors
Logistics
Environment Sensors
Modular Architecture
Cisco Connected Communities Infrastructure

A Cisco Intent-Based Network for Smart Cities and Connected Roadways

Cisco® Connected Communities Infrastructure
Cisco intent-based networking and Software-Defined Access

- Lighting
- Safety and security
- Roadways and urban mobility
- Waste
- Parking
- Environment and water

Cisco and partner applications
Cisco Kinetic™ for Cities

Catalyst IE3300, IE3400, IE4000 and IE5000 series
IW 3702, Aironet 1500 series
IR1101, 829, 809 ISR Rugged
Wireless Gateway for LoRaWAN
1240 CGR Router
Third Party V2X

Outdoor Wi-Fi
Cellular
LoRaWAN
Mesh

Ethernet and fiber
Industrial
Rugged
Wireless
Network
Infrastructure

Edge compute
IC3000
Virtual Networks and Segmentation

with Cisco Software-Defined Access
Virtual Networks and Segmentation

with Cisco Software-Defined Access
Cisco Software-Defined Access benefits
Networking at the speed of software

- **Identity-based policy and segmentation**: Security policy definition decoupled from VLAN and IP address
- **Automated network fabric**: Single fabric for wired and wireless with workflow-based automation
- **Insights and telemetry**: Analytics and insights into user and application behavior

**Benefits**
- 67% Savings in network provisioning time
- 80% Less time to issue resolution
- 48% Reduction in impact of security breach
- 61% Lower operating expenses

*Source: Internal TCO analysis with large enterprise customer (actual results may vary)*
Connected Communities Infrastructure

**Connected Communities Applications**
- Support for Cisco and partner applications
  - Cisco Kinetic for Cities
  - Smart City and Connected Roadways use cases
  - Compatible with Cisco Services offers

**Cisco intent-based networking**
- Simplified deployment and management
- Secure, segmented network for each service or department as needed

**Modular Access Network**
- Connect a broad range of systems and devices
  - Wired, Wi-Fi, wireless IoT and V2X
  - Edge compute capabilities
  - Ruggedized outdoor network devices
  - Modular architecture – deploy only what’s needed
Cisco’s Approach for Data Integration

- Cisco Kinetic for Cities
  - Application Layer
  - Infrastructure Layer
  - Cisco Connected Communities Infrastructure
Cisco’s Approach for Data Integration

**Data From Any Device**
- Connect with any technology
- Aggregate and normalize data across multiple sensors
- Provide a digital model for the city

**Cross-Domain Information**
- Enable cross-domain contextual control (i.e., With outdoor lighting & crime)
- Process automation through policies

**Open Ecosystem**
- Expose APIs for local and global ISVs applications
- Secure key management and Role-Based Access Control

Cisco Kinetic for Cities
Cisco Connected Communities Infrastructure for Cities
Cisco’s Approach for Data Integration
Example Kinetic Front End