Smart Cities and Smart Infrastructures: What They Mean to Connected Vehicles

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VISION, EXPERIENCE, ANSWERS FOR INDUSTRY

About ARC Advisory Group
Who are we?  What do we do?  Who are our Clients?

- Industry Analyst Firm Focused on Industrial Automation and Operational Technology
- Established in 1986
- Global Presence: US, Germany, France, Japan, China, Korea, India, Brazil, Argentina, Singapore
- Advisory Services for Users & Suppliers
- Global Events and Publications
- Market and Industry Research
  - Automation Products
  - Manufacturing IT
  - ALM, PLM, SCM
  - Industrial Cybersecurity
  - Industrial Internet of Things (IIoT)
  - Big Data & Analytics
  - Industry, Infrastructure, Smart Cities

Partial List of Energy and Manufacturing Clients

Partial List of ARC's Enterprise Software and Services Clients

Partial List of Automation Companies
ARC Coverage of the Automotive Industry

Design (PLM, embedded systems)

Smart Cities (Transportation)

Manufacturing (CNCs, Automation, MES, ERP, ALM)

Logistics (Supply Chain, WMS)

Assembly (Robotics, Automation, MES, ERP, ALM)
Agenda

- About ARC Advisory Group
- ICS and Auto Cybersecurity – Similarities and Differences
- Emerging Challenges in Protecting Control Systems
  - Changes in Control Technology
  - Expanding Connectivity with External Systems and People
  - Industrial Internet of Things (IIoT)
- Smart Cities Exemplify the Challenges of IIoT
  - Novel Applications Undermine Use of Conventional Cybersecurity Strategies
  - Expanding Responsibilities Demand New Perspectives
- Questions & Feedback
Vehicle and Plant Control Systems
Similar Goals but Different Challenges and Technologies

Vehicle Control System

Manufacturing Control System
Industrial Control System Cybersecurity
ARC Cybersecurity Model Aligns Cybersecurity Investments With Risks

Cybersecurity Management Solutions

- ICS Supplier or Cyber Service Provider
- Part-time Plant ICS Staff
- Full-time Plant ICS Staff
- Full-time ICS Cyber Operations Group

Level of Protection

- Physical Security, Security Practices, Access Control, Asset Inventory, Device Hardening, Vulnerability Mgmt
- DMZ’s, Firewalls, Unidirectional Gateways, Anti-Malware
- App Whitelisting, Zone Firewalls, Device Firewalls
- SIEM, Anomaly & Breach Detection
- Threat Intelligence, Incident Mgmt

Program Maturity

- Secure
- Block
- Contain
- Monitor
- Manage
Vehicle Cybersecurity
From SANS webcast – Securing Connected Vehicles: What You Need to Know

Secure Internal & External Communications
1. Block access to vehicle networks (Firewall)
2. Authenticate and/or encrypt comm.
3. Remote updates and analytics
   1. Record and maintain history
   2. Cloud-based services
   3. OTA security updates

Secure Block & Contain

Secure – by Design Devices

Secure – Design Devices

Information Sharing
1. Auto-ISAC and information monitoring
2. Incident response
3. Monitoring throughout product lifecycle

Development Process
1. Secure analysis and testing
2. Threat analysis & penetration testing
3. Industry standards (e.g. SAE J2061)

Monitor Vehicle Network and ECUs
1. Monitor and protect ECU computing platforms
2. Anomaly detection and event monitoring in-vehicle network
3. Plausibility checks of content
Industrial Control System Cybersecurity
The Current State of Industrial Cybersecurity

Cybersecurity Management Solutions

Level of Protection

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ICS Supplier or Cyber Service Provider

Part-time Plant ICS Staff

Full-time Plant ICS Staff

Full-time ICS Cyber Operations Group

Actual Resources

Actual Technology

Ideal

Resource Gap

Technology Gap
Changes Affecting All Control Systems

Every Change Has Cybersecurity Implications

Increased Connectivity & Cloud

Technology Changes

IIoT

Cyber Security
IIoT Will be the Most Significant Disrupter
Unconstrained Deployments Require Different Security Strategies

♦ IIoT/Industrie 4.0 is a vision for the future of Industrial Control
  ♦ IIoT includes an open “environment” for connectivity and a multitude of Industrial “Things” that freely inter-communicate
  ♦ Things include everything from simple sensors to smart devices with sophisticated embedded control systems (like vehicles)
  ♦ IIoT will include a motley mix of new and legacy Things (new and old vehicles)

♦ IIoT Use Cases
  ♦ **Within Existing Systems** - collect data for analysis, add new functionality
  ♦ **Outside Systems** – manage distributed assets, improve effectiveness (Smart Cities)

♦ IIoT Cybersecurity
  ♦ Users indicate that security is a major concern ... but this is not stopping deployments
  ♦ Organizations need IT and ICS/OT cybersecurity strategies to address all uses of IIoT
IIoT “Within” Control System Boundaries
New Challenges, But Security is Still Under Your Control

**Vehicle Control System**

- IoT Devices and Apps
- Remote/Cloud-based Services
- Secure Connected Gateway
- Gateway (CAN, LIN, Ethernet, etc.)
- Application Server (OTSA, etc.)
- Wireless Communication (Wi-Fi, etc.)
- ECU

**Vehicle Manufacturing Systems**

- 3rd Party Service Providers
- 3rd Party Apps
- Cloud Apps Analytics Pred Maint, Optimization
- IIoT Devices

**Security Concerns**
- Security of IIoT Things
- Security of IIoT software updates
- Isolation of control functions
- Security of IIoT connectivity

**Defensive Actions**
- Ensure Things are Secure-by-Design
- Ensure Updates are Valid
- Constrain Operations/Interactions
- Monitor Systems for Abnormality
Smart Cities Exemplify the Challenges of “Out of Control” IIoT
Smart Cities use IIoT to reduce costs, attract people and stimulate investments.

Security Concerns
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Defensive Actions
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Cybersecurity is a Major Concern for Every Smart City
High Concentration of People Greatly Amplifies Impact

Airport Power Outage

Atlanta Ransomware Attack

Six days after a ransomware cyberattack, Atlanta officials are filling out forms by hand

Atlanta takes down water department website two weeks after cyber attack

Cities Held For Ransom - Lessons From Atlanta's Cyber Extortion
Smart Transportation
Many Initiatives (U.S. DoT Smart City Challenge 2016)

78 Submittals

While the cities were diverse, many of the 78 applicants faced similar urban mobility challenges:

- Providing first-mile and last-mile service for transit users to connect underserved communities to jobs
  - Facilitating the movement of goods into and within a city
    - Trucks stuck in stop-and-go traffic in metropolitan areas cost shippers an estimated $80 billion annually in truck operating costs and wasted fuel.

- Coordinating data collection and analysis across systems and sectors
  - Reducing inefficiency in parking systems and payment
    - An estimated 20% of traffic in urban areas is reduced by smart parking.

- Limiting the impacts of climate change and reducing carbon emissions
  - Optimizing traffic flow on congested freeways and arterial streets
    - Occluded traffic signal timing causes more than 30% of all delay on major roads in urban areas.

- SEATTLE - shared data would provide dynamic routing for truck traffic, promote off-peak and overnight deliveries, and enable car share operators to deliver packages
- DETROIT - partnerships with industry leaders in the automotive and technology fields and academic institutions would help provide access to electric car shares, automated shuttles, and on-demand delivery trucks through integrated mobility apps
- LAS VEGAS - new connected autonomous shuttles would transport workers to Las Vegas Boulevard, and new solar powered electric vehicle charging stations would help reduce emissions
- NEW ORLEANS - dynamically-routed on-demand minibuses would provide affordable first mile, last mile transportation options to underserved communities
- BOSTON - "radically programmable" city streets with dynamic markings that can change from loading zones, to thoroughfares, to spaces for street hockey, depending on the time of day and season
- ATLANTA - a network of multimodal transportation centers serving as hubs for mobility, economic development, and community activity
**Smart Transportation**  
**U.S. DoT Smart City Challenge 2016 – Some of the Winners**

### Denver

**The Challenge**
The health of Denver’s economy is closely connected to efficient freight movements, yet growing populations along key freight corridors are creating congestion and reducing reliability, while the air pollution and noise caused by freight traffic disproportionately impact underserved communities.

**The Goal**
Make freight delivery more reliable and reduce air pollution, noise, and engine noise.

**The Solution**
Establish a connected freight efficiency corridor with comprehensive freight parking and traffic information systems, freight signal prioritization, designated parking and staging areas.

### Freight Delivery
- Increase Reliability
- Reduce Congestion
- Reduce Pollution
- $6 Million

### San Francisco

**The Challenge**
As the search for affordable housing continues to push people commuting into San Francisco farther from the city, the roads into downtown experience ever-growing congestion. The number of regional commuters that use carpooling to improve affordability, increase mobility and reduce congestion on roads and transit.

**The Goal**
Grow the number of regional commuters that use carpooling to improve affordability, increase mobility and reduce congestion on roads and transit.

**The Solution**
- Create connected regional carpool lanes and designate curb space for carpool pick up/drop-off
- Make carpooling easy by developing a smartphone app for instant carpool matching and establish carpool pickup places for riders without smart phones
- Use connected infrastructure to monitor and optimize the performance of carpool lanes

### Carpool Effectiveness
- Regional Carpool Lanes
- Connected Infrastructure to Reduce Congestion
- $11 Million

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**How We Move**
44 cities proposed projects to test the use of automated shared use vehicles to help travelers connect to their destinations.

**How We Move Things**
11 cities envisioned improving urban freight delivery by implementing smarter curb space management through sensors, dynamic reservations, and other technologies to speed loading and unloading.

**How We Adapt**
17 cities proposed using inductive wireless charging to charge electric vehicles, buses, or shuttles.

**How We Move Better**
53 cities proposed implementing Dedicated Short Range Communication (DSRC) to connect vehicles to infrastructure and each other.

**How We Grow Opportunity**
9 cities proposed providing free public WiFi on buses, taxis, and public spaces. The seven smart City Challenge finalists proposed over 62 unique strategies to increase access to jobs, provide training, reach underserved areas, and ensure connectivity for all.

**How We Align Decisions and Dollars**
45 cities proposed implementing a unified traffic or transportation data analytics platform, which would help them make better decisions with their limited resources.
Smart Transportation
U.S. DoT Smart City Challenge 2016 – The #1 Winner

Columbus

The Challenge
Each year in Franklin County, 150 babies die before their first birthday. And, twice as many African-American babies are likely to die as white children. In Columbus, these deaths are concentrated in neighborhoods in which there are lower levels of income, education and health. One neighborhood loses four times as many babies as in the neighborhood next door.

Reduce infant mortality by 40 percent and to cut the health disparity gap in half by 2020.

Columbus will leverage a new central connected traffic signal and integrated transportation data system to develop a suite of applications to deliver enhanced human services to residents and visitors. The City plans to integrate an electronic appointment and scheduling platform for doctor visits with transit tracking so that rescheduling is automated and expecting mothers need not wait weeks to reschedule appointments. These applications include a multi-modal trip planning application, a common payment system for all transportation modes, a smartphone application for assistance to persons with disabilities, and integration of travel options at key locations for visitors. Columbus will establish a smart corridor connecting underserved neighborhoods to jobs and services. The smart corridor will enhance Bus Rapid Transit (BRT) service by installing smart traffic signals, smart street lighting, traveler information and payment kiosks, and free public Wi-Fi along the route. Six electric, accessible, autonomous vehicles will be deployed to expand the reach of the BRT system to additional retail and employment centers.

The Goal

The Solution

An integrated transportation approach to address social issues: Infant mortality in less affluent neighborhoods

$40 Million
### Autonomous Vehicle Risks Expand in Smart City Initiatives

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The driver does everything</td>
<td>Driver</td>
</tr>
<tr>
<td>1</td>
<td>Automation can assist the driver in some aspects of the driving task</td>
<td>Driver</td>
</tr>
<tr>
<td>2</td>
<td>Automation conducts some parts of the driving, driver still monitors the environment and performs the rest of the driving task</td>
<td>Mostly Driver, Some OEM</td>
</tr>
<tr>
<td>3</td>
<td>Automation conducts some parts of the driving and monitors the environment, but driver must be ready to take back control when automation system requests</td>
<td>Shared</td>
</tr>
<tr>
<td>4</td>
<td>Automation system conducts the driving and monitors the driving environment without need for a driver to take control, except for certain environments and conditions</td>
<td>Mostly OEM, Some Driver</td>
</tr>
<tr>
<td>5</td>
<td>Automation system performs all driving tasks, under all conditions that a human driver could perform them.</td>
<td>OEM</td>
</tr>
</tbody>
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**Potential Impacts:**
- Personal Safety
- Public Safety
- Business Disruptions
- Public Health

**Affected Parties:**
- Individuals
- Employers
- Schools
- Retailers
- Health Services
- Public Safety
- Public Services
- Event Managers
- Etc.

OEMs Need to Look Beyond the Vehicle to Control the Increased Risks
Integrated Transportation Has Many Pieces and Stakeholders
Attack Surfaces Expand, Potential Impacts Grow

Many Different Goals:
- Accessible
- Convenient
- Reliable
- Comfortable
- Inexpensive
- Safe

Many Different Technologies:
- WiFi and IIoT Networks
- Mobile Apps
- Cloud Apps
- Smart Traffic Signals
- Vehicle Tracking Systems
- Vehicle Control Systems
- Autonomous Vehicles
- Analytics
- Digital Twins

End-to-End, Integrated IT-OT-IoT Cybersecurity is Essential
Cybersecurity Responsibilities are Broadening for Everyone
The Facebook Effect

The window for Facebook to make amends with the public is quickly closing

Zuckerberg survived two days of grilling by Congress, but Facebook's troubles are not over yet

U.K. lawmakers demand Facebook CEO Mark Zuckerberg appear before committee

Zuckerberg touts plans to protect Facebook users, but Congress appears skeptical
Organizations Need Integrated Cybersecurity Strategies
Siloed Programs Can’t Address All of the Issues

Today

- Control Systems
- IT Systems
- IIoT
- IoT

Tomorrow

- Control Systems
- IT Systems
- IIoT
- IoT

ICS
IT
OT
IoT
IIoT
Environment & Cloud

ICS-IT-IIoT
### A Strategy for an Integrated ICS-IT-IIoT Cybersecurity Strategy

**Changes are Needed in Every Strategy Dimension**

<table>
<thead>
<tr>
<th>Mission</th>
<th>Today’s Industrial Cyber Security Includes</th>
<th>Future Industrial Cyber Security Requires</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Protect Plants &amp; Infrastructure AIC</td>
<td>Protect Plants, Infrastructure, Smart Cities AIC and CIA</td>
</tr>
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</table>

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<table>
<thead>
<tr>
<th>People</th>
<th>Internal ICS Groups ICS Supplier Service Groups</th>
<th>Internal ICS &amp; IT Groups ICS &amp; IIoT Supplier Service Groups Public Networking Services Partners Cloud App &amp; Data Services Partners</th>
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How are you dealing with Your Smart Transportation Challenges?
Thank You.

For more information:
Contact the author at srsnitkin@arcweb.com
Visit our web pages at www.arcweb.com
Attend ARC’s 2019 Forum in Orlando, Feb 12-15