I3: some thoughts towards an Industrial Information-Centric Internet of Things

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I3: Information-Centric Networking for an Industrial Internet

- Starting point: Surveillance of industrial environment
  - Collaboration with MSA
  - Major deployment target: oil platforms and refineries
- Special focus: Distributed Gas sensing
  - Regular reporting about overall situation
  - Alerting in cases of dangerous emissions
- Safety-critical information flows
  - Requirements on reliability
  - Requirements on timing
- Can ICN outperform IP in a full-fledged solution?

About MSA

- Manufacturer of **worker's** and **facilities safety** products
- Main customer segments
  - Oil, gas, chemical industries
  - Fire fighters and first responders
- Core product groups
  - **Gas detection**
  - Personal Protective Equipment (PPE) and Self Contained Breathing Apparatus (SCBAs)
  - Fall protection

Area of application for gas detection products

- Industrial environments
  - Dangerous events may occur
    - Gas exposure
      - Toxic (H2S in refineries)
      - Combustible gases
    - Oxygen depletion
    - Gas leaks and flames
  - Areas are heavily regulated
    - Constrained access
    - Mandatory equipment
    - Mission protocols and logs
- Fire fighters and first responders
  - Unknown environments
  - Time pressure

Opportunities with ICN for IoT

- Mobility
  - Mobile devices are common for the use cases
  - Content counts, not addresses
- Security
  - False alarms may lead to shutdowns
  - Dropped alarms may lead to health risks
- Network management
  - Easy deployment and auto-configuration
  - Reducing total cost of ownership
- Network caches
  - May reduce latency for multiple services
  - Fixed devices provide network caches

Network Scenarios

- Sparse deployment (of fixed devices)
- Inhomogeneous node coverage
- Partitioned networks
- Mobility
- Intermittent connectivity
- Selected uplinks into a cloud environment

Typical IoT Communication Patterns in I3

- Request/response:
  - Access of configurations, system state, management policies, …
- Periodic reporting
  - Data tracking and archiving (possibly in the cloud)
- Event-triggered reporting
  - Alerting in cases of anomaly detections
- Tentative: Multicast and convergecast

Research Challenges

- ICN Routing & Mobility
- Security & Resilience
- Reliability & Caching
- I3 Environment

ICN Routing & Mobility

- Match scenarios and communication patterns
  - Current support for event-triggers insufficient
  - Approach to strengthen the **pub** in pub/sub
- Simplify ICN routing schemes
  - Publish and mobility cannot safely be pushed to routing
  - Explore & evaluate **PANINI** adaptation potentials
- ICN mobility is closely related to **multicast** mobility
  - @Receiver: transfer predictive handover
  - @Sender: bend routing to new source position
  - See RFCs 5757, 6224, 7287, 7411

Security & Resilience

- Authenticate/authorize I3 network members
  - Self-configuration & auto-validation of (thousands of) nodes
- Minimize use of public key crypto in IoT environments
  - Wireless link-layer security?
  - For IP: Plug authentication into DTLS?
- Make routing robust against failures and attacks
  - Protect messaging
  - Self-protection and self-healing of the distribution system

Reliability & Caching

- Design, implement, and evaluate storage layer and in-network caching
  - Data availability at lowest price
  - Storage might turn out the least constraint
  - Consistent replication with off-duty cycles
- Differentiate messaging service
  - Reporting, alerting, management
  - Differentiate w.r.t. time criticality and reliability
  - Code-Points/names <-> priorisation <-> replication

I3 Environment

- Node development: RIOT, networking, radios
  - Field constraints
  - Mobility compliance
  - Future technologies
- ICN network auto-configuration
- Distributed heterogeneous infrastructure
  - Keep ICN generically easy, while efficient
  - Programming models and APIs
- Rethink up-linking to the cloud
  - Identify the ‘right’ abstraction layer

Questions & Discussion?

- http://i3.realmv6.org/
- http://riot-os.org/