Session Agenda

- **IoT Overview**
- **Market Review**
- **Architecture, Technology, Use Case**
- **Use within Public Safety**
- **Security**
- **Q&A**

Defining the Internet of Things (IoT)

*"…the **networking** capability that allows **information** to be sent to and received from **objects** and **devices** (such as fixtures and kitchen appliances) using the Internet."*

(Source: Merriam-Webster)

AGRICULTURE:
Offspring Care, Crop Management, Soil Analysis

HOME:
Smart Temperature Control, Optimized Energy Use

MILITARY:
Situational Awareness, Threat Analysis

MEDICAL:
Optimized Patient Care, Wearable Fitness Devices, Quality Data Reporting

AUTOMOTIVE:
Vehicle Auto-Diagnosis, Optimized Traffic Flow, Smart Parking

INDUSTRIAL:
Machine-to-Machine Communication, Quality Control

RETAIL:
Threat Protection, Inventory Control, Focused Marketing

INTERNET OF THINGS

~26 billion IP-capable devices used world-wide by 2020, ~5 times the number of cellphones

(Source: Gartner)

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IoT Today: The Market

Public Safety IoT in the Press (Example #1)

Company:

NOONLIGHT
FORMERLY SAFETREK

The smart home of tomorrow will call 911 for you

by Heather Kelly @heatherkelly

July 16, 2018: 9:02 AM ET

https://money.cnn.com/2018/07/16/technology/noonlight-911/index.html

- **The Concept: Allowing devices (smart speakers, smart smoke detectors, security cameras, home assistants, etc.) in your home to call 9-1-1 on your behalf**

- **Using Artificial Intelligence (AI) to identify an emergency and trigger a notification**

- **Notification goes to call center and the call center calls PSAP**

Public Safety IoT in the Press (Example #2)

Arlo cameras are getting person detection and e911 services

Of course, these new fancy features aren't free.

Swapna Krishna, @skrishna
06.07.18 in Home
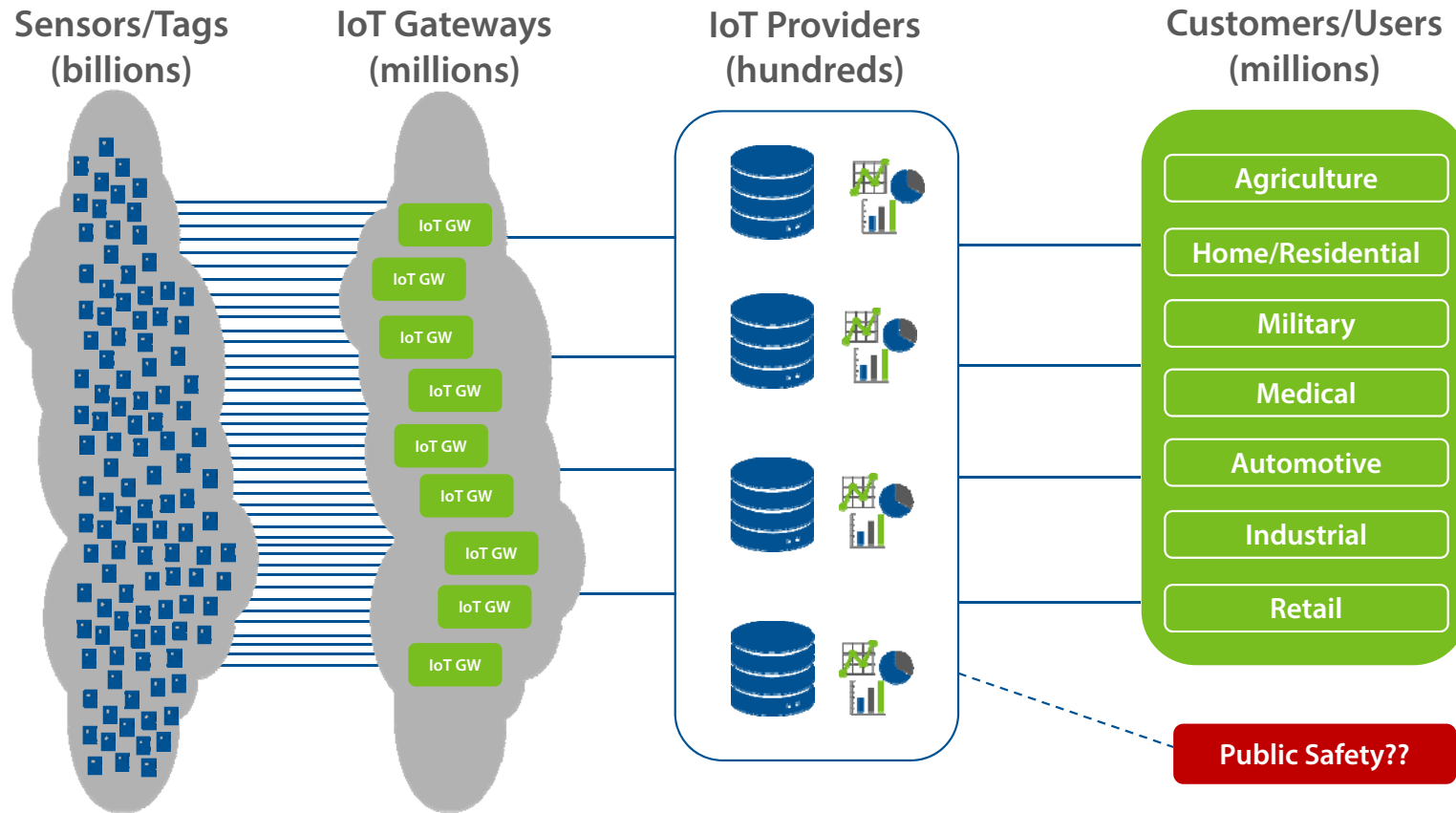
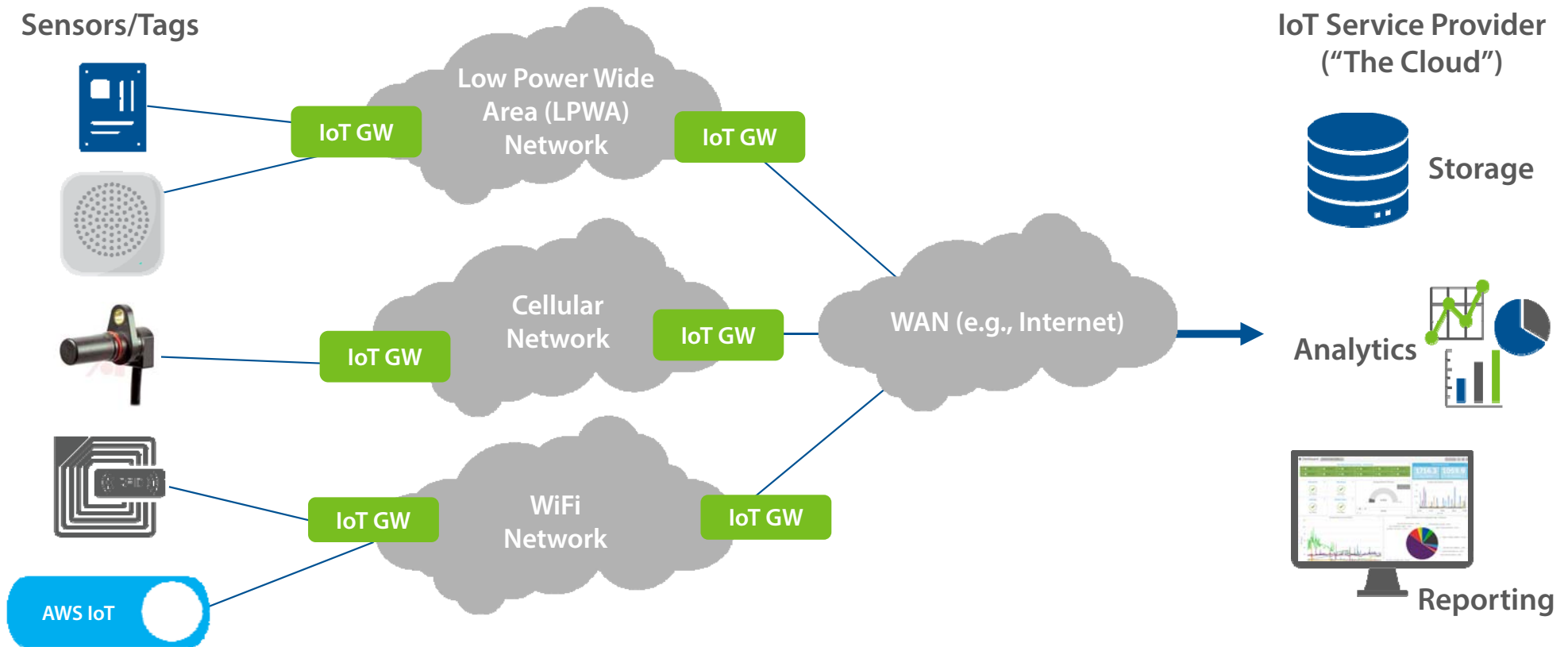2 Comments   142 Shares

Companies:

NETGEAR

Arlo Pro 2

https://www.engadget.com/2018/06/07/arlo-cameras-e911-person-detection-smart-notifications/

- **The Concept:** Allowing home owners to trigger a 9-1-1 call from their homes' location based on what they see through the security cameras within the home.
- If the security cameras identify a person in the home, an alert gets sent to the home owner, who can then view the video from their smartphone.
- The home owner then has the option to call 9-1-1 directly.
- 9-1-1 call routed based on home location, not on home owner's location

The IoT Architectural Ecosystem

High-Level IoT Architecture

Sensors/Tags

IoT Service Provider ("The Cloud")

Low Power Wide Area (LPWA) Network

IoT GW

IoT GW

Storage

Cellular Network

IoT GW

IoT GW

WAN (e.g., Internet)

Analytics

WiFi Network

IoT GW

IoT GW

Reporting

AWS IoT

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Network Transport Options

| Characteristic	Local Area Network (WiFi, BLE, Ethernet)	Cellular Network (2G, 3G, 4G)	Low Power Wide Area (LPWA) Network Sigfox, LoRaWAN	Cellular IoT CAT-M1, NB-IoT
Coverage	Not Ubiquitous – Enterprise, denser morphologies	Ubiquitous – nationwide coverage	Emerging	Emerging
Range	Short	Medium	Long	Long
Data Rates	High, but dependent on environment	High	Low-Medium	Low-Medium
Battery Life	Low	Low	High	High
Standards	Established	Established	Emerging	Emerging
Total Cost of Ownership	Low - Medium	High	Low	Low-Medium
Spectrum	Unlicensed	Licensed	Unlicensed	Licensed
Network Type	Overlay	Existing	Overlay	CAT-M1 – LTE Compatible NB-IoT – Overlay

Different IoT applications demand different technologies.

IoT for Public Safety (IoT-PS)

IP-based networks are enabling IoT-PS for consumers, smart cities, and first responders.

Consumers:
- Consumer products for health monitoring (e.g., FitBit, Nike FuelBand)
- External wearables (e.g., insulin pumps)
- Internally embedded devices (e.g., pacemaker)
- Stationary devices (e.g., home care cardio-monitoring device)
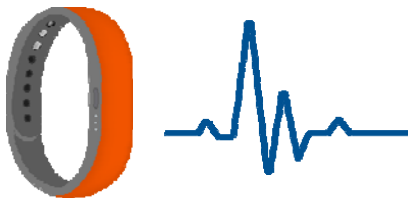
Smart Cities:
- Ecosystem
  - Security
  - Environmental
  - Industrial
  - Automotive
  - Agriculture
  - Residential
- Sensor Types
  - Chemical
  - Temperature
  - Position/Proximity
  - Acoustic/Vibration
  - Vision/Light
  - Motion/Speed
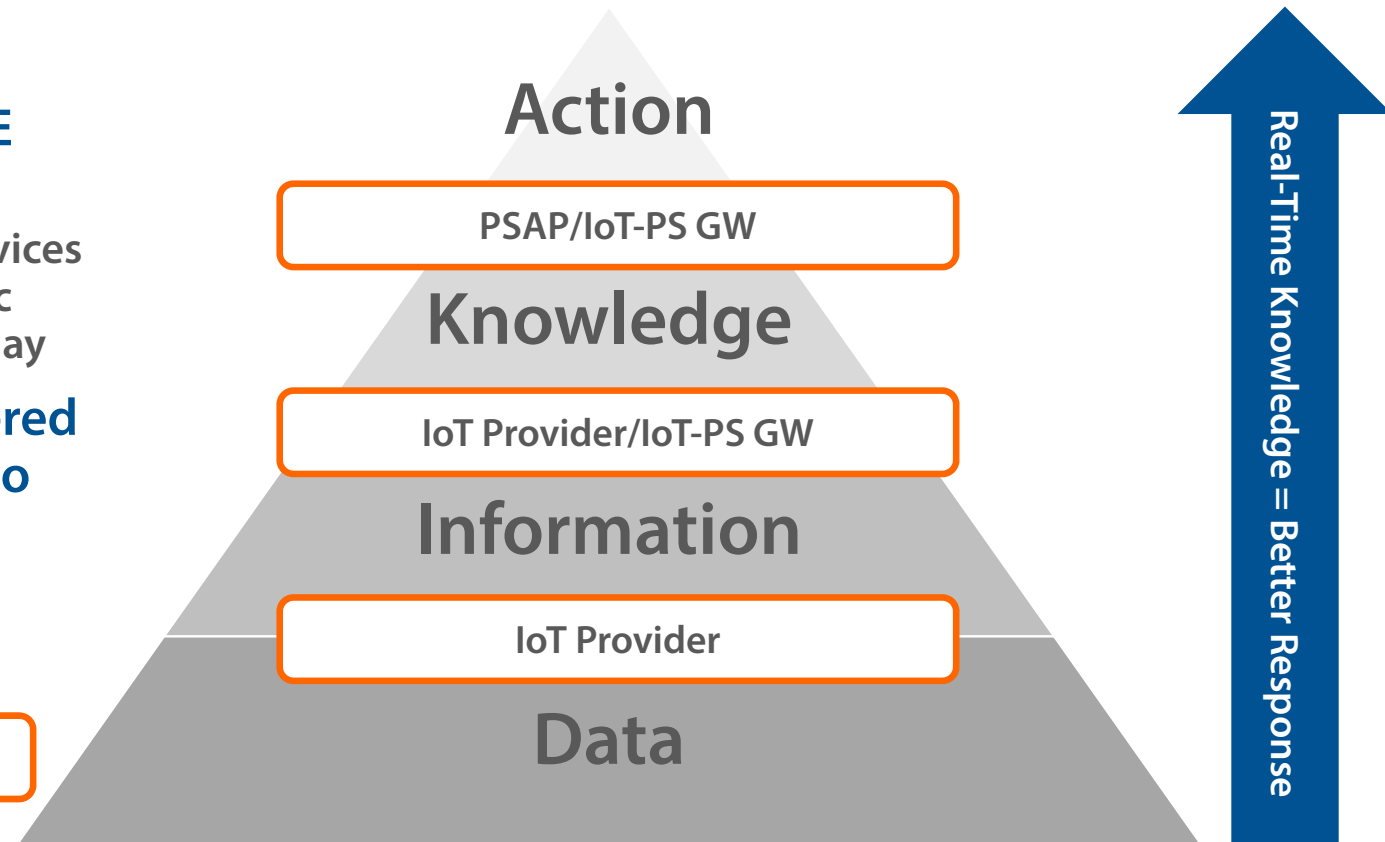 - Electromagnetic

Public Safety:
- Law Enforcement
  - Cameras
  - Firearm sensors
  - Chemical/Biological
  - Location tracking
  - Biometrics
- Fire
  - Biometrics
  - Equipment metrics
  - Chemical/Smoke/Temp sensors
  - Asset tracker
- EMS
  - Patient Stats
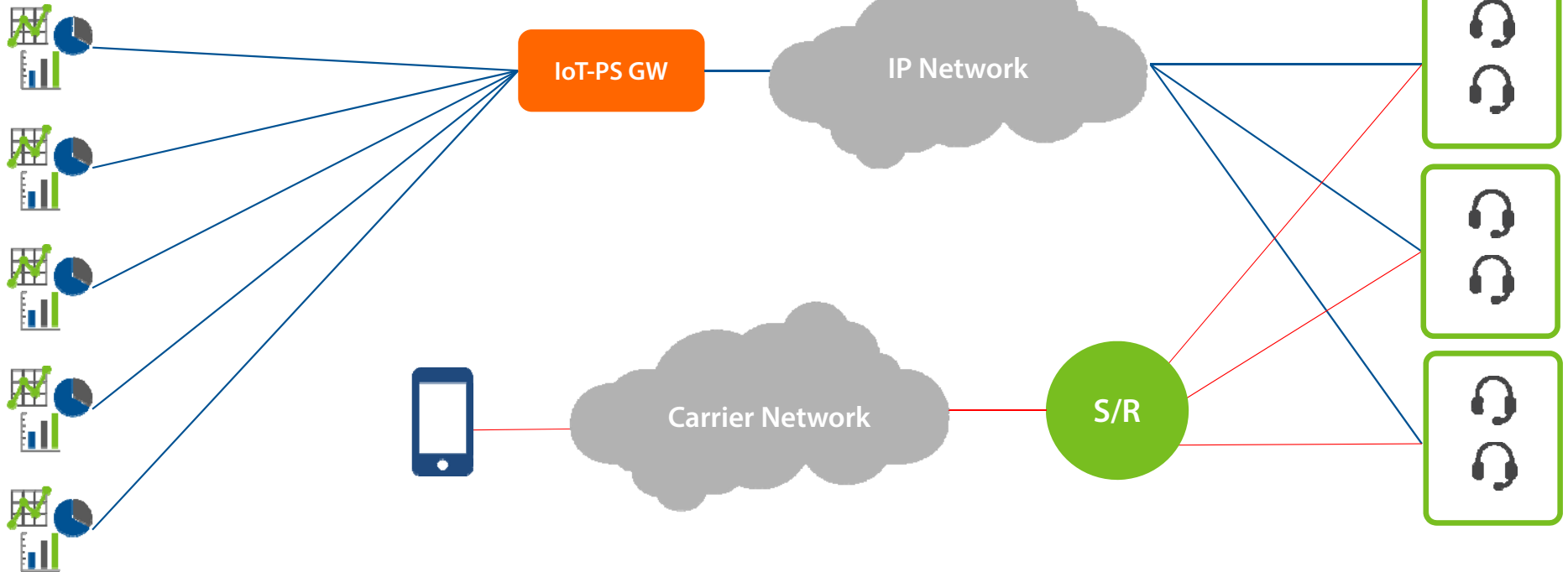 - Supply/Asset tracking
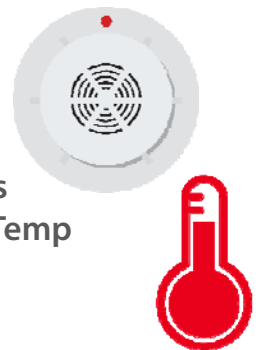
IoT-PS Value

- **IoT will produce HUGE amounts of data**
  - Assuming 1M IoT devices that sample 100B/sec results in 8.6TB per day
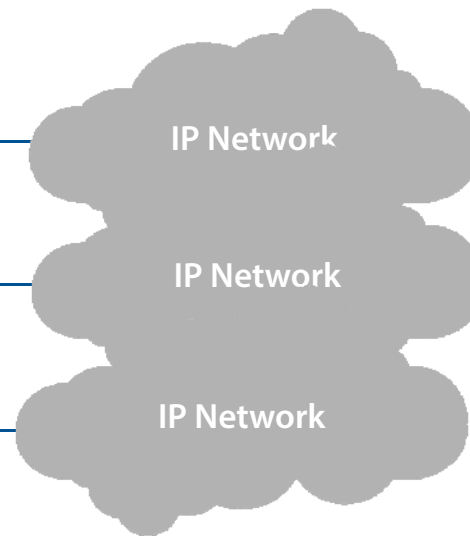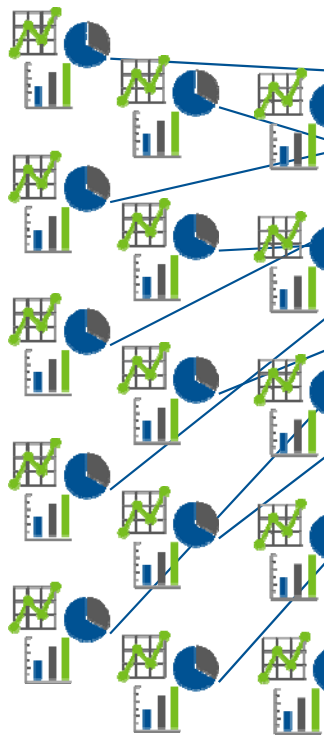- **The data must be filtered at each step in order to result in "action"**

Filtering Party

Action

PSAP/IoT-PS GW

Knowledge

IoT Provider/IoT-PS GW

Information

IoT Provider

Data

Real-Time Knowledge = Better Response

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IoT-PS GW

IoT-PS GW

IoT Service Providers

PSAPs

IoT-PS GW

IoT-PS GW

IoT-PS GW

IP Network

IP Network

IP Network

IoT-PS GW

IoT Service Providers

PSAPs

IoT-PS GW

IoT-PS GW

IoT-PS GW

IP Network

IP Network

IP Network

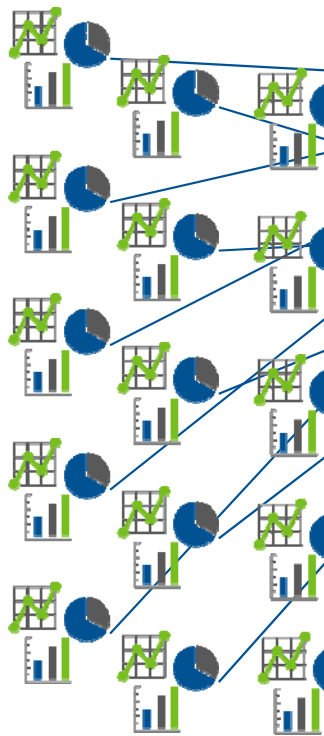# IoT-PS GW

IoT Service Providers
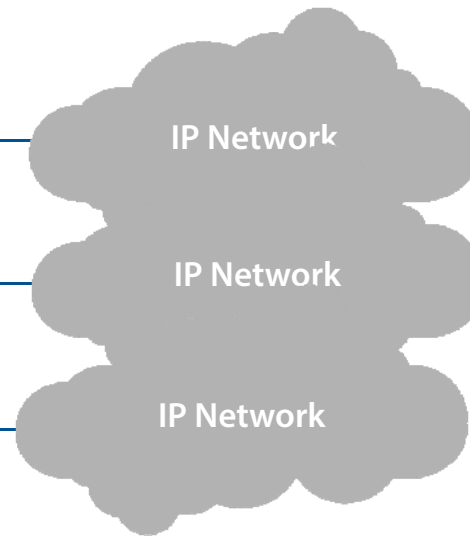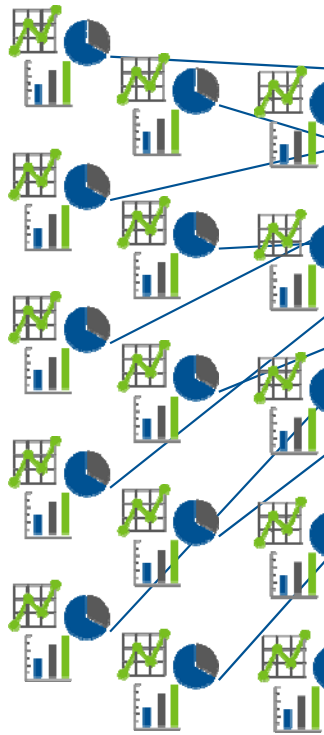
PSAPs

IoT-PS GW

IoT-PS GW

IoT-PS GW

NG9-1-1

NG9-1-1 can:
1. Act as the aggregator
2. Apply the appropriate policy to the IoT information
3. Route the information to the appropriate PSAP
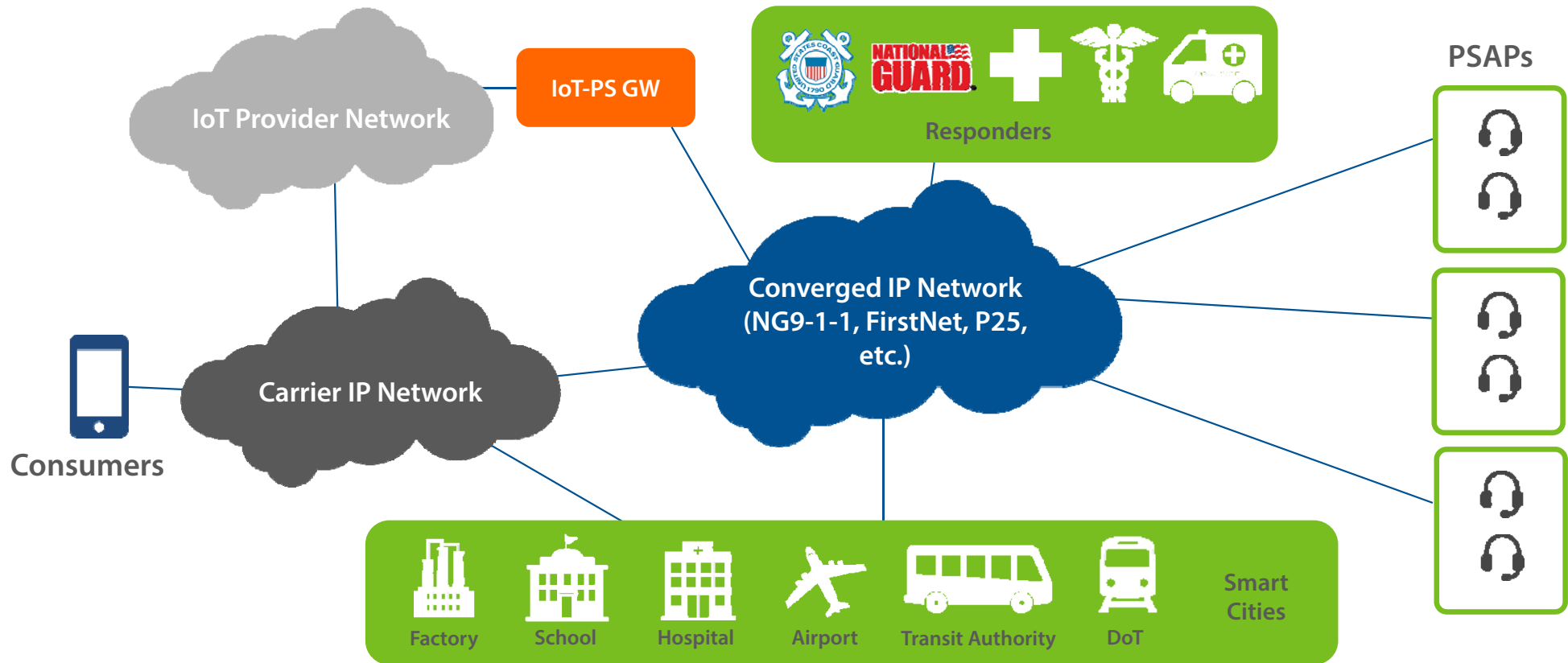4. Associate the information with an incident

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IoT-Focused Standards Activity

- **Public Safety Element**
  - **Alliance for Telecommunications Industry Solutions (ATIS)**
    - **IoT Categorization Focus Group (ATIS TOPS Council initiative)**
    - **On-Going effort to capture the IoT use cases, including public safety**
  - **NENA has IoT work group**
    - **Working to define best practices for IoT**
    - **Concept of a GW/aggregator on the origination side emergency network**
      - **GW/aggregator**
        1. **Aggregates IoT providers into single point**
        2. **Apply business rules**
        3. **Convert to i3 compliant protocol**
    - **Defining how IoT will integrate with NG9-1-1**
- **Others: 3GPP, Internet Engineering Task Force (IETF), Online Trust Alliance (OTA)**

Where is Public Safety Heading?

PSAPs

IoT-PS GW

IoT Provider Network

Responders

Converged IP Network (NG9-1-1, FirstNet, P25, etc.)

Carrier IP Network

Consumers

Factory   School   Hospital   Airport   Transit Authority   DoT
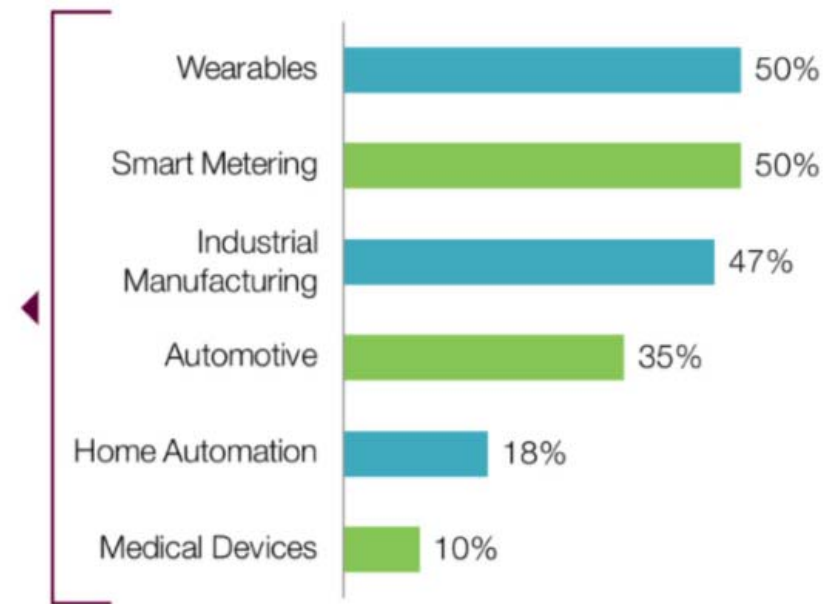
Smart Cities

IoT Security

- **IoT presents unique security challenges**
  - Large number of distributed and "dumber" devices
  - Limited computing power and/or storage on devices
    - May not be capable of supporting security tools
    - Some devices may lack ability to be upgraded OTA
    - Limited authentication/authorization capabilities
  - Perpetual internet connections and irregular communications patterns
  - Exposed admin ports and/or weak passwords
- **Best Practices**
  - Real-time threat detection, response & remediation are a must
  - Modification of IoT security framework and policies over time
 - Penetration testing and security assessments are essential

Wearables	50%
Smart Metering	50%
Industrial Manufacturing	47%
Automotive	35%
Home Automation	18%
Medical Devices	10%

N. Dragon, A. Giaretta and M.Mazzara

Percentage of executives who rate the IoT products in their own industry highly resilient to cyber attacks

https://arxiv.org/pdf/1707.08380.pdf

Concluding Remarks

- IoT is at the "knee" of the hockey stick
- Public Safety will be required to work with IoT providers and aggregators
- IoT allows for more predictable and proactive response
- IoT can provide a lot of very valuable data, however it must be systematically managed (e.g., machine learning algorithms) accurately to result in actionable information
- Next Generation 9-1-1 will be critical
  - o Supporting IoT as an "over-the-top" solution is a good transitional approach, but similar to Text to 9-1-1 is not a long-term vision

IoT
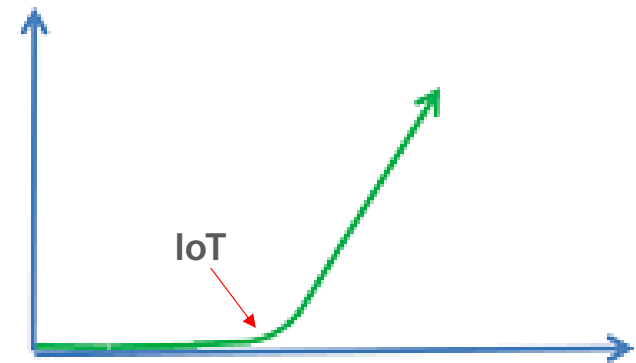
And remember, your refrigerator will call 9-1-1 one day!!! ☺

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