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Sensor Networks from Architecture Perspectives

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This paper/contribution discusses the applications of system architecture to address and identify the standards needs for sensors and sensor networks and to understand potential issues associated with the interoperability of sensors within a network (e.g., a system) and of sensors on differing levels of networks (e.g., systems of systems). In addition, the sensors and networks of dissimilar types, properties, functions, applications, and usage require interoperability among sensors and networks. It is important to identify data contents for compatibility and interoperability. Lack of sensor data interoperability becomes a hindrance in communication, display, processing, storage and retrieval, integration and fusion, and network services. Therefore, we can use system architectures to evaluate and identify what are required for interoperability of the following:

- Sensors;
- Networks; and
- Data.

Sensor networks can be categorized by application focus areas, for example:

- Home network – security, convenience, and computers;
- Medical networks – data transfer, remote health care;
- Transportation networks – ground tracking, emergency, and diagnostic, tolling systems, port and airport security, air/ground traffic control systems, on-platform sensor netting (e.g., automobiles);
- Industrial networks – building security, product manufacturing processes;
- Federal, State, Local civil networks – anti-terrorism, weather tracking and warning, first responders, local law enforcement and fire, city/local surveillance;
- Defense networks – multinational, coalition, defense/weapon sensors, force protection; and
- Other networks.

Depending on the application focus, common sensors and their networks can be used for different purposes. The sensor networks for various application focuses will have commonalities and differences. The players and entities on the sensor networks vary depending on the application focus. Even if the networked players and entities remain unchanged, their roles and responsibilities could differ from one application to another. Capturing each networked sensor's and its network's Concept of Operations (CONOPS), capabilities and functions, use cases, systems requirements, interface definition & control documents for each system and subsystem, is a demanding and iterative task.

A systematic approach using systems architecture will guide the sensor and network developers in various application areas. System architecture will provide tools to capture CONOPS, requirements, etc. and identify deficiencies in sensor, network, and data interoperability. These identified deficiencies in sensors, networks, and data provide the foundation for the sensor networks standards requirements. Having the sensor and network (e.g., sensor networks) standards provides realized system interoperability, and consequently leads to developmental and implemental schedule and cost savings.

The system architecture approach in various sensor network applications can capture commonalities and differences in the applications and then reference architectures can be developed for each application area (e.g., home networks, transportation networks, etc). The sensor networks standards for the sensor network reference architecture and implemented variations can be used in the community to baseline development and implementation of networked sensors.

In our contribution to the SGSN, we plan to present and discuss a system architecture approach using an example case. Hurricane Katrina disaster, in New Orleans, Louisiana, in 2005, involved all levels of sensing and systems from civil, military, and international communities. From lessons learned, interoperability of disaster relief was one of the most noticeable issues.