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# Conceptual model of real-time IoT systems

**Key words:** Internet of Things (IoT); Real-time system; Conceptual model; View; Hard/Soft real-time

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# Motivation

1. Many IoT practitioners ignore real-time aspects and consider IoT simply as an extension of the Internet.
2. A real-time IoT (RT-IoT) system should consider the timing constraints of system delay, clock synchronization, deadline, and so on.
3. We go into details of a real-time IoT system with four perspectives.

# Main idea

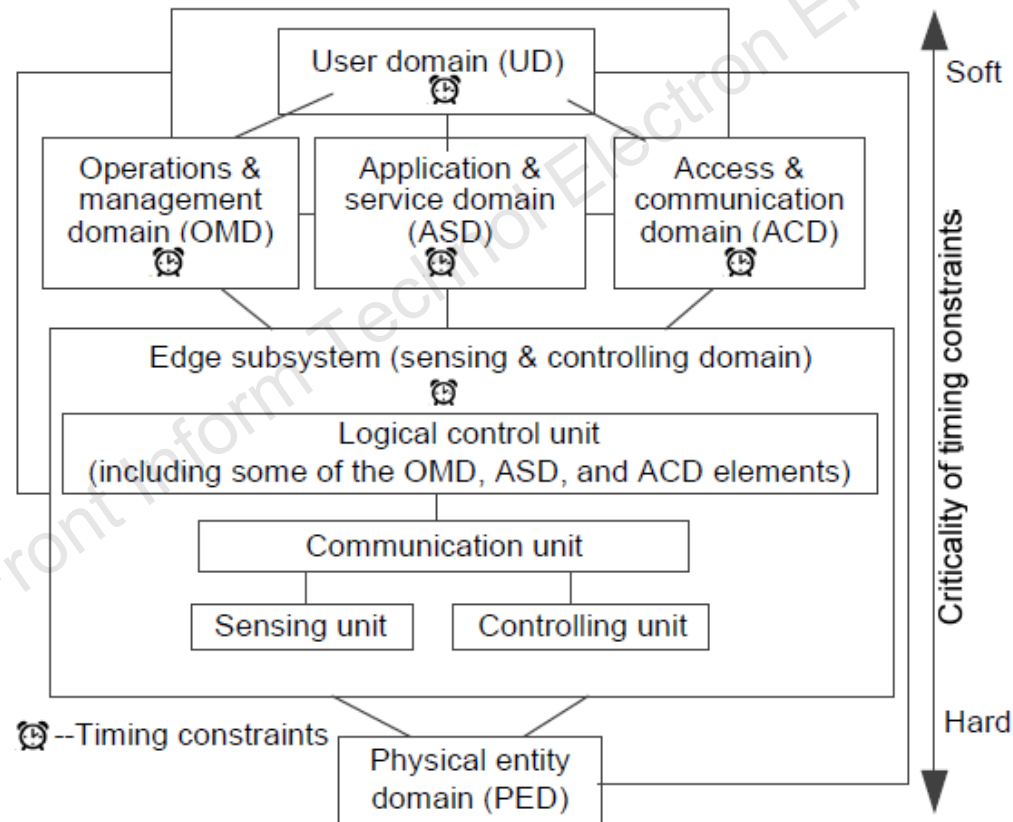
1. It is necessary to add a timestamp mark to the output of each unit to clarify the processing time of each step, which is a necessary condition to realize the real-time IoT system.
2. The time constraints of real-time IoT are divided into two categories: hard real-time and soft real-time.
3. The real-time conceptual model is introduced, together with four perspectives, the time view, computation view, communication view, and control view.

# Method

1. For hard real-time systems with high requirements, it is necessary to design them in the edge subsystem as close to the target object as possible.
2. Each view looks at a real-time IoT system from different perspectives and describes its properties and requirements.

# Major results

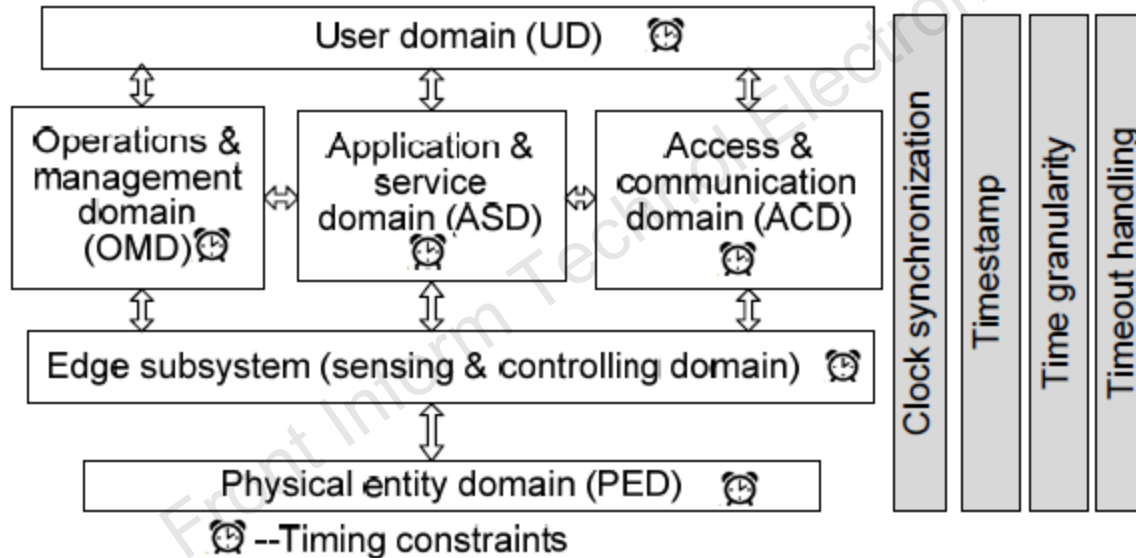
## Conceptual model design



**Fig. 1 Conceptual model of a real-time Internet of Things (IoT) system**

# Major results (Cont'd)

## 1. Time view



**Fig. 4 Time view of a real-time Internet of Things (RT-IoT) system**

# Major results (Cont'd)

## 2. Communication view

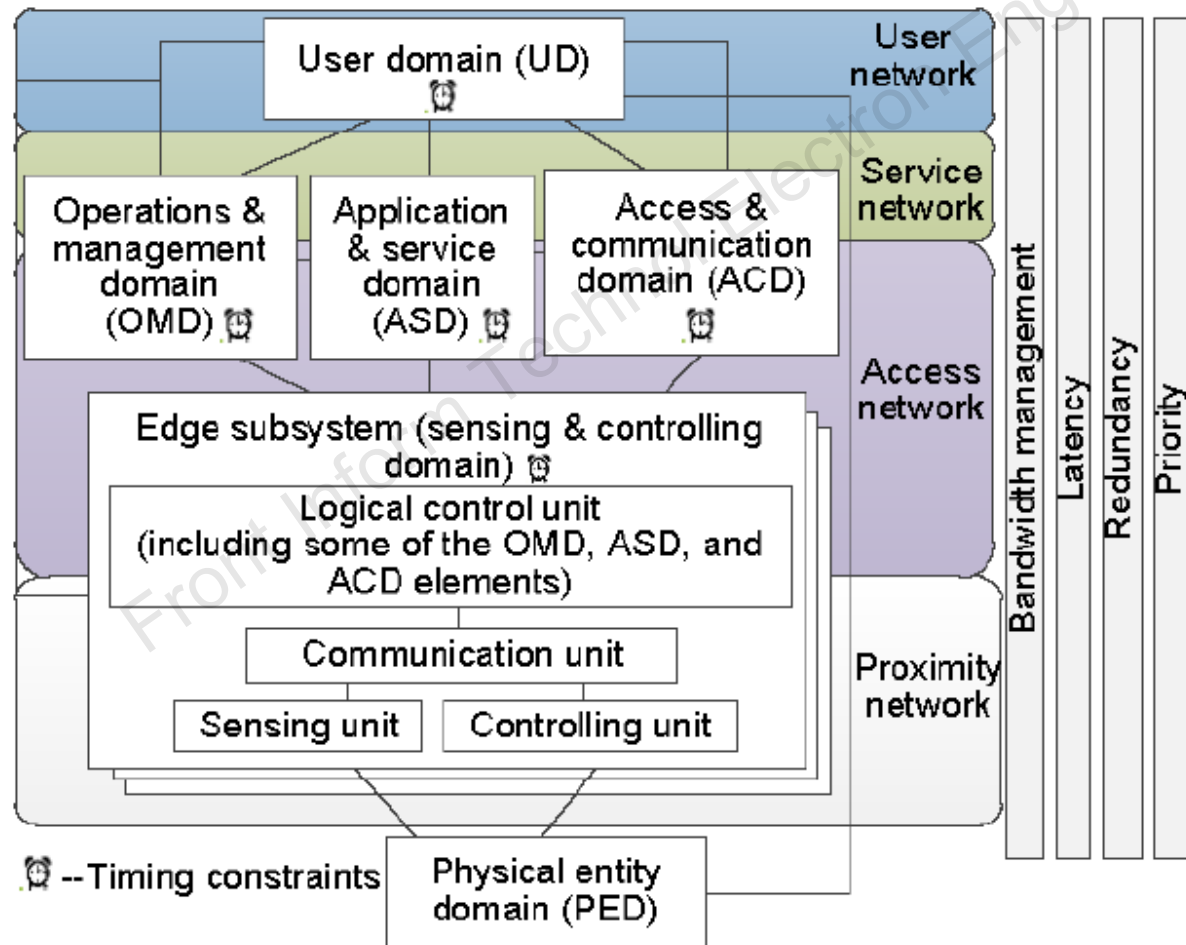
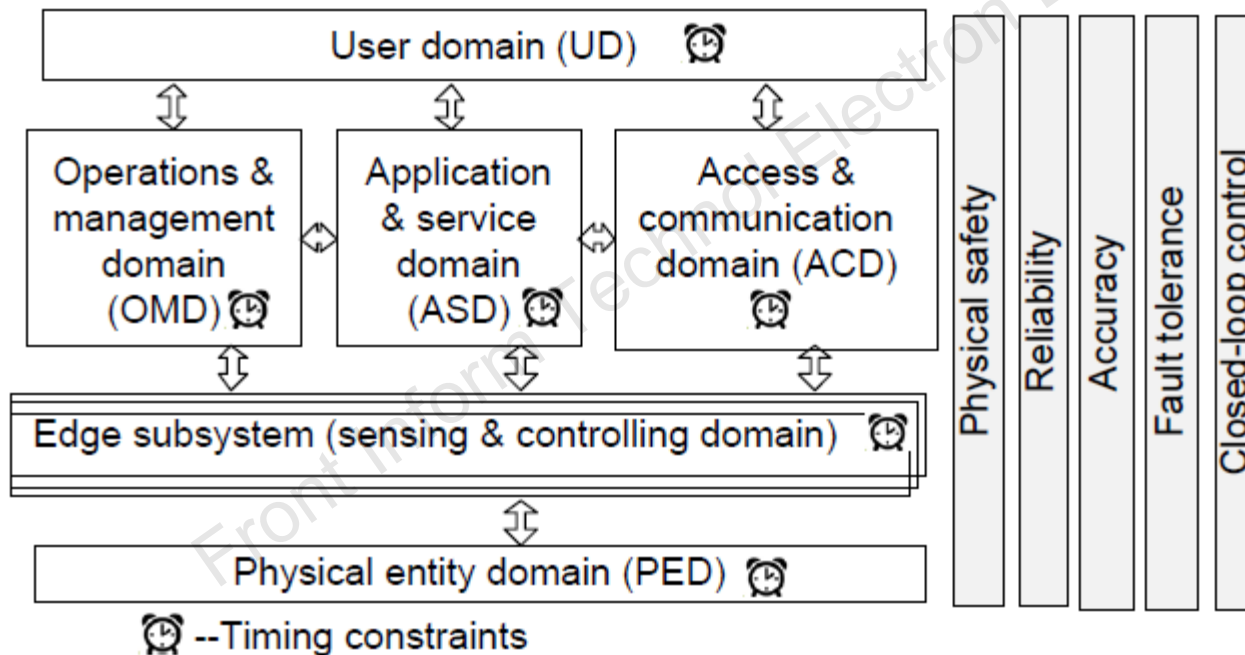


Fig. 5 Communication view of a real-time Internet of Things (RT-IoT) system

# Major results (Cont'd)

## 3. Control view



**Fig. 6 Control view of a real-time Internet of Things (RT-IoT) system**

# Conclusions

1. The real-time IoT emphasizes the time constraints in its implementation.
2. The real-time IoT system can contain multiple edge subsystems, and the edge subsystem is a system of systems.
3. The IoT as a real-time system is necessary and challenging.