



DIAT: A Scalable Distributed Architecture for IoT

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Introduction

- ▶ **Challenges in IoT are :**
- ▶ Heterogeneity
- ▶ Scalability
- ▶ Interoperability
- ▶ Security and privacy

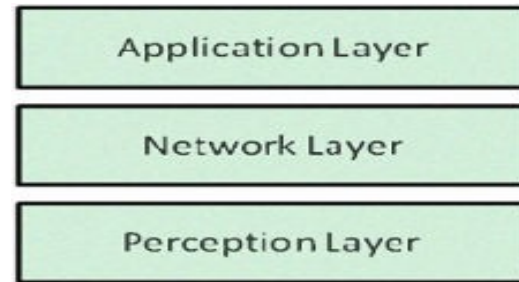
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- ▶ Proposed a layered and distributed architecture for IoT, called **DIAT**.
 - ▶ Potential to tackle many of the technical challenges.
 - ▶ Supports the desired characteristics of IoT objects and applications.
 - ▶ Various cognitive functionalities defined at various layers of the architecture
 - ▶ Usage control mechanism to support security and privacy in a distributed and dynamic environment
 - ▶ DIAT has distributiveness.

RELATED WORK

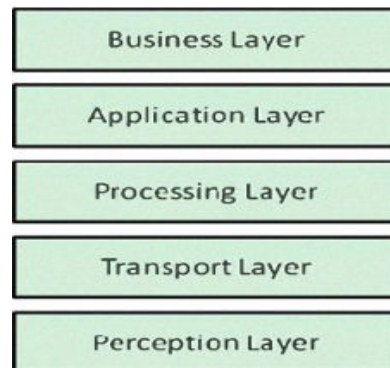
- ▶ Architectural model for IoT that are usually applicable to a specific application domain.
- ▶ For example, Castellani et al. have proposed an architecture for a smart office application [1]. Their main focus is only to interconnect wireless sensor networks and actuator networks to the Internet as a web service
- ▶ Many researchers have suggested layered architectures for IoT

Layered Architecture[2]

- ▶ 3-layer architecture consists of the Perception Layer, Network Layer and Application layer.

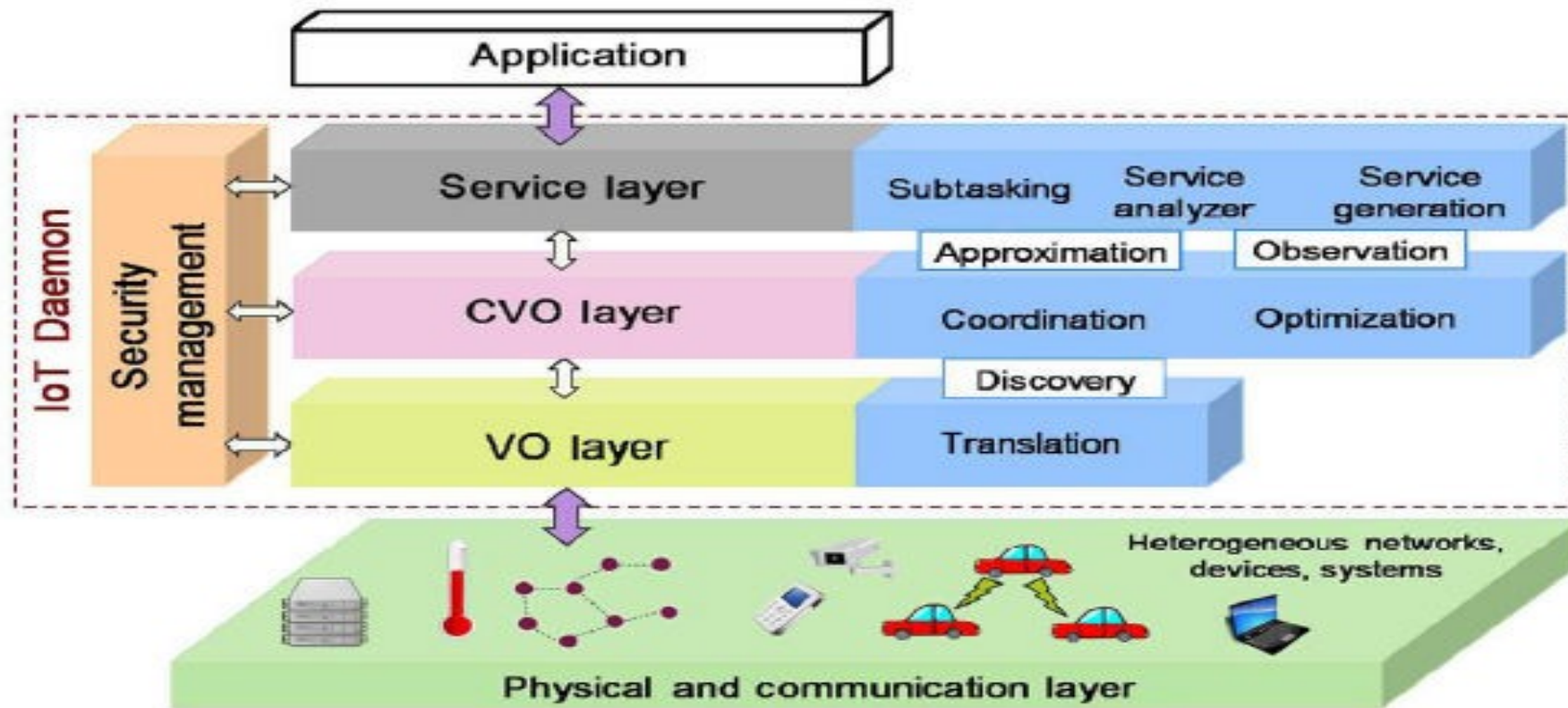


Established a new architecture similar to OSI. Divided IoT into 5 layers.



IoT DISTRIBUTED ARCHITECTURE[1]

- ▶ Multiple services are merged with minimal human intervention.
- ▶ Functionalities of IoT are grouped into three layers
- ▶ Virtual object layer (VOL)
- ▶ Composite virtual object layer (CVOL)
- ▶ Service layer (SL)



Layered architecture for the IoT

VO Layer

- ▶ Responsible for virtualization of physical objects.
- ▶ Hosts the virtual representations of the real-world objects, called VO.
- ▶ Plays the role of bridging the gap between physical and cyber world.
- ▶ Helps to tackle the heterogeneity , interoperability and reusability of objects

CVO Layer

- ▶ Created by forming a mash-up of one or multiple VOs.
- ▶ Plays the role of a coordinator.
- ▶ Dictates how the individual entities in its mash-up should work.
- ▶ Tries to optimize the operations among its entities by doing smart scheduling.

Service Layer

- ▶ Responsible for creation and management of services.
- ▶ Handles various service requests from users.
- ▶ Enable automatic service creation.
- ▶ SL analyzes and splits the service request into smaller subtasks.
- ▶ Decides how these subtasks are assembled to reach the final goal.

Security Management

- ▶ Addresses security and privacy challenge.
- ▶ To control the usage of data, resources, and services of the IoT objects.
- ▶ Responsible for the evaluation of policies enforced by the SL, CVOL, and VOL

IoT Daemon

- ▶ Acts as the basis of the distributed architecture in DIAT
- ▶ Consists of all proposed layers, their cognitive functionalities and SM.
- ▶ Every object with some processing power and memory runs its own IoT daemon.
- ▶ Presence of IoT daemon can relieve the burden of configuring each device manually.

COGNITIVE MANAGEMENT IN IOT DAEMON

- ▶ Observer plays a key role in automated machine to machine communication.

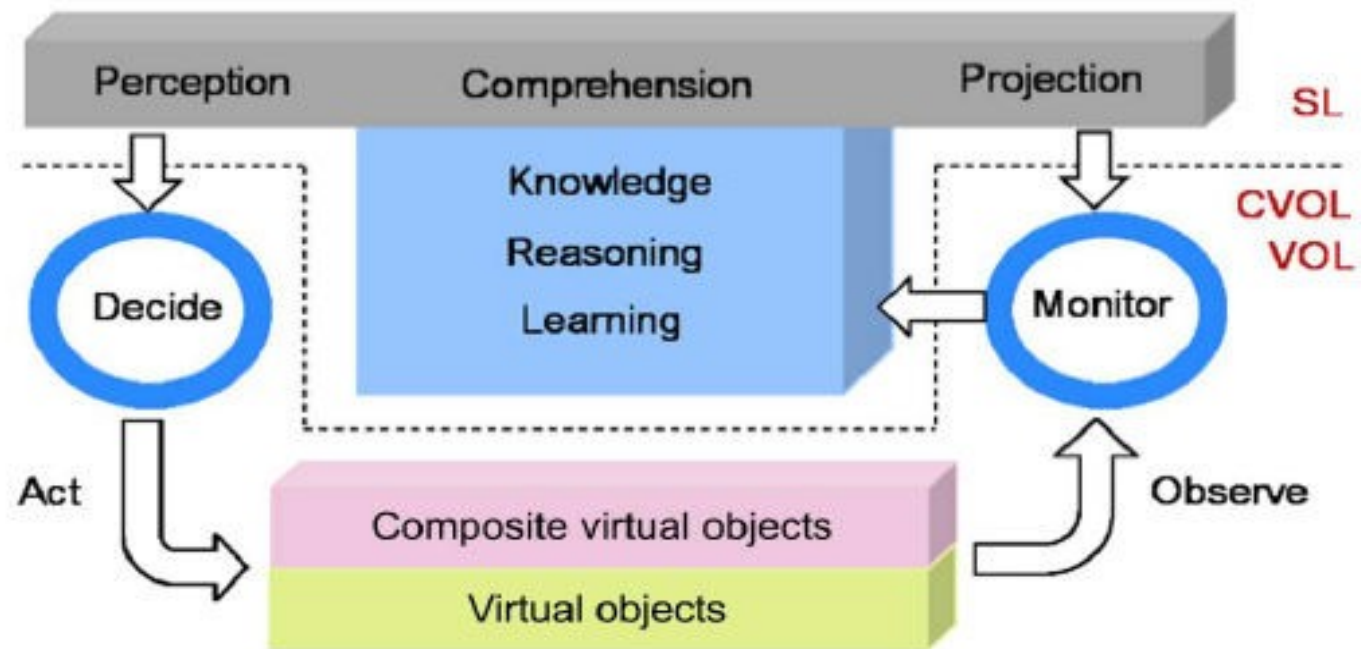
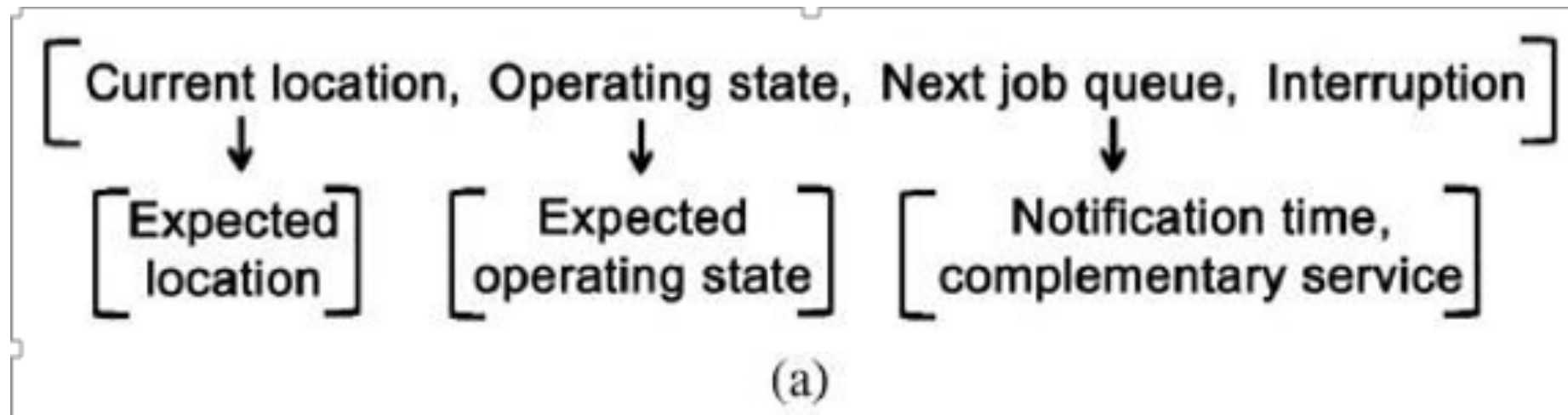


Figure : Functionalities and workflow of an observer

Dynamic Service Creation

- ▶ Observer stores the contextual information about each object.
- ▶ **Human object contains**
- ▶ Current Location
- ▶ Operating State
- ▶ Next Job Queue
- ▶ Interruption

- ▶ **Figure** : Contextual information vector for (a) Human object



- ▶ **Nonhuman object contains**
- ▶ Attention Flags
- ▶ Working Neighbor Group
- ▶ Group Collocation Neighbor Group

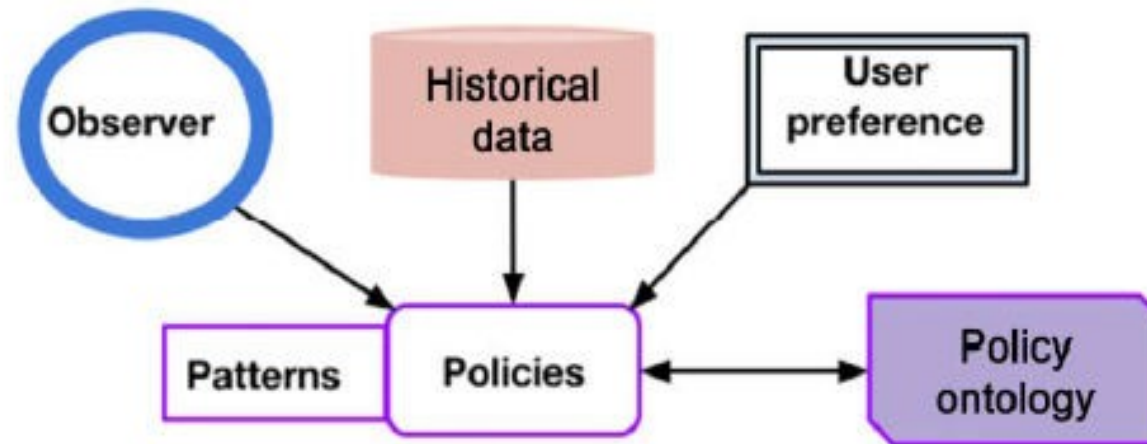
[Attention flags, Working neighbor group, Collocation neighbor group]

(b)

Figure : Contextual information vector for (b)nonhuman object

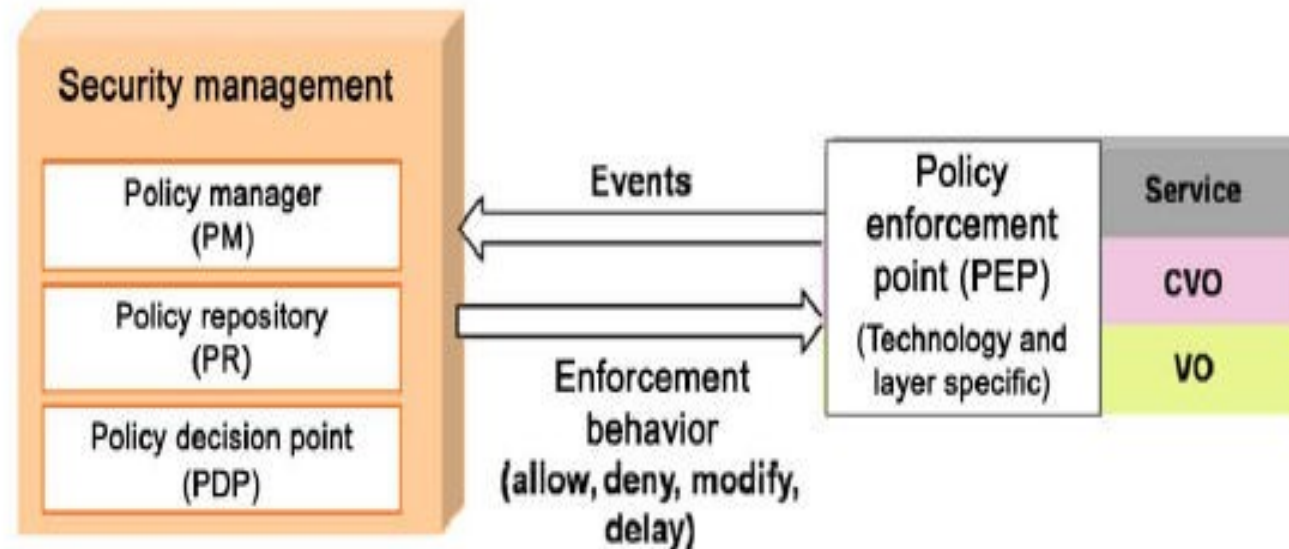
Dynamic Service Modeling

- Policies effectively adapt to dynamic environment and changing user requirements.



SecKit: SM Module

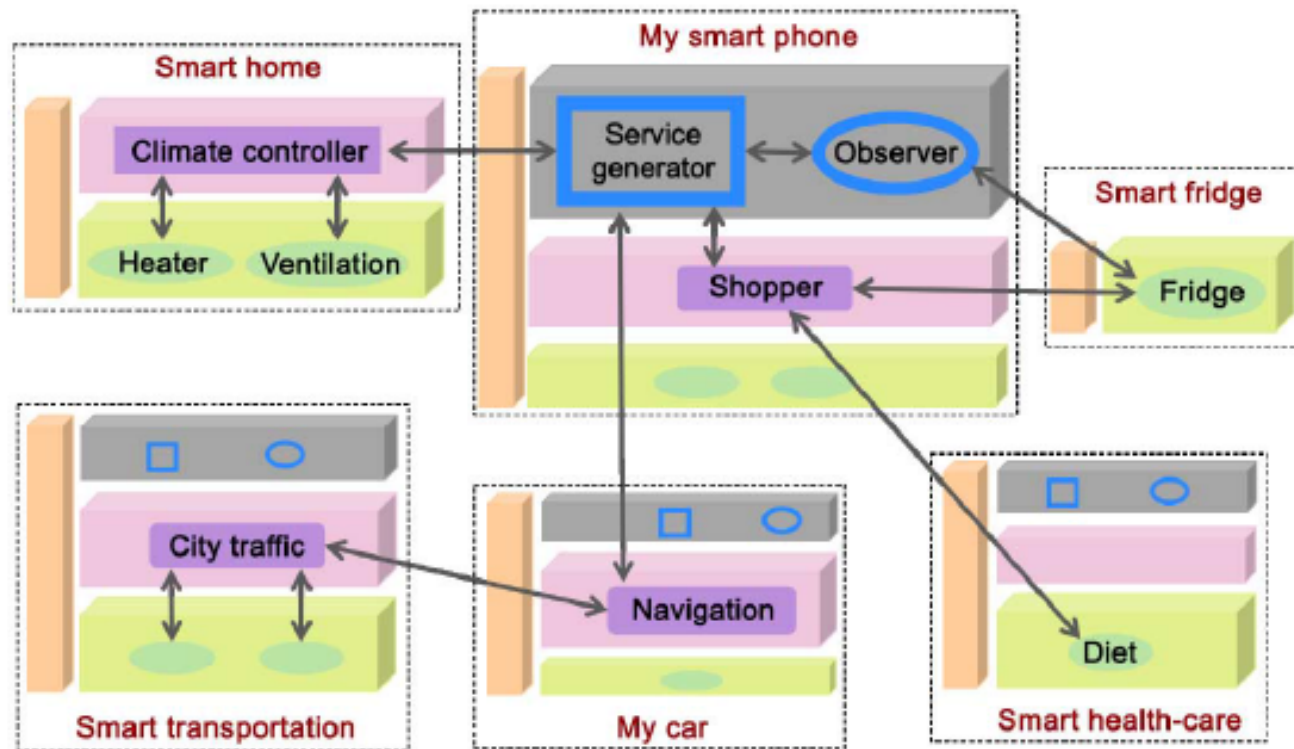
- ▶ SM module consists of three components
- ▶ Policy manager (PM)
- ▶ Policy repository (PR)
- ▶ Policy decision point (PDP)



COMPARATIVE STUDY

► Table 1 : Comparison among Architectural Proposals

IoT characteristics	DIAT	Butler [5]	Compose [6]	IoT-A [9]
Heterogeneity	Yes	Partially	Yes	Yes
Scalability	Yes	No	No	–
Interoperability	Yes	No	Partially	Yes
Security and privacy	Yes	Yes	Partially	Yes
Automation	Partially	Yes	Partially	Yes
Distributiveness	Yes	Partially	No	–
Layered design	Yes	No	Yes	No



Use-case showing the unification of various applications based on the distributed IoT architecture

Conclusion

- ▶ DIAT is Simple and Scalable.
- ▶ Accommodates heterogeneous objects and support interoperability.
- ▶ Implement security and privacy aspects using usage control policies.
- ▶ Automation, intelligence, dynamicity, and zero configuration are integral part of DIAT.
- ▶ DIAT satisfies the key characteristics and goals of an IoT architecture.

References

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