IoT Open System Architecture

CETC

Information Science Academy

Institution of IoT

Introduction

China Electronics Technology Group Corporation (CETC) is an important key enterprise approved by the state council. It is one of the ten greatest military industry groups controlled by central committee of CCP directly. It is based on electronics research institutes and hi-tech companies of former Ministry of Information Industry.

CETC Information Science Academy (CETC-ISA) was founded in 2013. It is an important move by the group to reform science system and drive development by creation. It's principle is "Build with creation, Power with unions, Thrive with talents and Control with cautions." It's goal is to build creation development platform, discover mechanism innovation and build a talent hub and result transformation platform.

Institute of IoT is an import department of ISA based on IoT technology innovation and focus on IoT and smart city related fundamental science research.

CONTENTS

1 The Development of IoT

01 The Development of IoT

Internet of Things is the network based on the need of individuals and society. It realizes the information acquirement, transaction, storage, process from people to people, people to things and things to things. It is smart and able to sense environment and content. It provides ubiquitous all-around information service to individuals and society.

People to Things

People can understand information and the capability of things. Thus they can use Internet to find information and things and use them to accomplish their goals.

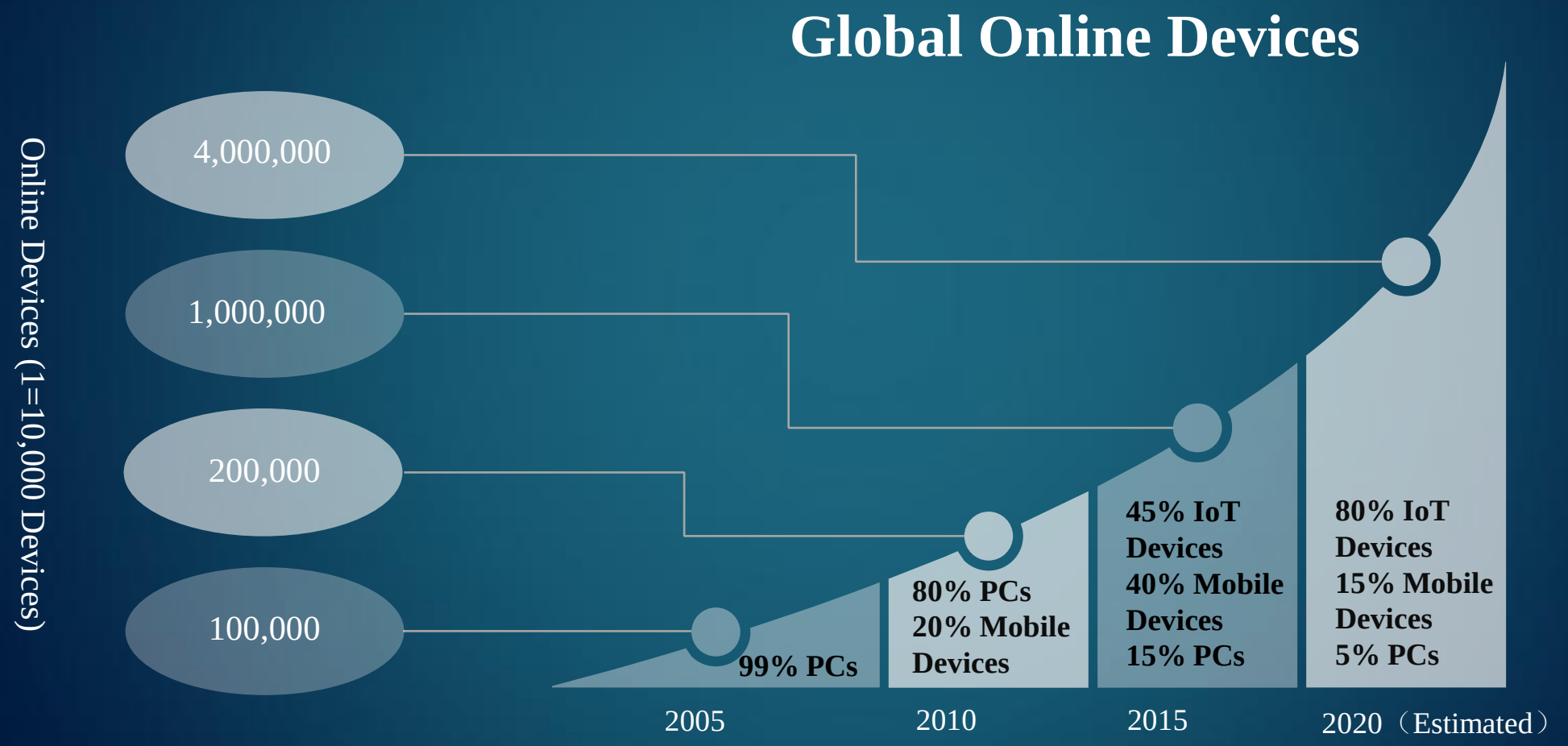
Things to Things

Things can understand the capability of other things. They can also find other things through network initiatively and use their capabilities to get the job done.

People to People

People use network to interact with other people. Things in the network can understand people's semantics needs and enable the connection and application between people in the network.

The Development of IoT



（Data Origin：Gartner, IDC, Strategy analytics）

01 The Development of IoT

Early Stage

Sensor Network

Distributed autonomous sensors **monitor** the physical or environmental conditions, then pass the collected data via computer network.

Current

Closed-loop **control** systems are built, with signal operation, decision assistant and control functions based on typical sensor network.

Sensor Control Network

Future

Everything Connected Smartly

Connected things will be able to **understand** the things capabilities, discover and know how to use them.

Final Stage

IoT will form a network which is **beyond Internet** and include all resources on the Internet. IoT will use the greatly enriched internet resources.

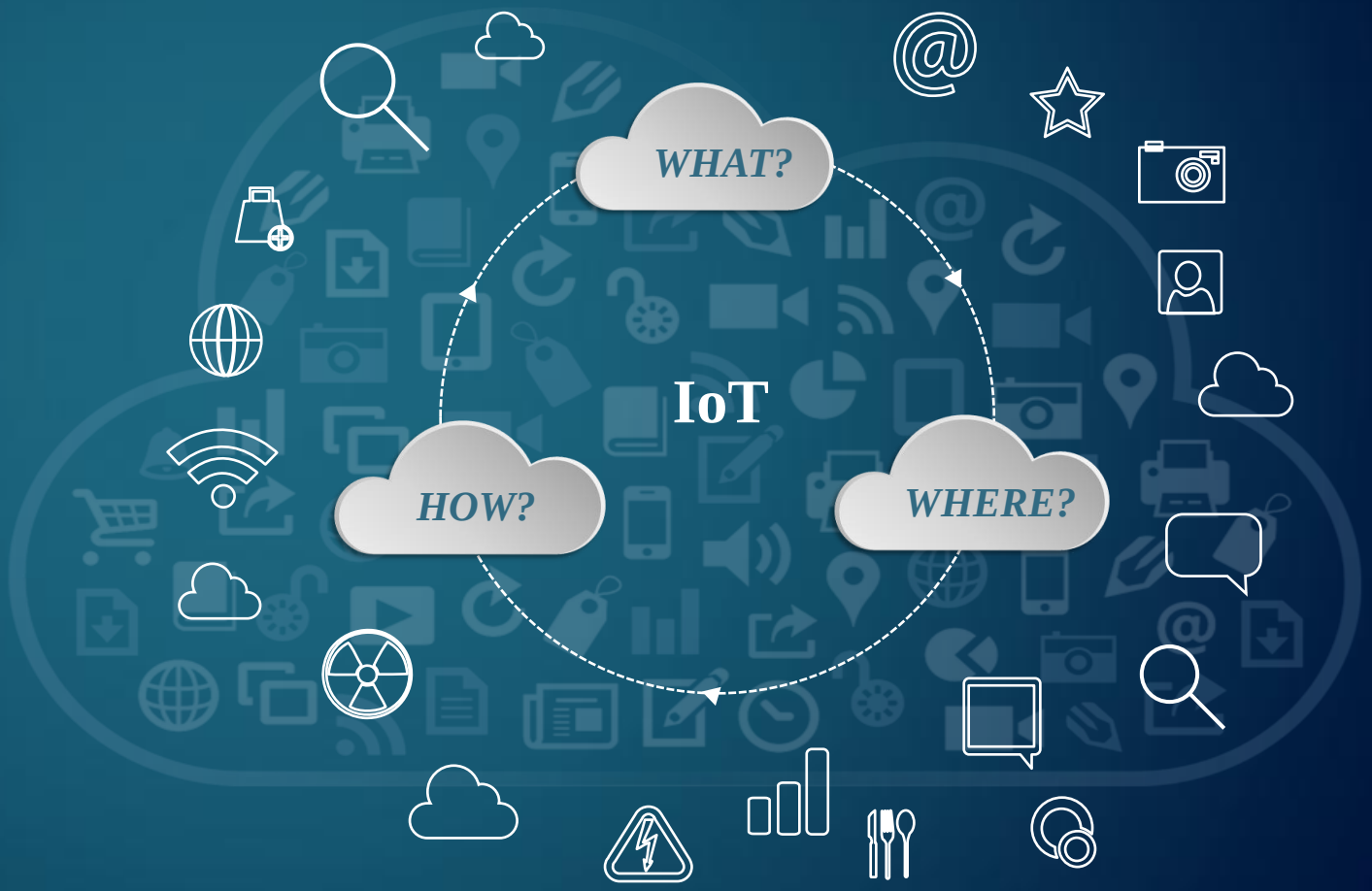
Era of IoT

01 The Development of IoT

What is it

Where is it

How to use it



The Development of IoT

HOW?

How to smartly-connect everything?

What is the thing		What is thing's capability
Where is the thing	capability	Where is thing's capability
How to use the thing		How to use the thing's capability

Capability: Things can interact with other things with its functions and data.

01 The Development of IoT

Base on massive IoT project practices and consider internet as an entirety, CETC-ISA innovatively come up with the IoT Open System Architecture. This architecture could promote the overall capability of the network, breed new business method and lead the development of IoT technology and industry. This could push the internet era into IoT era.

- What is it?
- Where is it?
- How to use it?

IoT Open System Architecture

2 IoT Open System Architecture

IoT Open System Architecture

Architecture Idea

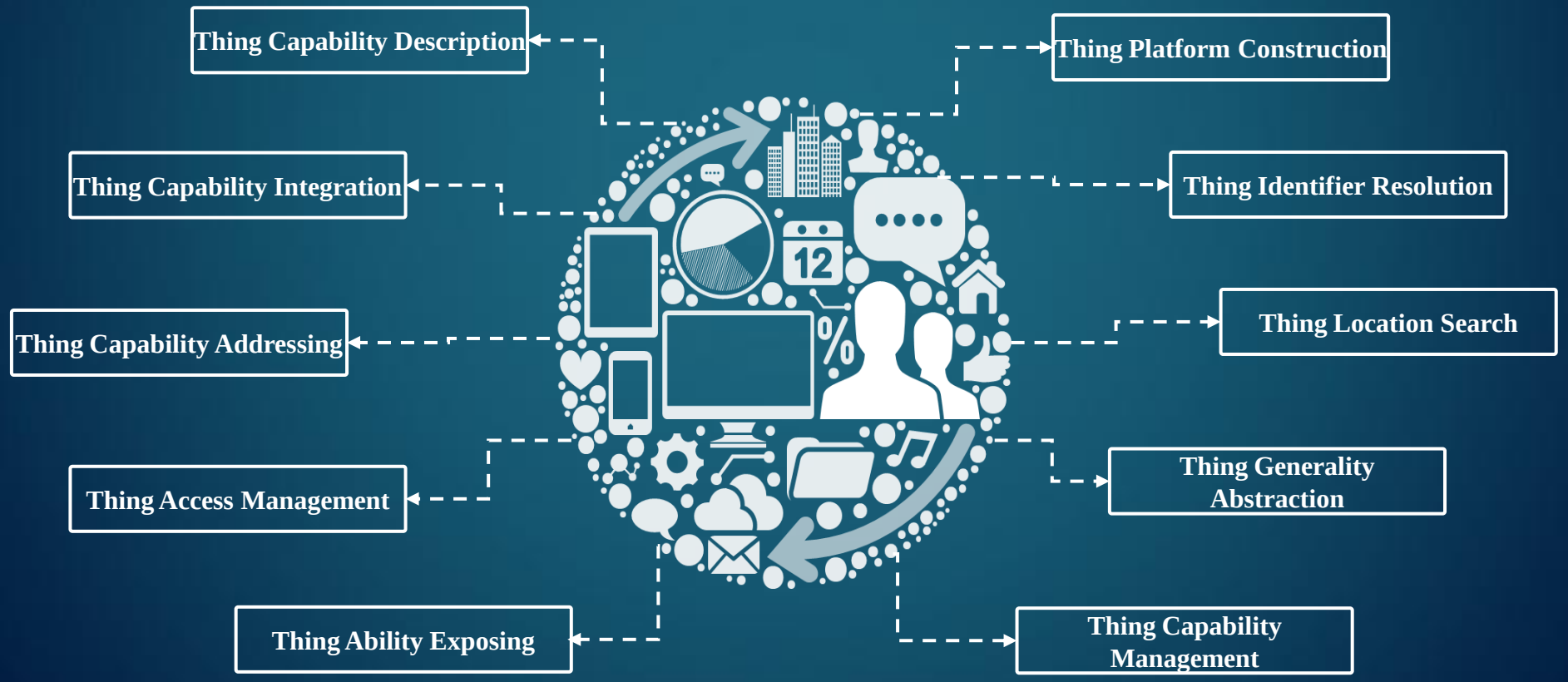
- *Compatibility: Advance based on Internet, develop with compatibility, promote ‘Internet Era’ to ‘IoT Era’*
- *Open: Treat the net as a whole, enhance the ability to describe and search things’ capabilities, build open infrastructures.*
- *Flexibility: Extensible, start with real demand, leave space for future development. Support sustainable development.*

Architecture Goal

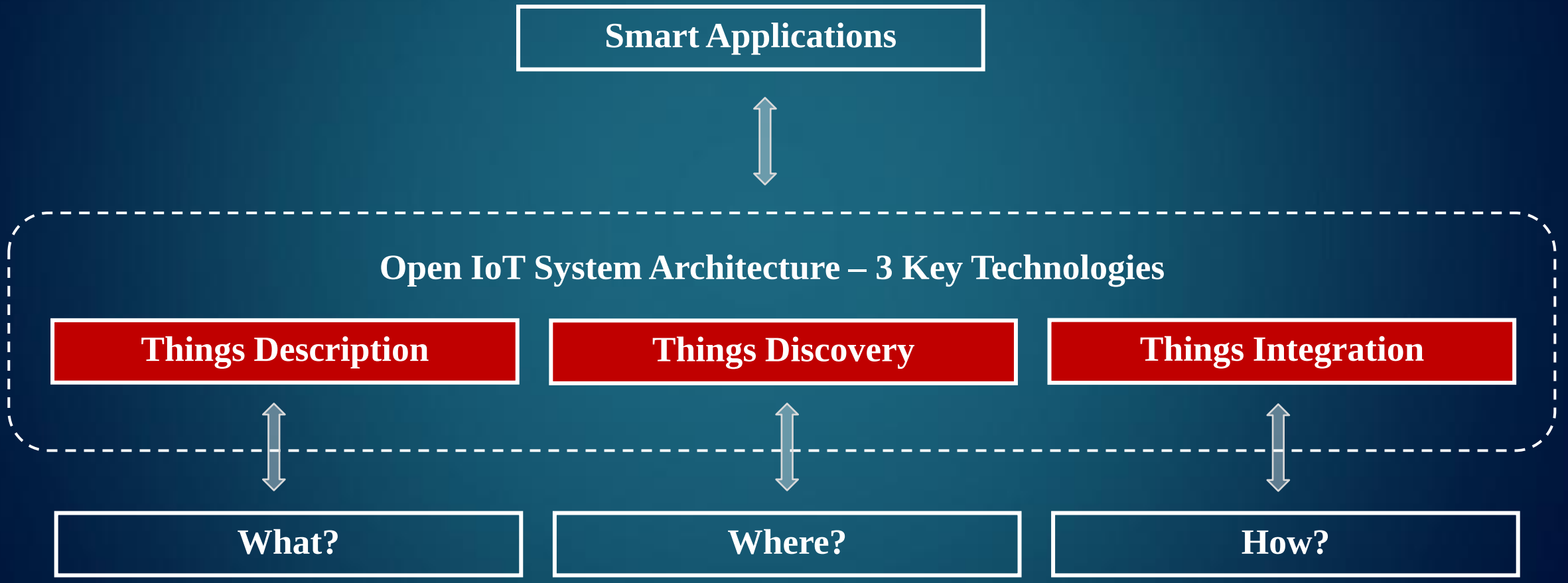
Solve ‘What’	*Define thing capability ,describe it and supply capability ontology construction, build capability knowledge atlas.*
Solve ‘Where’	*Build IoT Open System Architecture Identification Resolution System, compatible with current identifiers and resolution. Support identification and resolution of capabilities.*
Solve ‘How’	*Use technologies of the platform layer, manage thing’s capability, support capability integrity service to achieve thing capability smart connection.*

IoT Open System Architecture

IoT Open System Architecture Functionalities

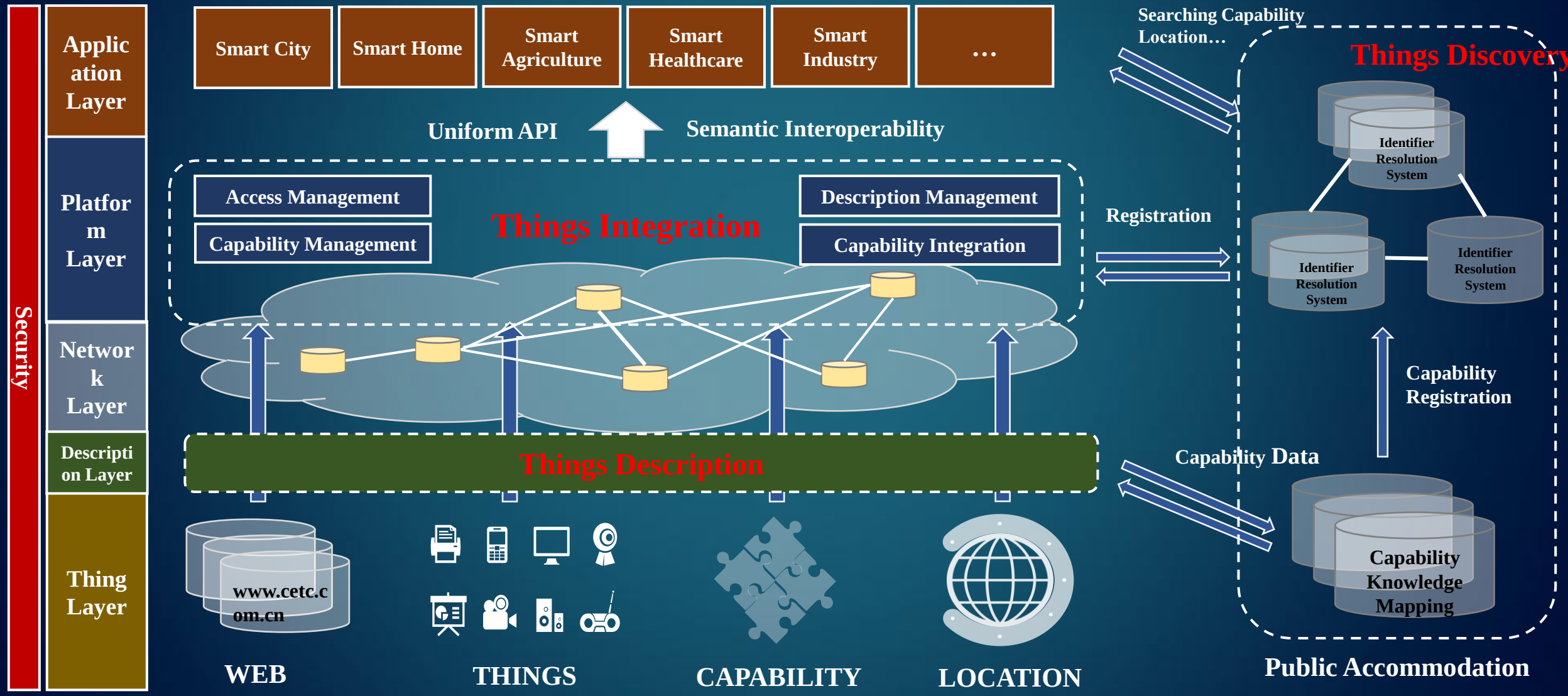


IoT Open System Architecture



02 IoT Open System Architecture

CETC ISA



02

IoT Open System Architecture

CETC ISA

Things Description

IoT Things Description

Description language differs

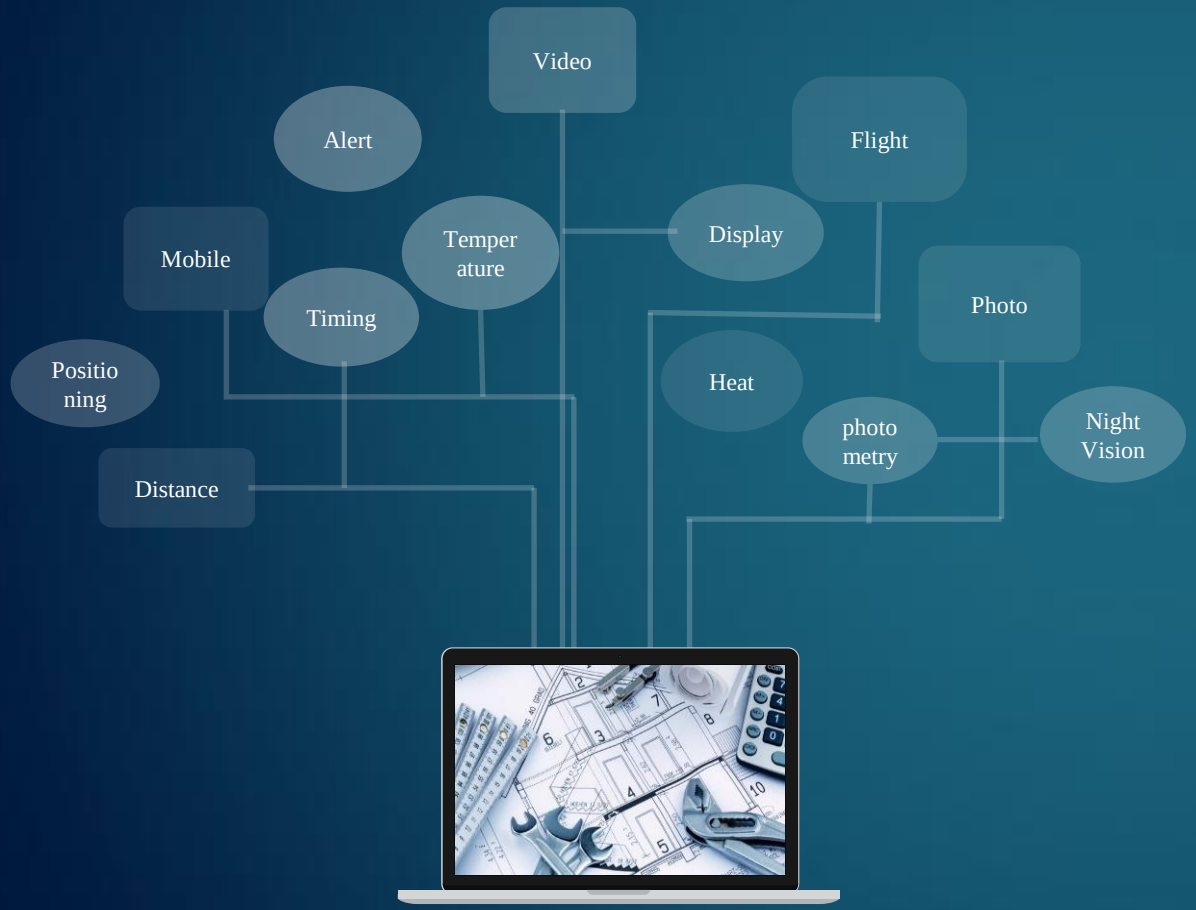
Lack of description capability

Different description metadata

Metadata unable to semantically intercommunicate

No general capability knowledge mapping

IoT Things Description



Capability Description

Describe a thing's capability. A thing can have multiple abilities and several things can have the same capability. This realize the separation of things and capability.

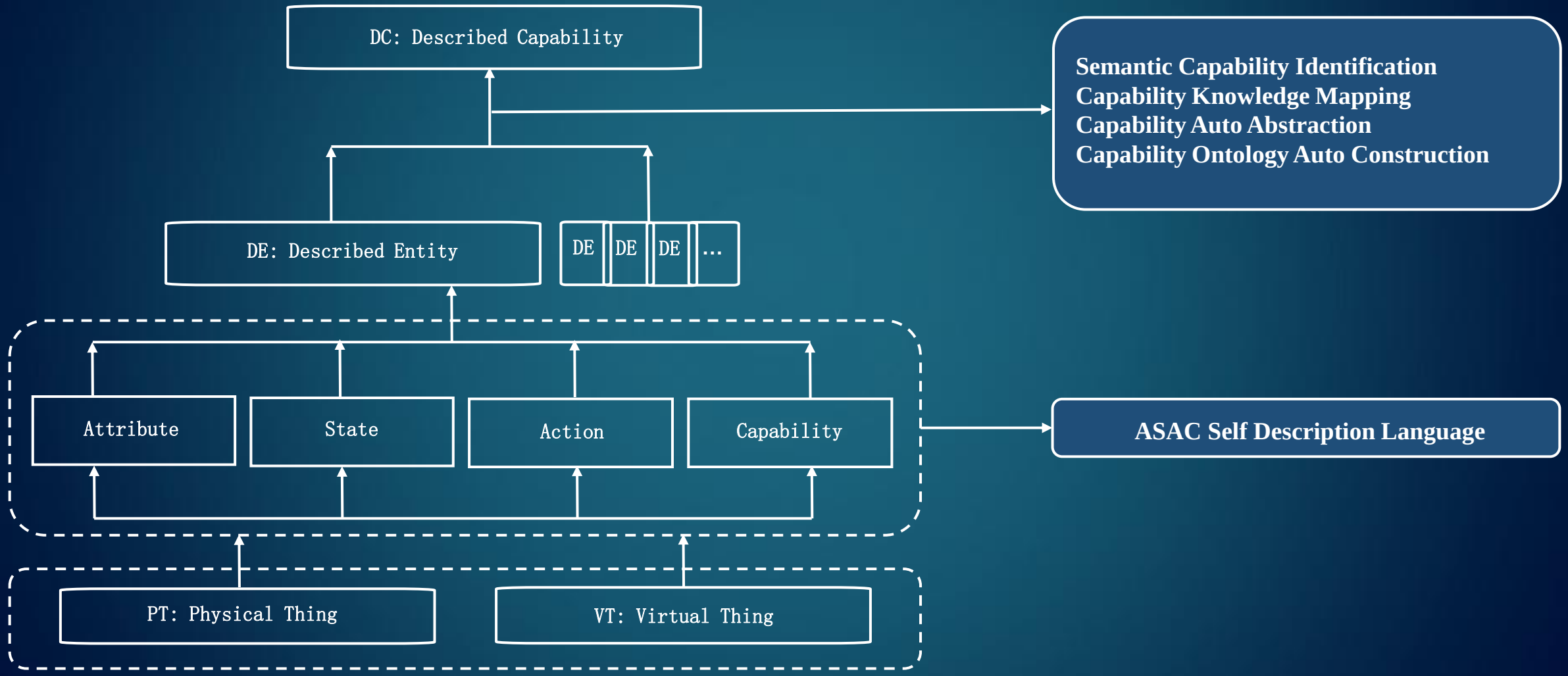
Capability Abstraction

Abstract the same capability of things and capabilities of the same thing to build a set of things or a set of capabilities.

Capability Knowledge Mapping

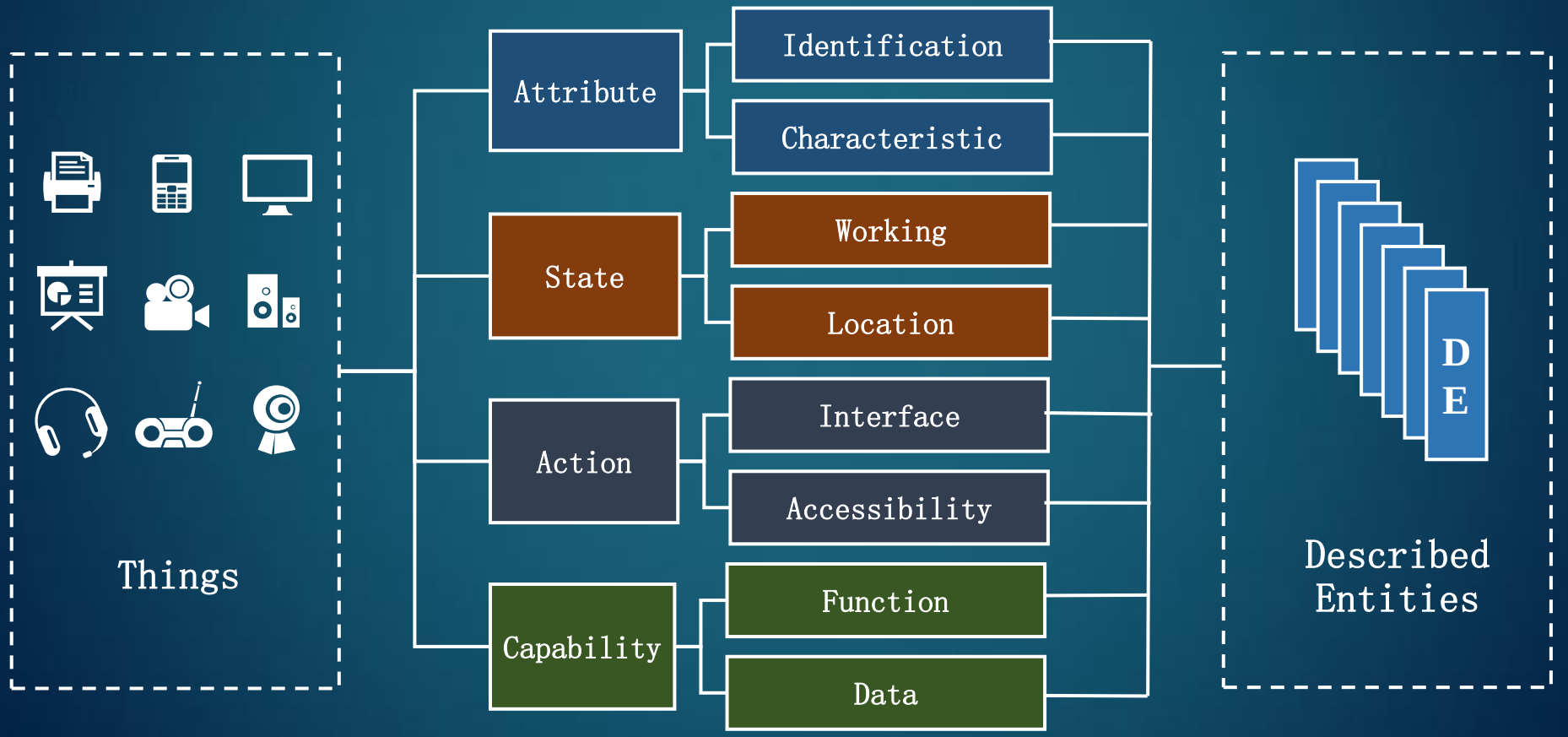
As the joint capability grows, we can set up an capability atlas to standardize the semantic description of capabilities and build the foundation of the intercommunication between things.

IoT Things Description

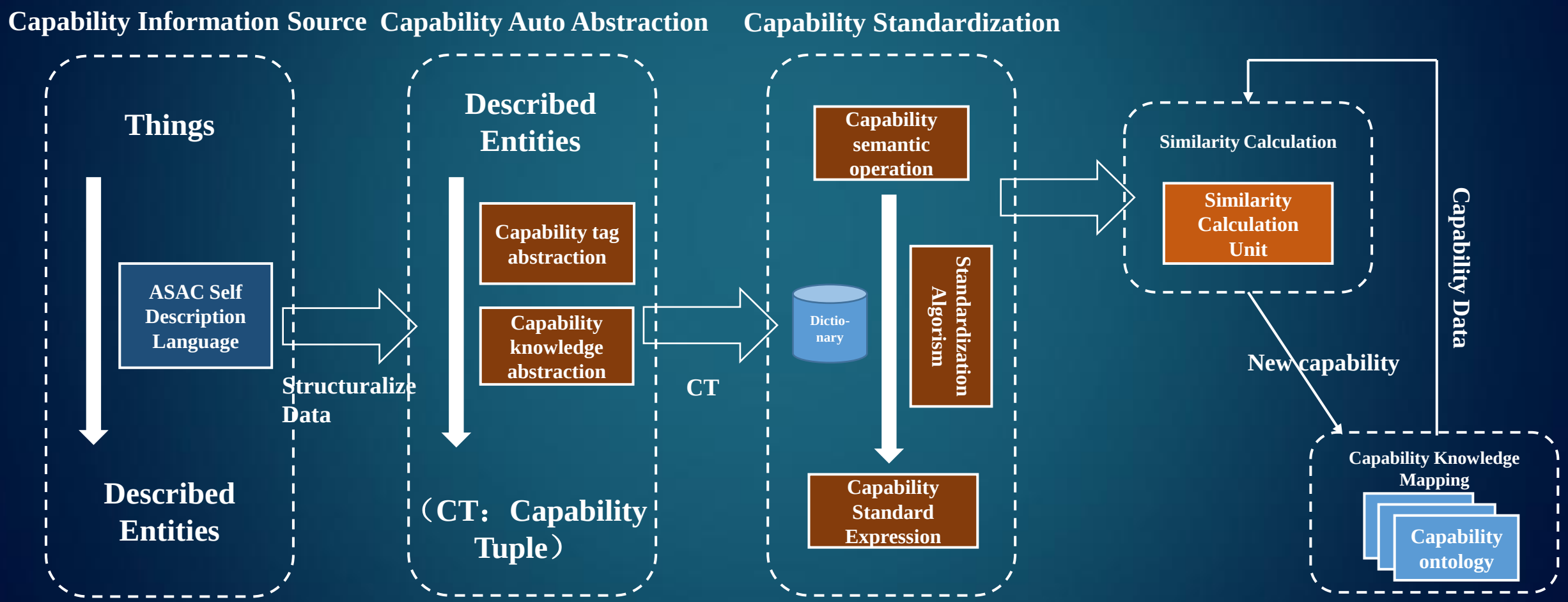


IoT Things Description

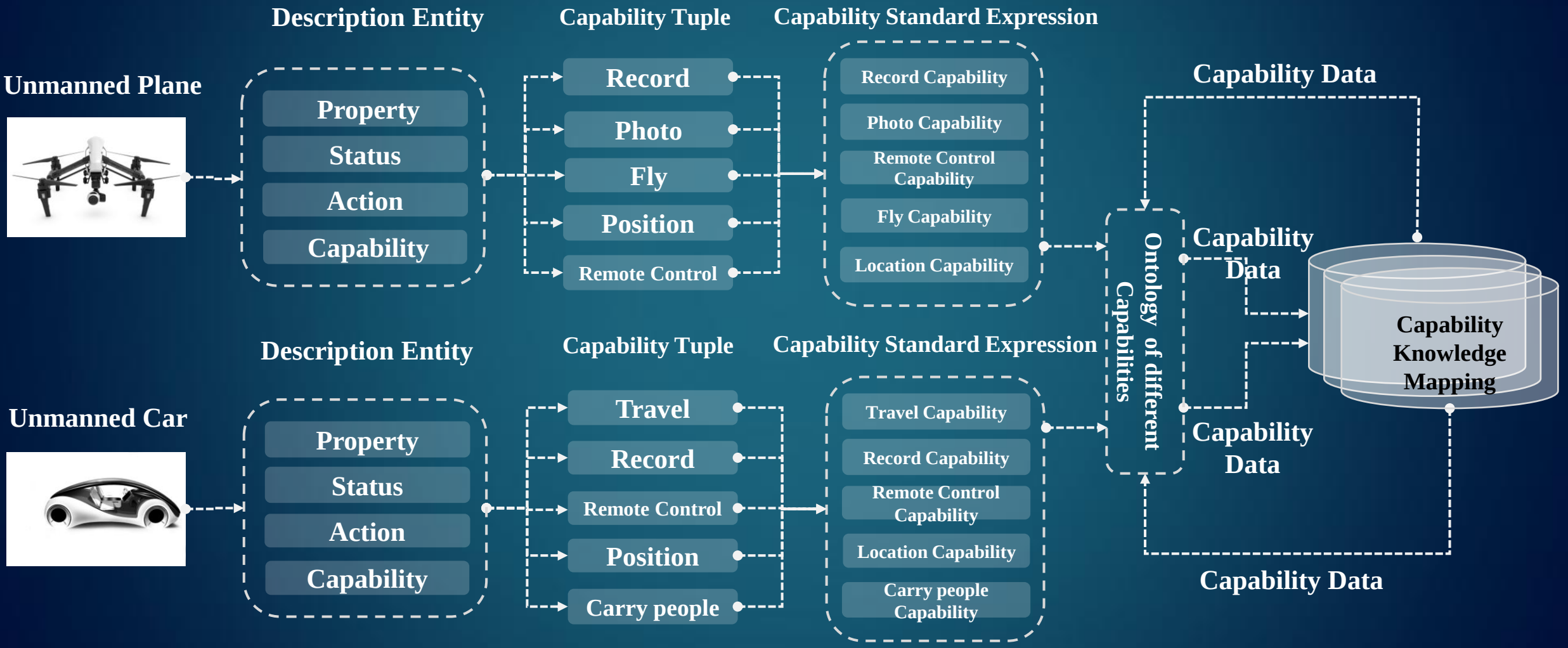
ASAC Self Description Language



IoT Things Description



IoT Thing Description

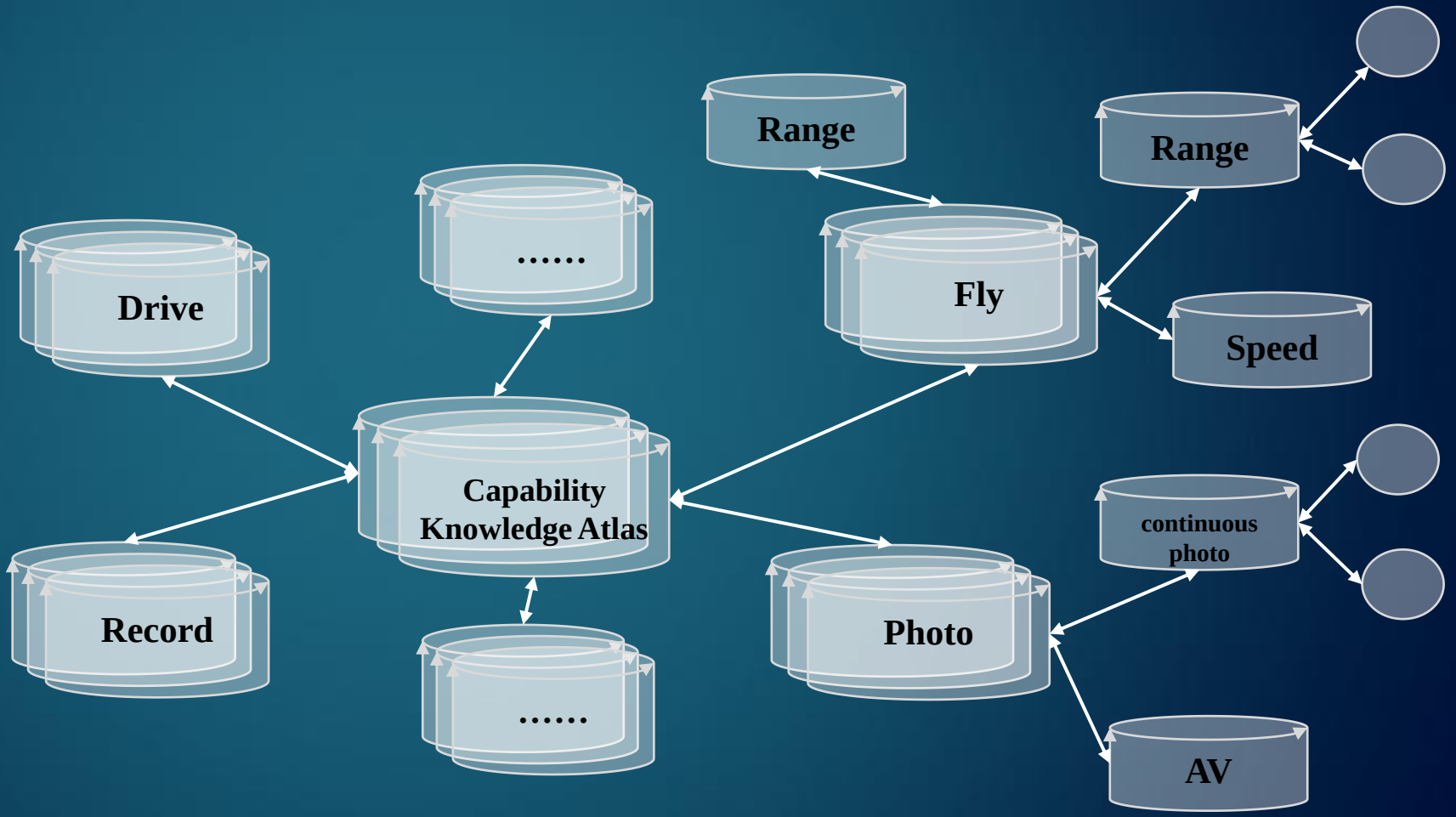


ASAC Self Description Language | Capability Auto Abstract | Capability Semantic Identification | Capability Ontology Auto Construction | Capability Knowledge Mapping

IoT Thing Description

Capability Knowledge Atlas：

- **Capability Knowledge Atlas is a massive public service infrastructure based on capability ontology and sematic network.**
- **The more times and wider range capability interact with atlas, the more information the atlas gets.**
- **Fusion of capability of all fields so that thing capability could interconnect.**
- **Atlas gain information form entire IoT.**



Things Discovery

IoT Things Discovery

- Identifications differ
- No capability identification
- Lack of Geolocation identification
- Lack of security in DNS of Internet
- No specific IoT resolution system

IoT Things Discovery

Categories of TRS Services

Capability Resolution Service

Identify Capability: Use the thing description tool to identify a thing's ability in the net work. One thing can have multiple abilities.

Resolution System: Resolute the ability identification of a things and map the ability with its address

Network System: Compatible with TCP/IP and could be extended to other networks.

Location Resolution Service

Identify Location: Compare to information in Internet, the geological location of a things is much more important than network address.

Resolution System: Resolute the location identification of a things and map the location with its address

Network System: Compatible with TCP/IP and could be extended to other networks

Name Resolution Service

Identify Things: A thing's identification is mapped as the ID of the VE to mark the thing's IP or other addresses. Among them, **URL** is the most popular one on the Web.

Resolution System: Use URL, EPC and other indemnification to map the name of a thing and network address.

Network System: TCP/IP, Ethernet, IP network etc.

IoT Things Discovery

External Identification: Follows human sematic understanding, for human-thing interaction.

Internal Identification: Follows thing identification principle, for thing-thing interaction.

TRS

TRS Identification System

TRS

Use for capability identification resolution

Top-level root identification, use to explain mode category.

Unique Identification Method：capability.location.thing.mode

Use for positioning, compatible with legacy systems.

Compatible with legacy systems, including DNS

TRS

capability	thing	location	mode
sensing control complex …	URL EPCglobal Ecode …	longitude latitude attitude …	conly Tonly tns …

IoT Things Discovery

TRS System

Due to the dispersity and unknowability of IoT thing coding, and DNS can only resolve unified and knowable resource address like URI, a new resolution system is required to solve the problem.

IoT Open System Architecture TRS system not only compatible with DNS and other identification resolution systems, also specially design for capability and position identifications, so that it's possible to search capability and positions individually. This greatly expanded TRS system in IoT. With the fusion of 3 sub-systems, it is safe and efficient.

TRS Resolution System

Comprehensive resolution system based on thing name system and other systems.

TRS Root Server

Store and allocate top-level service type names and allocate them to second level.

TRS Second Level Server

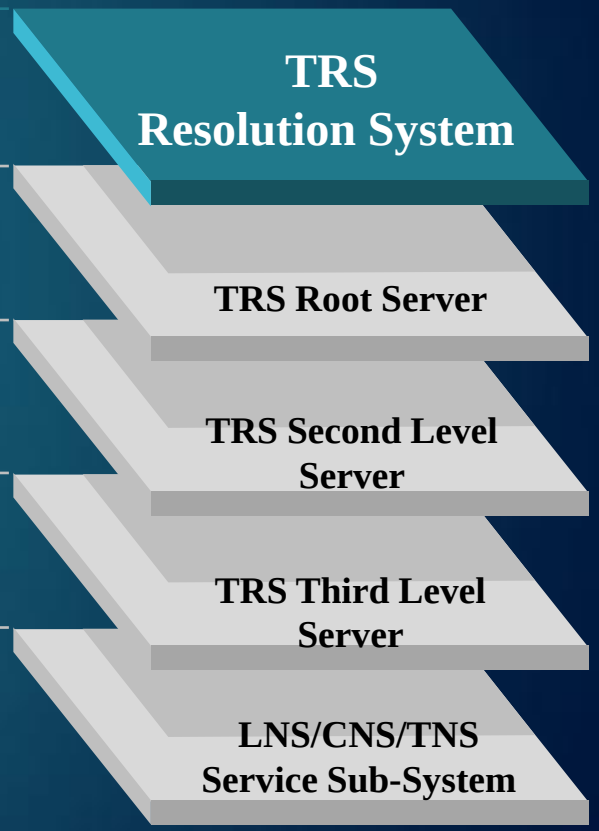
Use to decide real name according to service type and allocate to third level.

TRS Third Level Server

Allocate identifications to servers according to service requests and fuse with return.

TRS Sub-System Servers

Resolve capability, position and thing name and return to third level server.



IoT Things Discovery

Introduction of Sub-Systems

CNS

Capability Resolution Sub-system

Capability name tag, network address of things with this capability

Return list of things with entered capability and addresses.

capability

LNS

Position Resolution Sub-system

Position tag, network address of things with this position

Return list of things with entered capability and addresses.

location

TNS

Thing Name Resolution Sub-system

Name tag, network address of things with this name

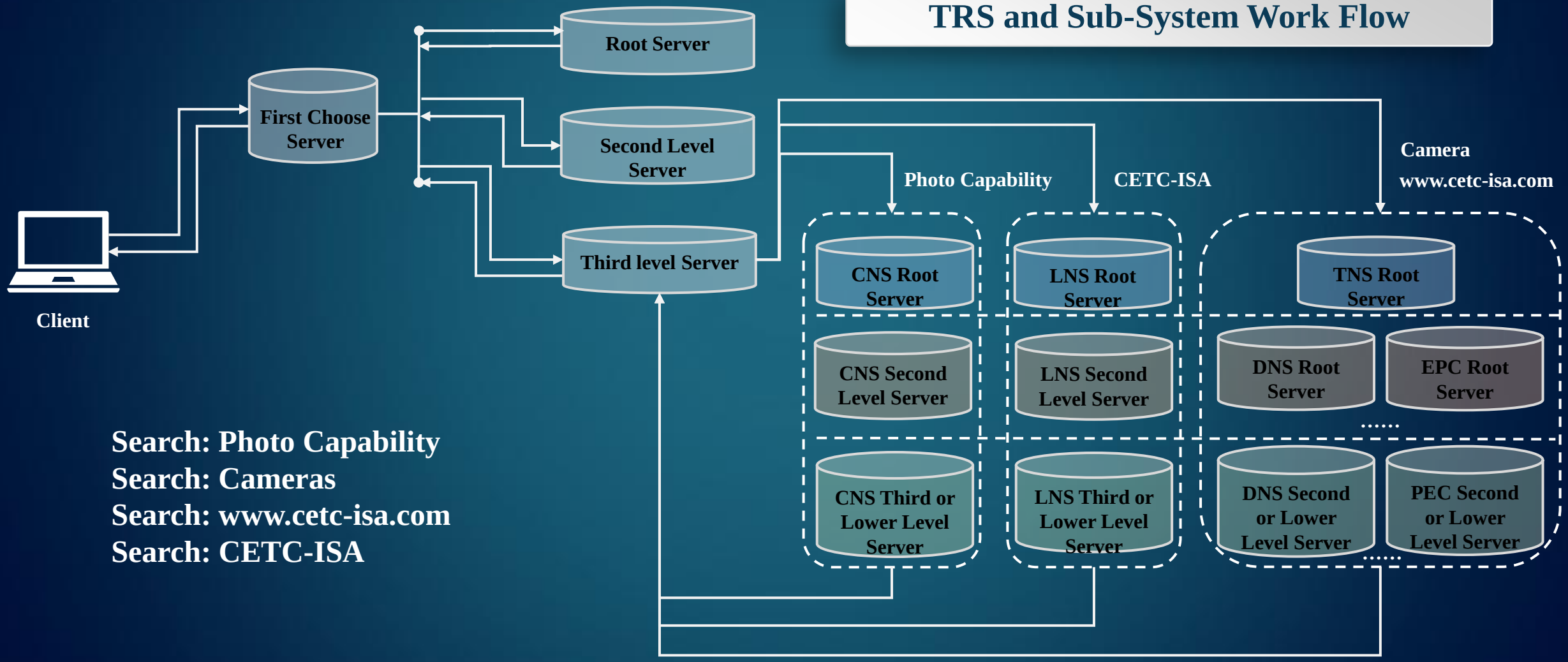
Return thing address.

thing

- DNS — DNS-Sub-System
- EPC — EPC-Sub-System
- ……

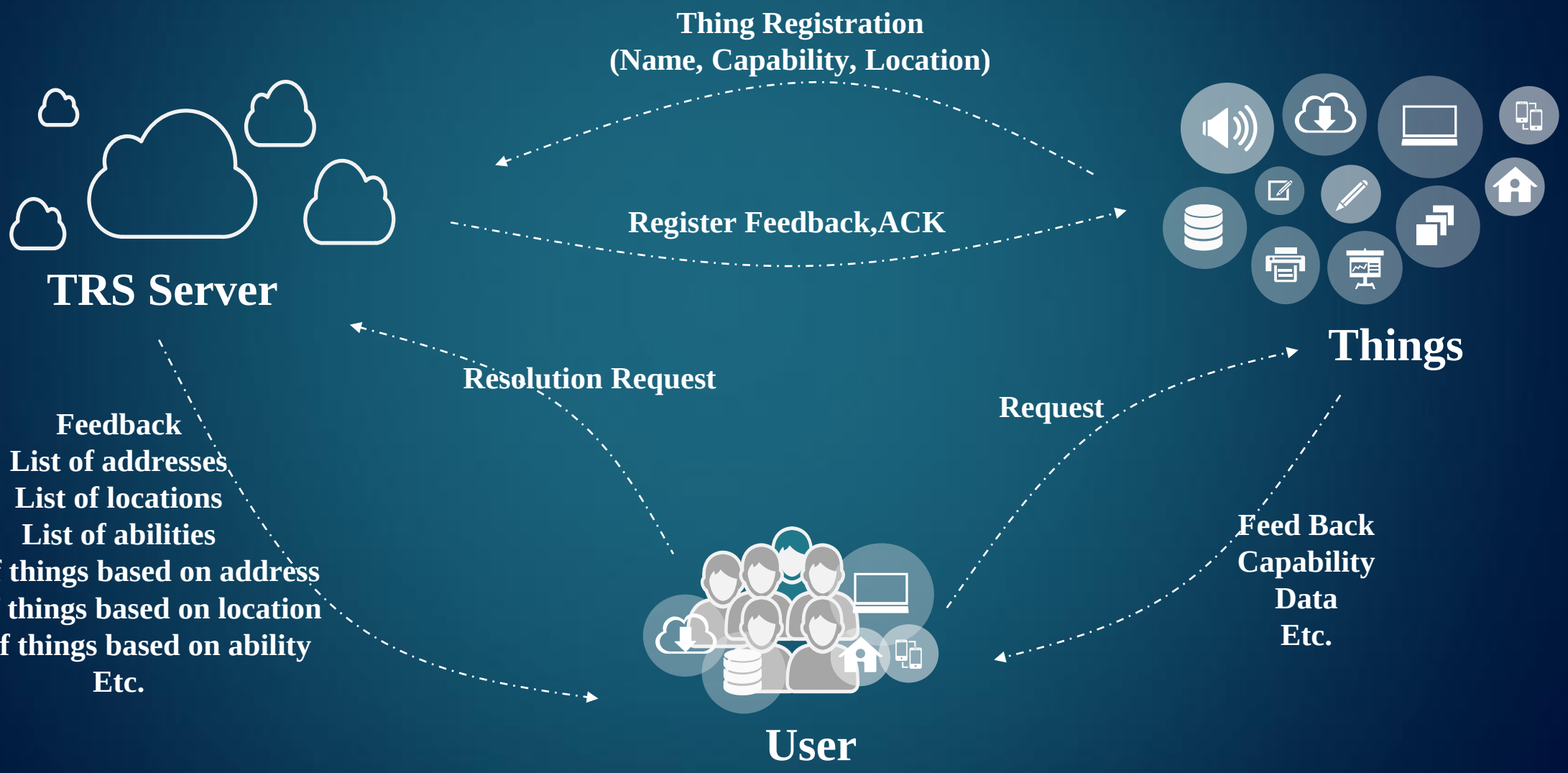
IoT Things Discovery

TRS and Sub-System Work Flow



Search: Photo Capability
Search: Cameras
Search: www.cetc-isa.com
Search: CETC-ISA

IoT Things Discovery



IoT Things Discovery

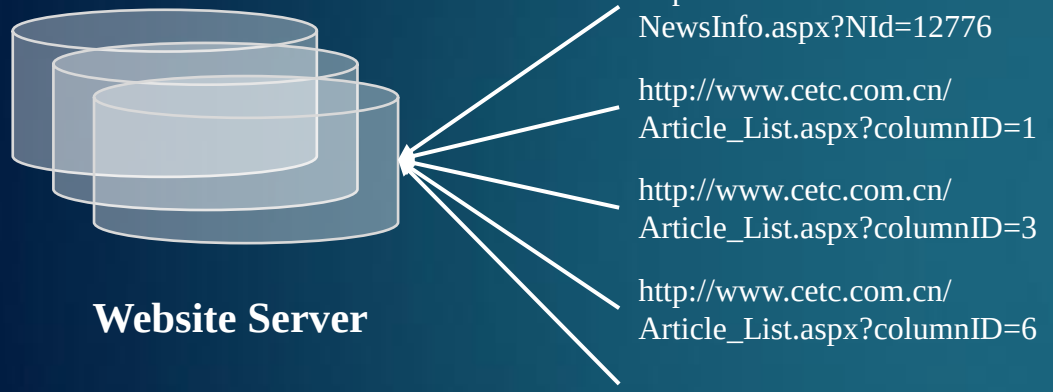
IoT Open System Architecture TRS Global Server Location Blueprint

Things Integration

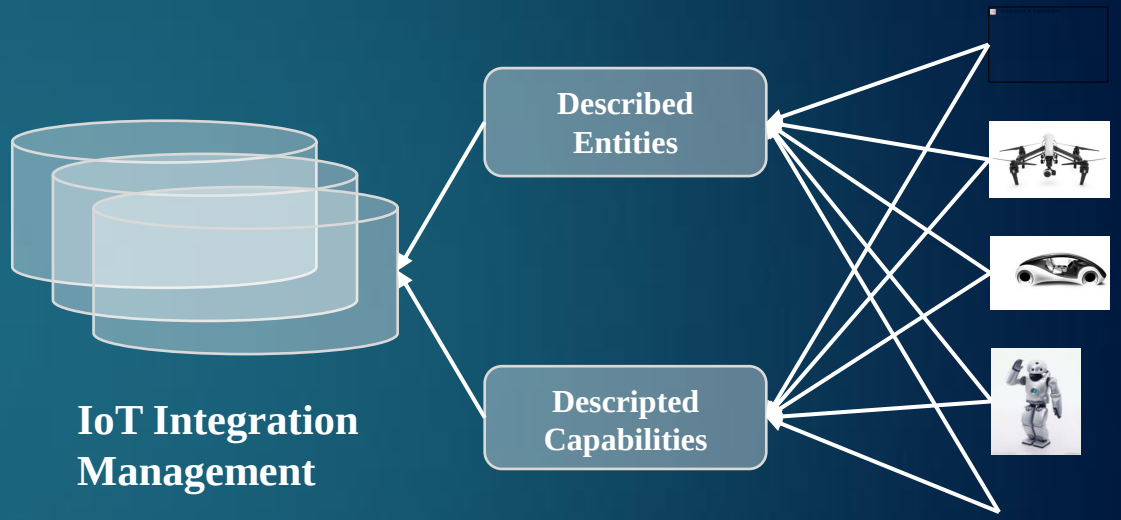
IoT Things Integration

The number of things is much more than current PCs and have different APIs and capabilities. Unified management is required together with better security system. A platform is needed to screen the difference of things, control the access and management of things, and expose unified APIs and capability services.

IoT Things Integration

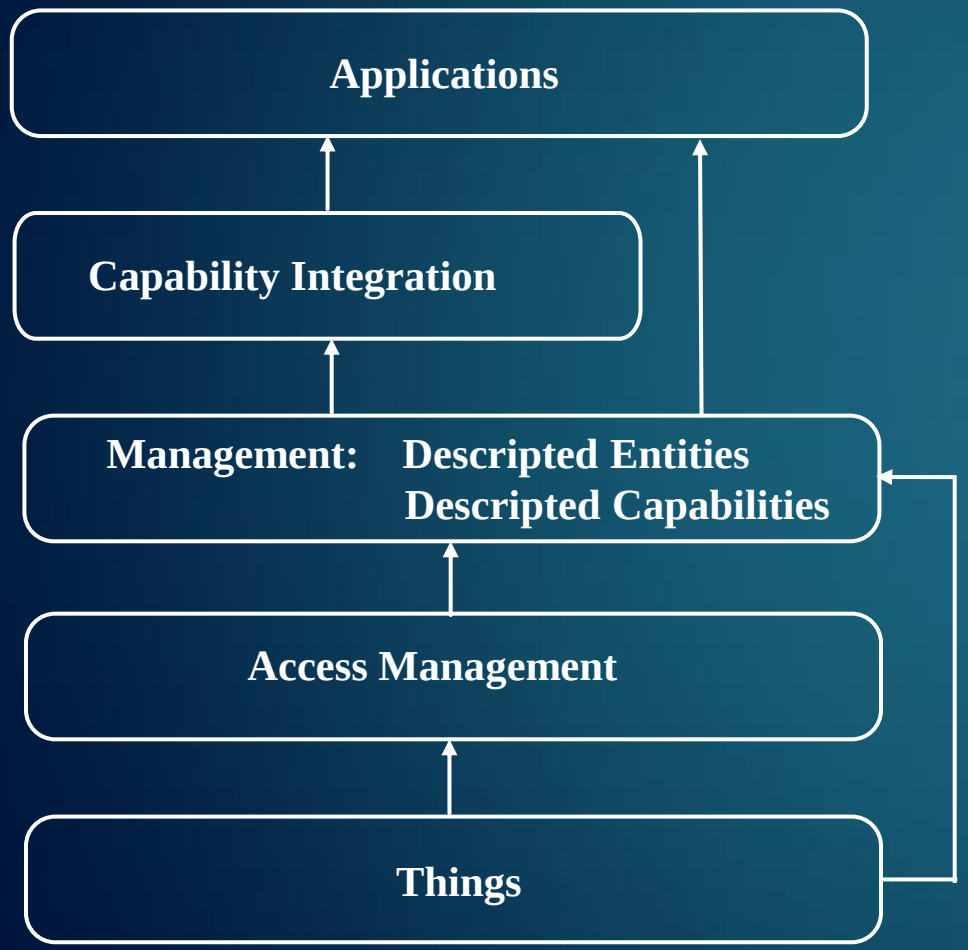


In web system, a web server controls all pages under a realm name and achieve the management of the website.



Things integration management would achieve unified thing access and control through the platform layer and maintain the description entities and capability descriptions.

IoT Things Integration



Access Management

Support multiple access methods. Can connect directly or through a gateway, etc.

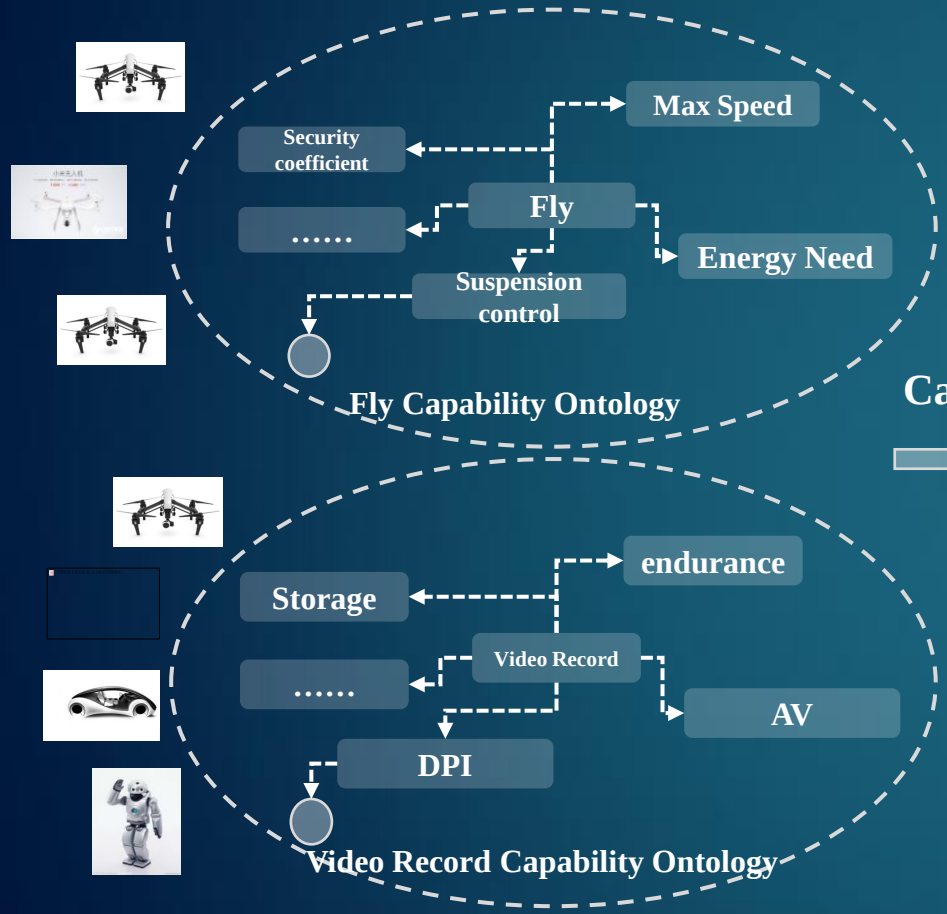
Descripted Entity and Descripted Capability Management

Descripted entities and descripted capabilities for things are managed and maintained by the platform layer. It will mapped with corresponding things.

Thing Capability Integrity

Things integration management platform can do some level integration of capabilities and provide capability integrated services.

IoT Things Integration



IoT Things Integration

Capability Integration: By smartly connecting things, we can enrich things' capability. It could expanded to new capability which could not be achieved by one thing individually.

Move

Recognition

Record

Fly

Illumination

Record

Fly

Recognition

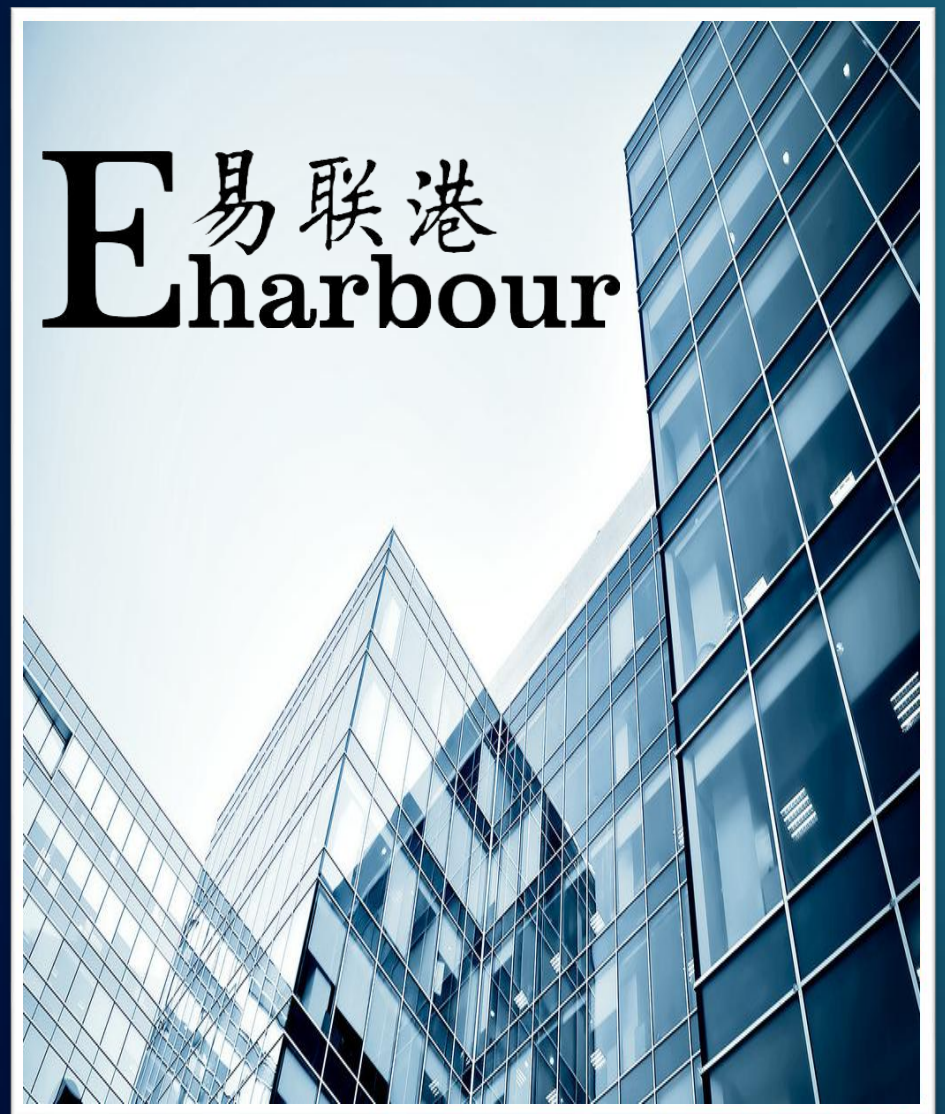
Illumination

Move

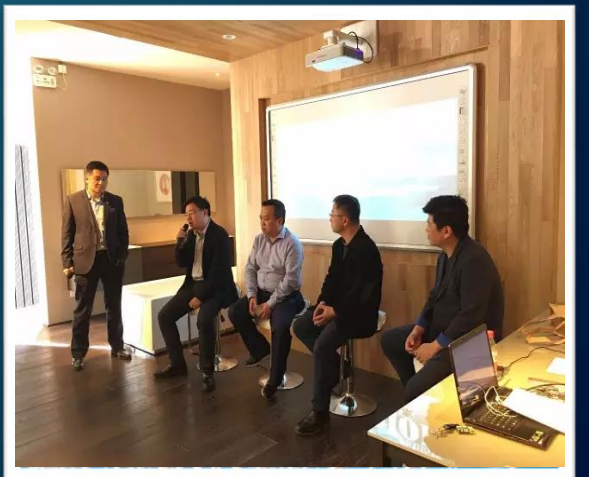
The robot use capability of other things to reach things beyond its height in darkness.

Architecture Use Cases

架构技术应用案例



E-Harbour is a real estate projected promoted by Beijing Wuliangang Tech Ltd and Loushichuanmei Group Corporation with the help of CIoTA and CETC Open IoT System Architecture. It unites many real estate companies and smart-device producers to come up with a IoT smart house, smart community solution, and advanced IoT implantation in buildings and offices.



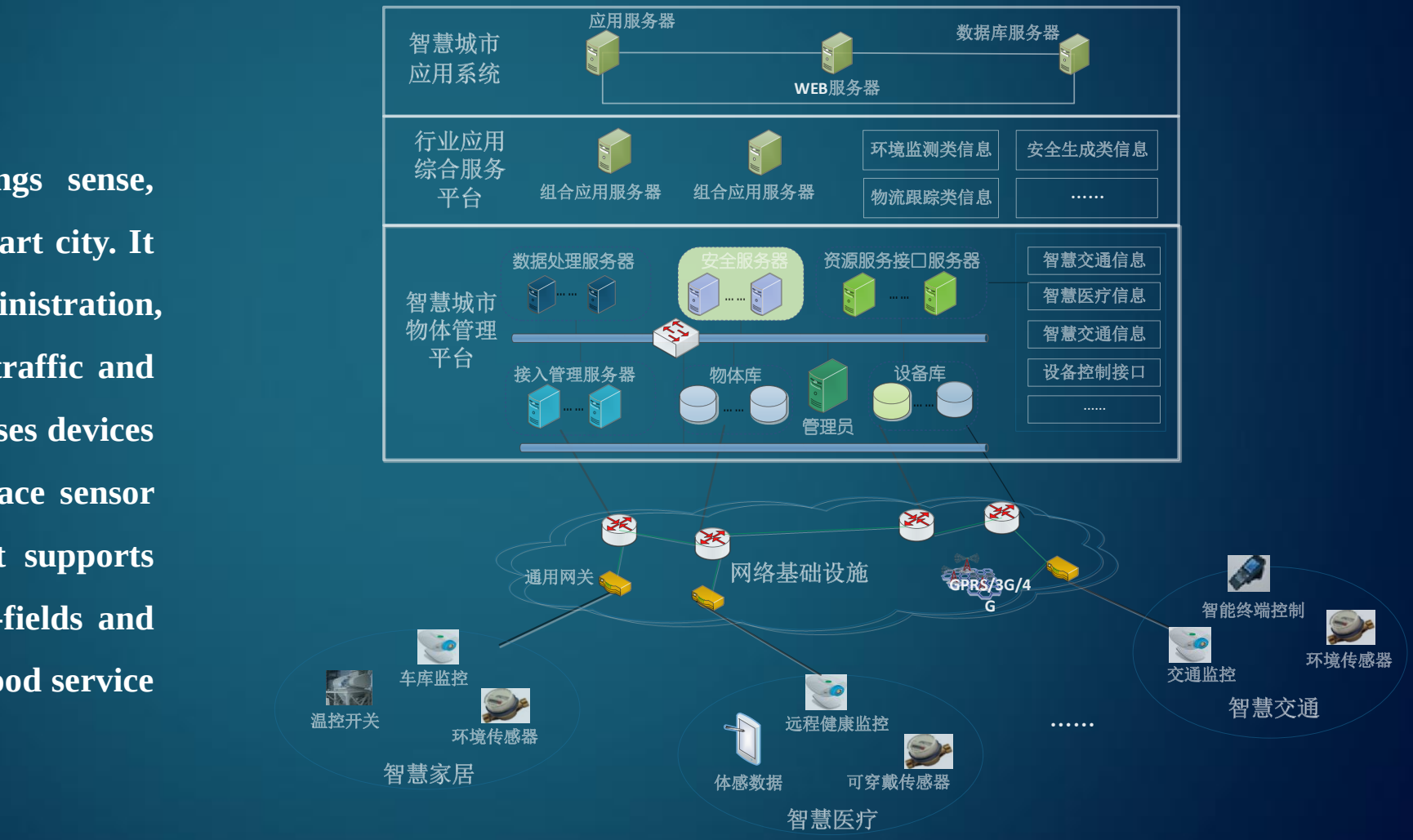
CETC Wuzhen Street View Platform

This platform display live video of Wuzhen for government to control security and visitors to feel the sight of Wuzhen. Through IoT Open System Architecture, it's possible to control fluorite devices and get information about devices or live stream.

架构技术应用案例

Smart City

IoT supply unified things sense, management, services for smart city. It supports devices for city administration, environment, water supply, traffic and other fields. It unified addresses devices to build a integrated city space sensor system. At the same time it supports devices and app share cross-fields and cross-zone. It supports live hood service and administration power.



Thank You !

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