# 边缘计算参考架构3.0

**Edge Computing Reference Architecture 3.0**

# 目录
## Contents

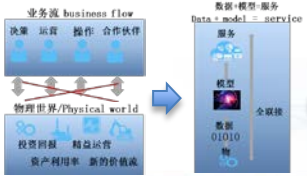
## 边缘计算产生的背景与需求
## Background and Requirements of Edge Computing

### 行业数字化转型以数据作为生产要素，以智能化创造经济与社会价值

**Industry digital transformation uses data as a factor of production and uses intelligence to create economic and social value**


## 边缘计算产生的背景与需求
## Background and Requirements of Edge Computing

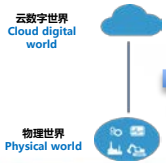
### 行业数字化转型需要四个关键转变，连接+数据+模型是基础
**The industry's digital transformation requires four key changes . The connection + data + model is the foundation.**




- **物理世界与数字世界从割裂转变为协作融合；** The physical world and the digital world have changed from fragmentation to collaborative integration;
- **运营决策从模糊的经验化转变为基于数字化、 模型化的科学化；** Operational decision-making has changed from vague empiricalization to scientificization based on digitization and modelling;
- **流程从割裂转变为基于数据的全流程协同；** The process shifts from fragmentation to data-based full process collaboration;
- **行业单边创新转变为基于产业生态的多边开放创新;** The unilateral innovation of the industry has turned into a multilateral open innovation based on industrial ecology.

# 边缘计算产生的背景与需求
# Background and Requirements of Edge Computing

## 物理世界与云数字世界连接存在诸多挑战
## There are many challenges in the connection between the physical world and the cloud digital world.




**时延 /Delay**

- 工业场景一般要求处理时延低于10ms；Industrial scenarios generally require a processing delay of less than 10ms

**带宽 /Bandwidth**

- 无人驾驶汽车10G数据/公里；Driverless car 10G data / km;
- 飞机引擎10,000G数据/飞行30分钟；Aircraft engine 10,000G data / flight 30 minutes;

**安全/Security**

- 数据安全管制要求；Data security regulatory requirements;
- 数据企业私有化；Data enterprise privatization;

**可靠 /Reliable**

- 边缘与云的联接不可靠；The connection between the edge and the cloud is not reliable;

## 边缘计算产生的背景与需求
## Background and Requirements of Edge Computing

**连接+数据+模型需要分布到网络边缘侧，实现物的自主化和协作化**

**Intelligence needs to be distributed to the edge of the network to achieve autonomy and collaboration.**

# 边缘计算是分布式开放平台 /Edge computing is a distributed open platform

## 边缘计算的概念与价值
## The Concept and Value of Edge Computing


**边缘计算开放平台**
**Edge computing open platform**

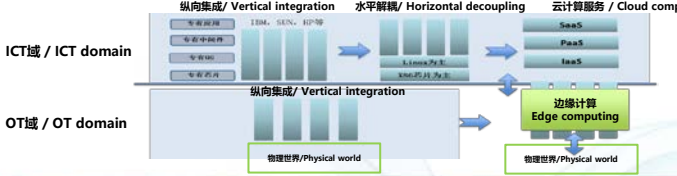
**概念 /Concept**

- 边缘计算是一个**开放分布式平台**，在网络边缘靠近数据源就近提供网络、计算、存储等服务，满足了行业数字化转型在联接、智能、实时、数据优化和安全的诉求。
- Edge computing is an open distributed platform that provides network, computing, storage and other services close to the data source at the edge of the network, meeting the demands of the industry's digital transformation in connectivity, intelligence, real-time, data optimization and security.

## 边缘计算的概念与价值
## The Concept and Value of Edge Computing

**边缘计算通过水平解耦与纵向集成协作，实现ICT和OT域融合**

**Edge computing achieves ICT and OT domain fusion through horizontal decoupling and vertical integration.**



# 边缘计算参考架构
# Edge Computing Reference Architecture
# 设计理念
# Design Ideas

## 模型驱动的参考架构/Model-driven reference architecture

实现物理世界和数字世界的协作
Achieve collaboration between the physical world and the digital world

减少系统异构性，简化移植
Reduce system heterogeneity and simplify cross-platform porting

实现跨产业的生态协作
Achieve cross-industry ecological collaboration

有效支撑系统的全生命周期活动
Effective support system for full life cycle activities

## 技术迁移与创新/Technology migration and innovation

技术迁移/Technology migration

- SDN NFV
- Business Orchestration
- Micro service
- Virtualization

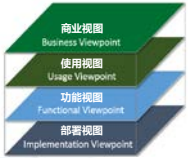

独特创新/Unique innovation

- TSN
- AI algorithm optimization
- CCF
- Low power OS
- Low power chip

边缘计算是OT和ICT融合产业
Edge computing is the OT and ICT convergence industry

## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0

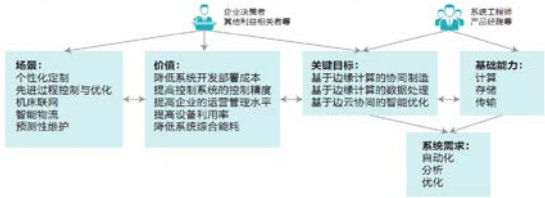

- **基于ISO/IEC/IEEE 42010的多视图呈现 / Viewpoints from ISO/IEC/IEEE 42010**




- 阐述利益相关者间的关系及商业愿景
- Explain the relationship between stakeholders and business vision
- 阐述如何指导实现可靠、复杂的边缘计算系统功能
- Describe how to guide the implementation of reliable, complex edge computing system functions
- 阐述系统功能组件及及其关系、结构、交互接口
- Explain system function components and their relationships, structures, and interfaces
- 阐述系统部署的模式和部署过程
- Explain the pattern and deployment process of system deployment

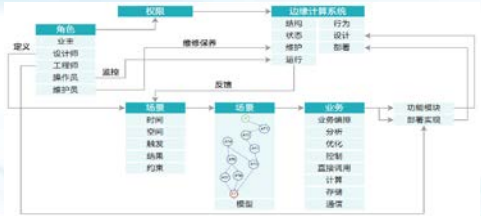
**边缘计算参考架构 3.0**
**Edge Computing Reference Architecture 3.0**

- **商业视图 /Business Viewpoint**

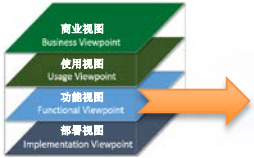
**边缘计算参考架构 3.0**
**Edge Computing Reference Architecture 3.0**

- **使用视图 /Usage Viewpoint**

**边缘计算参考架构 3.0**
**Edge Computing Reference Architecture 3.0**

- **功能视图 /Function Viewpoint**




## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0

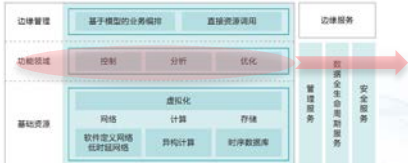

- **功能视图 /Function Viewpoint**


- **基础资源 /Basic Resources**

- **网络：时间敏感网络（TSN）提供边缘侧高实时转发能力，软件定义网络（SDN）提供全局的网络综合管控能力；Network: Time-sensitive network (TSN) provides high real-time forwarding capability on the edge side, and software-defined network (SDN) provides global network integrated management and control capabilities;**
- **计算：包括通用计算能力（x86、ARM）和专用计算能力（FPGA、GPU、AI芯片）等；Compute: including general computing power (x86, ARM) and dedicated computing power (FPGA, GPU, AI chip), etc.**
- **存储：包括结构化数据库和时序数据库（ TSDB Time Series Database）等；Storage: including structured database and time series database (TSDB Time Series Database);**
- **虚拟化：将功能与硬件能力分离、解耦，提供灵活的迁移能力；Virtualization: Separating and decoupling functions from hardware capabilities and providing flexible migration capabilities.**

## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0


- 功能视图 /Function Viewpoint



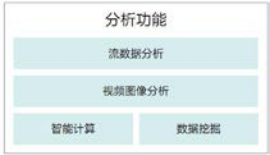

- 各领域功能模块/Function Modules in various fields
- 控制功能/Control function


- 感知与执行:基本物理接口功能块，提供实时的感知与执行功能。/Perception and execution: The basic physical interface function block provides real-time awareness and execution.
- 实体抽象:易于控制系统的上下文表征，将系统硬件资源软件化和服务化易于系统构建。/Entity abstraction: It is easy to control the context representation of the system; transforming system hardware resources into software and services makes system building easy.
- 建模:构建系统基本模型库，通过模型复用简化建模过程。/Modeling: Build a basic model library of the system and simplify the modeling process through model reuse.
- 资产管理:对控制系统操作的管理，上线、配置等。

## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0


- **功能视图 /Function Viewpoint**


- **各领域功能模块/Function Modules in various fields**
- **分析功能/Analysis function**




- 针对不同分析应用场景，提供所需要的基本操作与基本算法功能块，例如，数据获取功能块、图像特征提取功能块、遗传算法功能块等。
- For the different analysis application scenarios, this function provides the basic operations and algorithm function blocks, for example, a data acquisition function block, an image feature extraction function block, a genetic algorithm function block, etc.

## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0


- **功能视图 /Function Viewpoint**

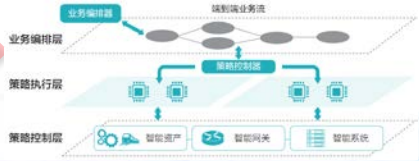

- **各领域功能模块/Function Modules in various fields**
- **优化功能/Optimization function**


- **车间级别/Workshop level**
  - **车间排产优化，包括需求预测模型优化、供应链优化管理、生产过程优化等。/Workshop scheduling optimization, including demand forecasting model optimization, supply chain optimization management, production process optimization, etc.**
- **生产线级别/Production line level**
  - **优化控制参数，多元控制协同优化提高产线控制系统性能。/Optimize control parameters, using multi-control collaborative optimization to improve production line control system performance.**
- **设备级别 /Device level**
  - **优化数据通信与事件管理，提高信号传递的实时性与事件的响应速度。/Optimize data communication and event management to improve real-time signal transmission and event response speed.**

## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0


- 功能视图 /Function Viewpoint
- 边缘管理/Edge management


- 基于模型的业务编排/Model-based business orchestration

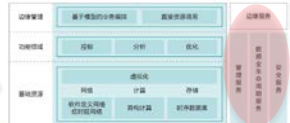



- 直接资源调用/Direct resource call

- 通过代码管理、网络配置、数据库操作等方式直接调用相应的资源，完成业务功能。
- The service function is completed by directly calling the corresponding resources through code management, network configuration, database operation, etc.,

## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0


- **功能视图 /Function Viewpoint**
- **边缘服务/Edge Service**




- **数据全生命周期服务/Data lifecycle service**
  - 通过业务编排层定义数据全生命周期的业务逻辑/Defining the business logic of the data lifecycle through the business orchestration layer
  - 通过功能领域优化数据服务的部署和运行/Optimize the deployment and operation of data services through functional areas


- **管理服务/Management service**
  - 支持面向终端设备、网络设备、服务器、存储、数据、业务与应用的隔离、安全、分布式架构的统一管理服务。Support unified management services for isolated, secure, and distributed architectures for end devices, network devices, servers, storage, data, business and applications.
  - 支持面向工程设计、集成设计、系统部署、业务与数据迁移、集成测试、集成验证与验收等全生命周期。Support full lifecycles for engineering, integrated design, system deployment, business and data migration, integration testing, integration verification and acceptance.

## 边缘计算参考架构 3.0
## Edge Computing Reference Architecture 3.0

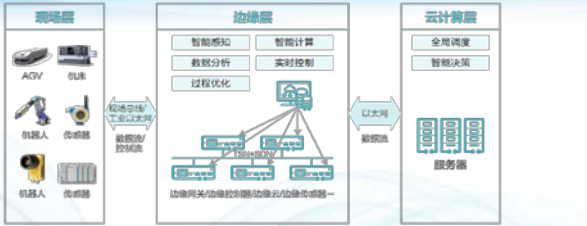

- **功能视图 /Function Viewpoint**
- **边缘服务/Edge Service**



- **安全服务/Security service**
  - **安全服务需要覆盖边缘计算架构的各个层级/Security services need to cover all levels of the edge computing architecture**
  - **统一的态势感知、安全管理与编排/Unified situational awareness, security management and orchestration**
  - **统一的身份认证与管理/Unified identity authentication and management**
  - **统一的安全运维体系/Unified security operation and maintenance system**

**边缘计算参考架构 3.0**
**Edge Computing Reference Architecture 3.0**

- **部署视图 /Implementation Viewpoint**

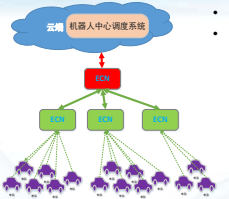
## ECC产业发展与商业实践
## ECC Industry Development and Business Practice

### AGV应用场景
### Logistics Sorting Application Scenario

- 大规模AGV的实时调度与规划
- Real-time scheduling and planning of large-scale AGV

大规模AGV路径规划

多AGV路径冲突问题的避让控制




分布式边缘协同/Distributed edge collaboration

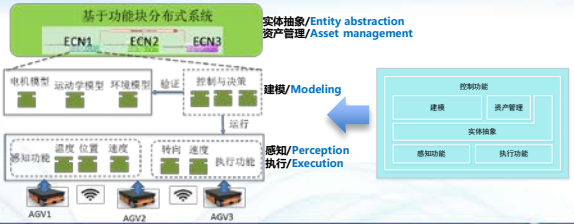
- 整体解决方案/Solution
- 通过引入边缘计算，将大规模的集中式计算划分成不同层次的中小规模的协同计算，将实时任务与时间不敏感型任务分开执行，充分发挥各种计算单元的优势，实现性能、成本、功耗等方面的均衡。/By introducing edge computing, large-scale centralized computing is divided into small-scale collaborative computing at different levels. Real-time tasks are executed separately from time-insensitive tasks, giving full play to the advantages of various computing units to achieve a balance of performance, cost, and power consumption.

# ECC产业发展与商业实践
# ECC Industry Development and Business Practice

## 物流分拣应用场景
## Logistics Sorting Application Scenario

## 具体实现/Concrete implementation

- 感知功能/Perception function
  - 获取AGV位置信息/Get AGV location information
- 执行功能/Execution function
  - 下发AGV执行指令/Send AGV execution command
- 建模/Modeling
  - AGV运动离散模型/AGV motion discrete model
  - 用于前期设计时控制决策算法的验证/Verification for control decision algorithms used in pre-design.
- 实体抽象/Entity abstraction
  - ECN节点抽象为一个软件实体通过IP地址唯一标识/An ECN node is abstracted as a software entity uniquely identified by an IP address.
- 资产管理/Asset management
  - 对软件实体的启动、暂停，以及软件实体内部单个功能块的在线管理（增加、删除、改参数等）/startup, suspension of software entities, and online management of individual functional blocks within a software entity (add, delete, change parameters, etc.)

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