砥砺前行，厚积薄发

Against All Odds, Practice Makes Perfection

刘少伟，ECC副理事长，华为网络研发部总裁
Swift Liu, Vice Chairman of ECC, President of Network R&D, Huawei

联盟成员 ECC Members

全球化　多行业　全产业链

Globalization

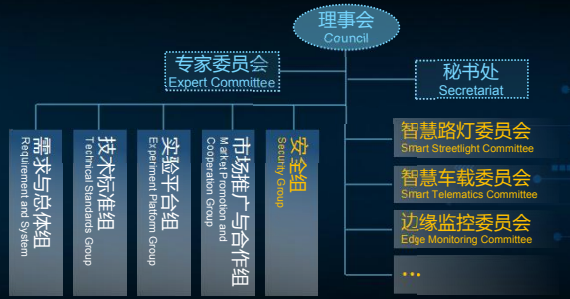
Many Industries

Whole Industry Chain

- 已发展154家会员。154 global members.
- 成立专家委员会，已有50+行业专家加入。Expert Committee has been established, with 50+ industry experts involved.

组织架构
Organizational Structure

完善水平能力　加强商业落地
Improve Horizontal Competence and Strengthen Commercial Implementation



组织架构优化 / Improvement in organizational structure

- 安全组 / Security Group
  - ✓ 安全技术研究 / Safety technology research
  - ✓ 促进安全规范与标准制定 / Promote safety norms and standards development
  - ✓ 安全技术和产品推广 / Safety technology and product promotion
- 行业委员会
  - ✓ 与行业协会紧密合作（ISA、CSA、TIAA等）/ Work closely with industry associations (ISA, CSA, TIAA, etc.)
  - ✓ 瞄准行业价值场景与核心需求，联合创新，构建测试床 / Innovate and build Testbeds with partners aimed at the industry valued scenarios and core requirements.
  - ✓ 联合推广复制，加速商业成功 / Jointly promote replication, accelerate business success

测试床 Testbeds

客户　创新　商业
Customers, Innovation, Business

4个行业，21个 测试床
4 industries, 21 Testbeds

工业制造 Manufacturing

电力能源 Energy / Power

	测试床/Testbed	关键技术/创新点 Key Technology Verification / Innovation
1	智能协作机器人助手	工业机器人与人工智能技术结合，包括：机器人的便捷人机交互，标准信息模型，云端接入，集群控制，深度学习等技术
2	面向个性化定制的自适应模块化制造	生产设备在数字世界的虚拟化和模型化；网络资源、生产设备、生产工艺的智能编排
3	机床物联网	机床故障自诊断、可预测性维护，提高设备可靠性，降低停机时间，提高生产使用效率
4	工业机器人预测维护	VM/容器，SDN开放集成框架；提高维护效率，降低维护成本
5	梯联网	电梯运行数据采集、分析和处理；实现状态感知，实时分析，故障诊断，可预测性维护，预期效果：业务中断降低80%；SDN实现集中管理，运维成本降低50%
6	工业机器人边缘计算控制器	机器人应用功能和运动控制功能的解耦，提高机器人的接口能力和计算能力
7	生产设备互联	对生产车间新旧设备互联感知，多个设备和系统间的数据交互，设备数据的采集、传输和云端接入
8	TSN	实时以太网标准TSN技术验证；OPC-UA Over TSN验证
9	AMI	通过PLC-IOT技术，降低线损，防窃电，自动抄表，提高运营效率
10	面向石化/油田的工业物联网验证	动态服务组合的SCADA编程技术；OPC UA的实时服务封装技术

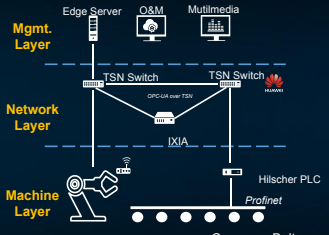
智慧城市 Smart City

	测试床/Testbed	关键技术/创新点 Key Technology Verification / Innovation
1	智慧环保-智能感知	降低监测成本，高密度城市环境网格化监测，提高运营效率，城市级海量传感器高效维护
2	照明物联网	降低能耗80%；SDN百万级云管理，结合GIS可视化管理，运维成本降低90%
3	智能楼宇	故障时间降低80%，故障率降低70%，维护人力降低60%
4	智慧水务	提高供水质安全性，增加供水设备可靠性，提高供水效率
5	智能水务-边缘智能	边缘与云计算协同，引入边缘流处理引擎，结合深度学习，保证供水系统高效、安全、可靠运行
6	智能安监	提升安全处置能力，减少人员及财产损失等
7	无人零售店	多种人工智能技术，人员/商品的识别监控等
8	智慧物流运输管理边缘计算	利用移动通信、物联网、大数据、智能传感等技术实现感知互联，目标：提升运输管理效率、规范司机驾驶行为、保障货物质量等
9	智慧保护区	全方位环境及生态信息感知，大数据挖掘，环境关联模型，提升工作效率
10	智慧农业	边缘与云计算协同：多级智能决策控制，云端高级智能控制+前端控制
11	智能车辆管理系	规范司机驾驶行为，保障车辆财产安全，降低运营费用，增加企业运营收益

交通 Transportation

TSN Testbed 1.0

促进OT与ICT融合
Facilitate OT and ICT Convergence



Huawei-Fraunhofer FOKUS TSN Testbed

Huawei-Fraunhofer FOKUS TSN Testbed

- 验证TSN IEEE 802.1协议 / Verify TSN Protocols (IEEE 802.1)
- 验证OPC-UA Over TSN / Verify OPC-UA Over TSN
- 验证边缘计算 / Verify Edge Computing

Value of TSN

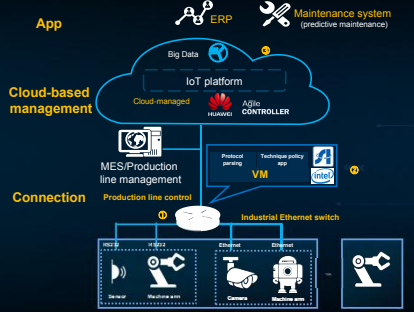
- 交互性，适配标准以太网 / Interoperability: compatible with standard Ethernet
- 可靠性：多路径/冗余路径技术 / Reliability: multipath / redundant path technology
- 低时延：时延<10μs, 抖动<1μs / Low latency: latency < 10μs, jitter < 1μs
- 资源管理：支持SDN / Resource management: support SDN

Huawei-Fraunhofer FOKUS 联合TSN测试床在2017年11月7日的柏林边缘计算峰会发布
Huawei-Fraunhofer FOKUS Testbed was released at Berlin Edge Computing Forum on 7th, Nov. 2017

智能制造测试床
Smart Manufacturing Testbed

加速生产制造智能化转型
Accelerate Smart Manufacturing Transformation

2017年11月7日荣获中国国际工业博览会创新金奖



边缘计算 Edge Computing CONSORTIUM | HUAWEI

关键技术/Key Technologies

- SDN使能，X-Ethernet端到端承载 / SDN and X-Ethernet Enabled
- 开放网关预置控制App，边云协同，全生命周期管理，使能柔性生产 / Open Gateway is preset with control App, Edge and Cloud are collaborative, Lifecycle Management enables flexible production
- 边缘采集监控+云端分析和诊断，实现设备可预测性维护 / Edge Acquisition Monitoring, with Cloud Analysis and Diagnostics, for predictive maintenance of the equipment

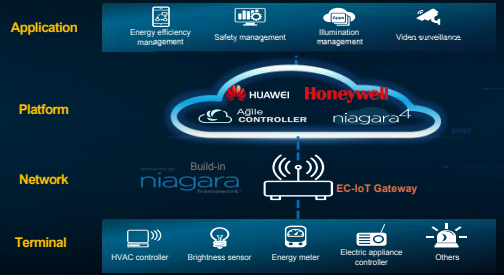
客户价值/Value of Customer

- 时延：2毫秒→2微秒；生产效率提升40% / Latency: from 2 milliseconds to 2 microseconds; Productivity increased by 40%
- 工艺流程调整周期：1周→1天 / Process adjustment cycle: from 1 week to 1 day
- 产线设备故障率降低70% / Line equipment failure rate reduced by 70%

智能楼宇测试床
Smart Building Testbed

功能型 → 智能型
Functional → Smart

孤立系统 → 多系统联动
Isolated System → Multi-system Interaction



关键技术/Key Technologies

- 支持20多个物联网接口 / 20+ IoT Interfaces
- 支持1000+协议能力 / 1000+ vertical protocols
- 自动互联，运维数据实时分析决策 / Automatic interconnection, real-time analysis of O&M data and decision-making
- 移动应用，支持随时随地管理 / Mobile App，Management Anywhere，Anytime
- 智能检测亮度、温度、湿度和人流；智能调整亮度、HVAC、能源分配，降低能耗 / Intelligent detection of brightness, temperature and humidity and flow; intelligent adjustment of brightness, HVAC, energy distribution, lowered energy consumption

客户价值/Value of Customer

- 降低 60% OPEX / Reduce OPEX by 60%
- 降低 50% 能耗 / Reduce energy consumption by 50%

HVAC：Heating, Ventilation and Air Conditioning

边缘计算
Edge Computing

定义　特点
Definition, Characteristics

- 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, as well as edge intelligence services near the network edge or data sources, and meets the requirements of industry digital transformation in connections, real-time services, data optimization, intelligence, security and privacy protection.

天然的网络和联接属性
Born with Connectivity and Network

支持多种网络和功能
Multiple Network Types/Functions

数据“第一入口”
"First Entrance" of Data

大容量，低时延
Massive Data Volumes, Real-time

软硬件约束
Software & Hardware Performance Constraints

成本受限，性能受限，恶劣工作环境
Low Cost, Limited Performance, Poor Working Condition

分布式
Distributed

软硬件解耦，动态编排，统一管理
Decoupled, Dynamic Orchestration and Unified Mgmt.

服务与协同
Service and Collaboration

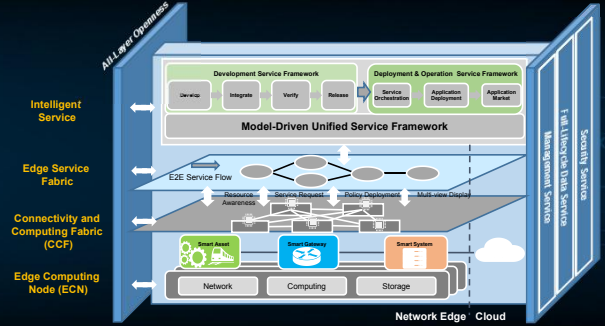
ICT和OT功能服务化，边缘与云协同
ICT+OT Converged Services Edge and Cloud Collaboration

边缘计算参考架构2.0

Edge Computing Reference Architecture 2.0 (ECRA 2.0)

模型驱动 业务编排 智能服务

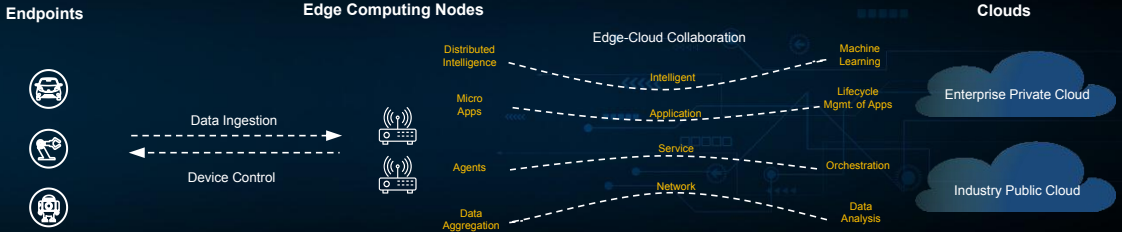
Model-Driven, Business Orchestration, Intelligent Service



架构特点 / Architecture Features

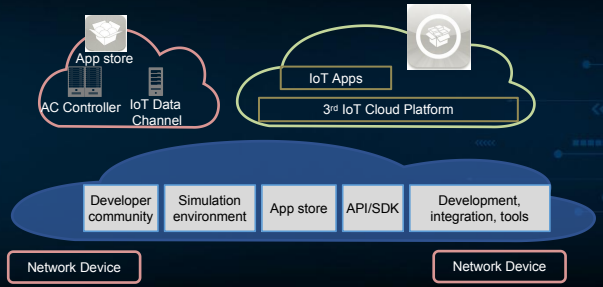
- 模型驱动的开放架构，实现： / Model-driven open architecture enables
  - ✓ 物理世界和数字世界的协作 / Collaboration between the physical world and the digital world
  - ✓ 跨产业的生态协作 / Cross-industry ecological collaboration
  - ✓ 减少系统异构性，简化跨平台移植 / Reduce system heterogeneity and simplify cross-platform migration
  - ✓ 有效支撑系统的全生命周期活动 / Effectively support system life cycle activities
- 智能分布式架构，实现：/ Intelligent distributed architecture enables
  - ✓ 架构极简/ Simplest architecture
  - ✓ OICT设施自动化和可视化/ OICT infrastructure automation and visualization
  - ✓ 资源服务与行业业务需求的智能协同/ Intelligent synergy for resource service and industry requirement
- 开发框架,实现： / Development Framework enables
  - ✓ 开发服务与部署运营服务协同 / Synergy f or developments service and deployment services
  - ✓ 架构的全层次开放 / All-layer openness
  - ✓ 快速孵化产品与生态 / Rapid incubation of products and ecosystem

边缘计算与云的协同
Collaborate with the Cloud



开发与测试公有云

Edge Computing Simulation and Development Cloud



特性 / Specifications

- 云化，多租户 / Cloud-based, Multi-tenant
- 提供开发测试仿真环境 / Provide development, testing, and simulation environment
- 提供开发者社区，代码仓库，工具链 / Provide developer community, code warehouse, and tool chain

价值 / Values

- 快速验证原型 / Fast prototype verification
- 加速开发测试流程 / Accelerate the processes of development and debugging
- 快速上市 / Fast Go-To-Market

标准 Standards

推动产业共识　促进分工协作　牵引产业发展

Promote Industrial Consensus, Promote Division of Labor and Cooperation, and Promote Industrial Development

2017年3月	IEEE	在IEEE推动边缘计算成为P2413（Standard for an Architectural Framework for the Internet of Things）重要内容之一。Pushed edge computing to become one of the important components of P2413.
2017年5月	ISO JTC1 IEC	在IEC/ISO JTC1 SC41推动成立边缘计算研究组。Promoted the establishment of an edge computing research team in IEC/ISO JTC1 SC41.
2017年7月	中国电子技术标准化研究院	与CESI合作，在中国制造2025标准体系中推进边缘计算架构与技术的应用。Cooperated with CESI and promoted the application of edge computing architecture and technology in the standard system of "Made in China 2015".
2017年9月	IEC	华为与Fraunhofer FOKUS牵头输出IEC Vertical Edge Intelligence白皮书并正式发布。Huawei and Fraunhofer led the output of IEC Vertical Edge Intelligence white paper and officially released the white paper.
2017年9月	ISA	与国际半导体照明联盟（ISA）联合成立智慧路灯委员会，共同制定智慧照明技术标准。Jointly established Smart Streetlight Committee and developed smart lighting technology standards with International Semiconductor Lighting Alliance (ISA).

技术创新
Technological Innovation

雅典学院式学术沙龙
The School of Athens

20+ Workshops，30+ ECC Members，50+ Experts

成员间技术交流
Workshops Between Members

学术研讨大会
Academic Seminars

2017.5 深圳学术研讨会

McAfee 安全架构 Security Architecture	Huawei 边缘计算应用框架和数据集成 APP Framework and Data Integration for Edge Computing
SIA 工业网络 Industrial Network	iSoftStone 价值驱动的IoT架构 Value-Driven IoT Architecture

2017.8 沈阳学术研讨会

SIA 软件定义的工业网络 SD-Industrial Network	Huawei 边缘计算参考架构 Edge Computing Reference Architecture
SIASUN 机器人产业与边缘计算 Robots Industry and Edge Computing	SJTU 基于边缘计算的物理信息系统 Edge Computing and CPS

技术成果
Achievements

- Technology White Paper and Reference Architecture 2.0
- Innovative Testbed (TSN and Smart Manufacturing)
- White Paper & Standards
  - IEC VEI White Paper
  - IEC/ISO JTC1 SC41
  - IEEE P2413

产业合作
Industrial Cooperation

推动产业共识 提升产业影响力
Promote Industry Consensus and Enhance Industry Influence

2017年4月	SDNFV INDUSTRY ALLIANCE	与SDNFV产业联盟正式签订合作协议。Cooperation agreement with SDNFV Industry Alliance.
2017年6月	industrial internet CONSORTIUM	与工业互联网联盟（IIC）签订合作MOU。Cooperation agreement with IIC.
2017年8月	CAA	与中国自动化学会（CAA）签订合作协议。Cooperation agreement with China Automation Society (CAA).
2017年11月	AVNU	与Avnu Alliance签订合作MOU。Cooperation agreement with Avnu Alliance.
2017年11月	工业互联网产业联盟 Alliance of Industrial Internet	拟与工业互联网产业联盟（AII）签订合作协议。Plan to sign cooperation agreement with AII today.

主要合作领域：Major Cooperation Fields

- 架构合作研究、互操作、架构互认；Cooperative research, interoperation, and mutual recognition of architectures
- 白皮书撰写、联合发布；Drafting and joint release of white papers
- 测试床联合开发；Joint development of testbeds
- 标准联合研制、标准活动合作；Joint research and development of standards and cooperation on standards activities
- 产业合作协同、产业生态发展；Cooperation, collaboration, and ecological development in the industry
- 识别与共享优秀实践。Identification and sharing of best practices

产业推广
Industrial Promotion

测试床与产业营销促进商业成功
Testbeds Lead to Business Success

201703
ECC亮相CEBIT展，发布智能楼宇测试床和解决方案

201704
ECC亮相汉诺威工业展，发布工业预测性维护测试床与解决方案

201705
发布11个商业测试床

201706
ECC在日本Interop展获得巨大的关注

201709
ECC参展HC2017，展现形式包括Keynote、展览展示、峰会论坛、CXO圆桌会议等多种

201710
OMG主席Richard到访ECC展台，并与展台工作人员进行了产业发展与合作的交流

201711
沈自所、Intel、华为联合打造的“自适应柔性制造平台”测试床获得中国国际工业博览会金奖

201711
TSN测试床在德国柏林发布

201711
发布9个商业测试床

2018，技术，更进一步
Shift the Technology in 2018

测试床
Testbeds

- 建立TSN测试床2.0和vPLC测试床并在汉诺威工业展发布
  Build TSN Testbed 2.0 and vPLC Testbed and release it in Hannover MESSE

高校与科研院所联合创新
Universities and Institutes

Fraunhofer

中国科学院 CHINESE ACADEMY OF SCIENCES

- 吸引中国、欧洲、美国顶尖大学和科研机构加入ECC，并进行技术创新与联合研发
  Attract top universities and research institutions in China, Europe, and the US to join ECC, and jointly innovate in edge computing.

国际学术组织互动与交流
International Academic Organizations

ACM Association for Computing Machinery

西安电子科技大学 XIDIAN UNIVERSITY

- 边缘计算全球学术研讨会（ACM+ECC发起，西电承办）
  Global Edge Computing Symposium (Sponsored by ACM+ECC, Organized by Xi Dian Univ.)

2018，踏上新的征程
Embark on a New Journey in 2018

欧洲与全球发展
Global Development

- 在欧洲注册ECC的分支机构，加快会员发展与行业合作
  Establish ECC subsidiary in Europe, speed up the cooperation with European and global partners

国家数字化转型政策
National Policies for Digital Transformation

- 欧洲：自下而上 (Testbed)、自上而下(标准)参与工业4.0工作
  Europe: I4.0, Bottom Up + Top Down
- 中国：依托国家产业政策和资源构建边缘计算平台，作为重要行业的使能平台
  China: Build an open edge computing platform

产业协同与营销
Industrial Collaboration and Promotion

- AII、IIC、IEC：标准与测试床 /
  Standard and Testbeds
- Hannover MESSE：产业营销 /
  Industrial marketing and promotion

ECC：拉瓦尔喷管的窄喉

ECC: Narrow Throat of Laval Nozzle


边缘计算
Edge Computing
CONSORTIUM
HUAWEI
独行者 步疾 结伴者 行远
If you want to go fast, walk alone,
If you want to go far, walk together.
Collaborate in Edge Computing，Build a Better Connected World！