



# The Cloud is here – now comes the Fog

Die Verbindung zwischen Cloud, Big Data und IoT

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# Agenda

- Why do we need Fog computing?
- Concepts and Architecture of Fog computing
- Fog in the context of IoT/loE
- Use Cases and Solutions
- Summary and Conclusion

# The New Industrial Revolution

Mechanised  
Production



18<sup>th</sup> Century  
(1784)

Steam

Mass  
Production



19<sup>th</sup> Century  
(1870)

Electric Power

Automated  
Production



20<sup>th</sup> Century  
(1969)

Information Technology



Today

Digitization

# The New Digital Business/City/Country

Digital business is the creation of new business designs that connect people, business and things to drive revenue and efficiency.

**Gartner**

*These objects can include sensor devices, asset-tracking devices, smart machines, smart grids, 3D printing and robotics, and smart cities and drone delivery services.*



**Simplify / Automate  
Processes**

Leads To:

Faster Time to Market  
Leaner Operations



**Empower Workforce  
Efficiency & Innovation**

Leads To:

Increased Productivity  
Better Retention



**Personalize Customer/  
Citizen Experience**

Leads To:

Increased Loyalty  
Greater Insight



# Ecosystem



## DIGITAL

Countries

Cities

Businesses



## INTERNET OF EVERYTHING

Manufacturing

Government

Financial

Energy

Retail

Healthcare

## APPLICATION INTEGRATION



## FAST INNOVATION / FAST IT

Solutions

Innovation

Architecture

## SOLUTIONS

Workforce Experience

Customer Experience

Business Innovation

IT Transformation

## INNOVATIONS

ACI

Intercloud

Analytics

Mobility

## ARCHITECTURES

Enterprise Network

Data Center

Security

Collaboration

Consulting

Support

Professional

SOFTWARE

SECURITY

Managed



DIGITAL



INTERNET OF EVERYTHING



FAST INNOVATION / FAST  
IT



SECURITY

# Fog: because Data is Massive, Messy, and Everywhere



# Fog Computing Defining Characteristics

## Fog Computing

Extends the Cloud Computing paradigm to the network edge

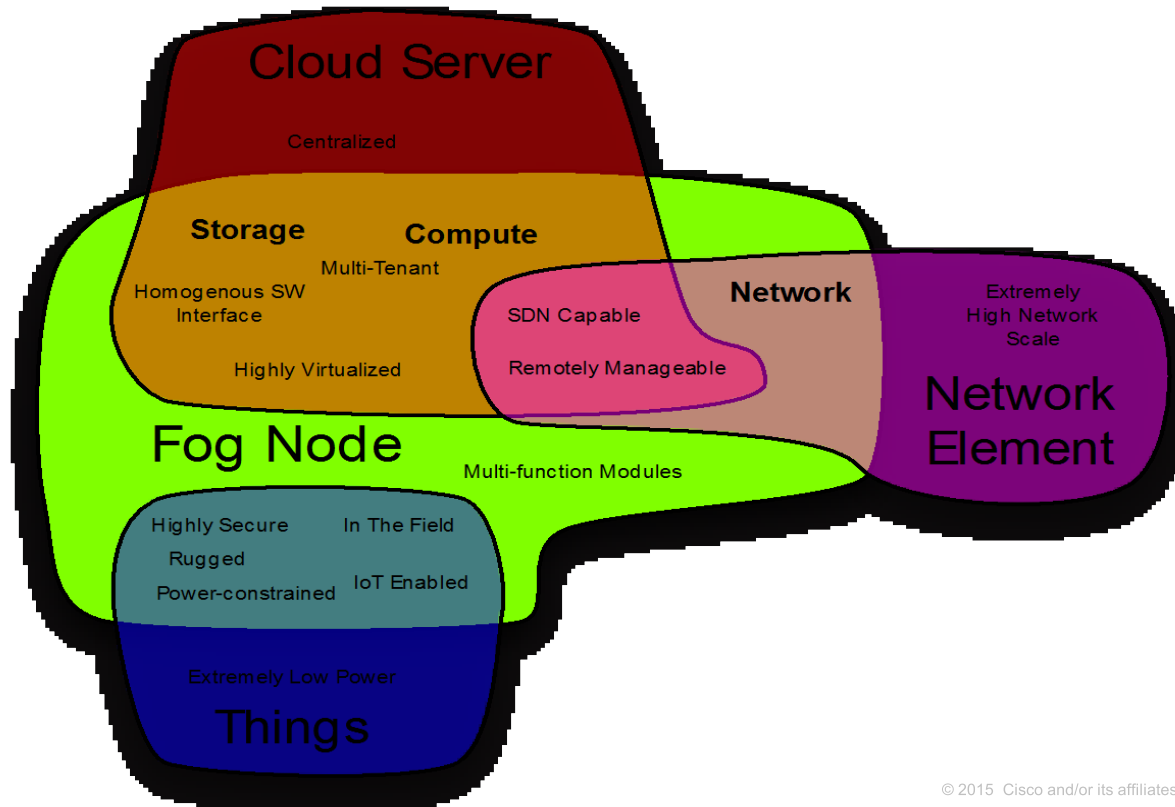
Enables a new breed of applications and services

Provides distributed compute, storage and network services

- Edge location, low latency and location & context awareness
- Wide-spread geographic distribution
- Very large number of nodes
- Predominant role of wireless access
- Real time analytics & control close to source
- Heterogeneity – different form factors, different environments

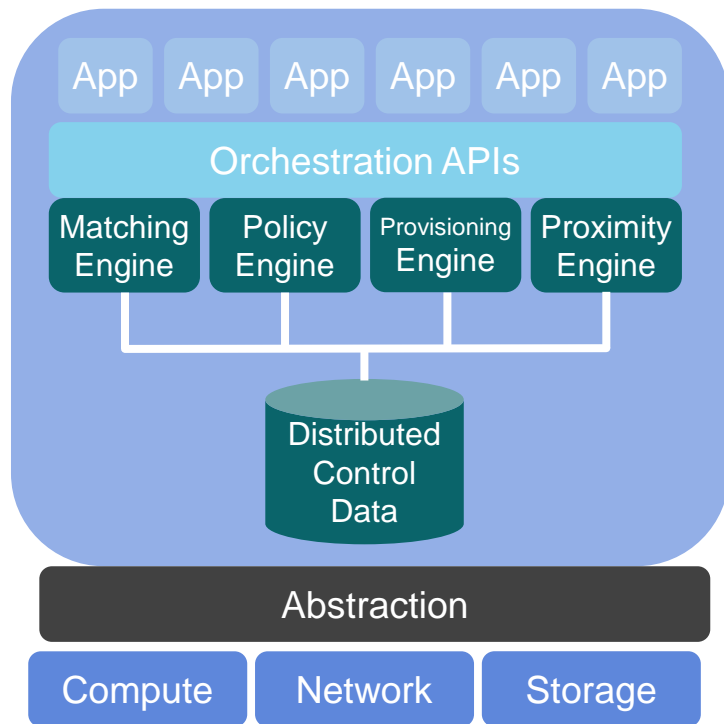
IoT Applications  
Smart Grid  
Connected Vehicle  
Smart Cities

# Concept of a Fog Node





# Fog Node Architecture



## Fog Applications

Various user developed apps on host O/S

## Service Orchestration and Automation

Service management for subscribers, open API to apps, SDN

Proximity Engine – redirection to a closer service instance

Policy Engine - Implements tenant business policies

Matching Engine – Matches capabilities to a service instance

## Heterogeneous platform

Various form factors, host O/S and service capabilities (storage, RAM....)

## Hardware Abstraction Layer

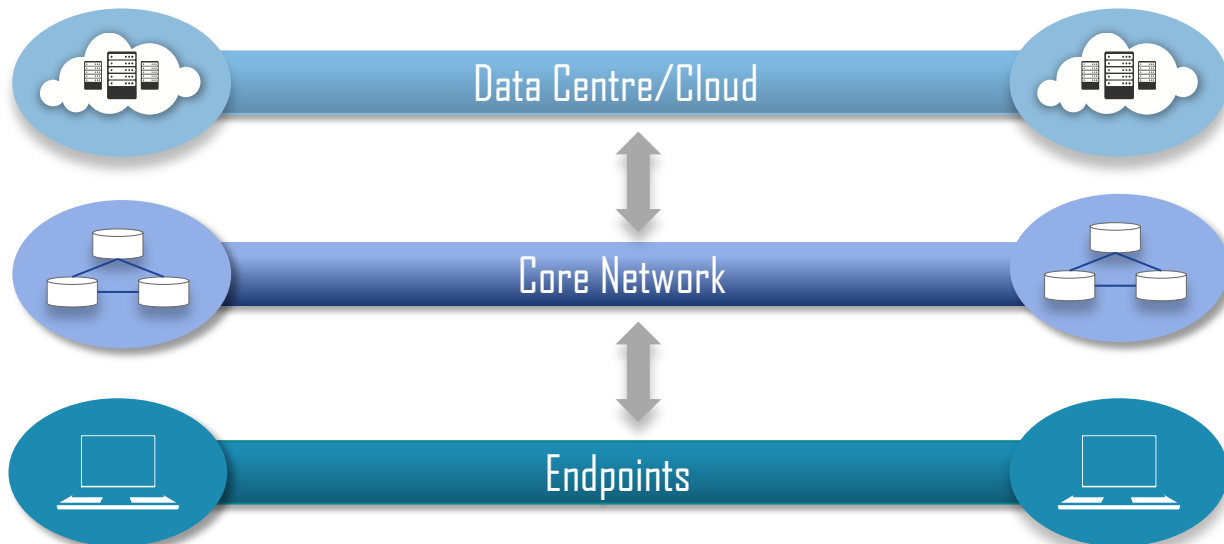
Provides uniform interface to compute, network, storage resources

Provides resource isolation for different tenants (multi-tenancy)

Supports virtualisation (Thin Hypervisor) multiple O/S on physical machine

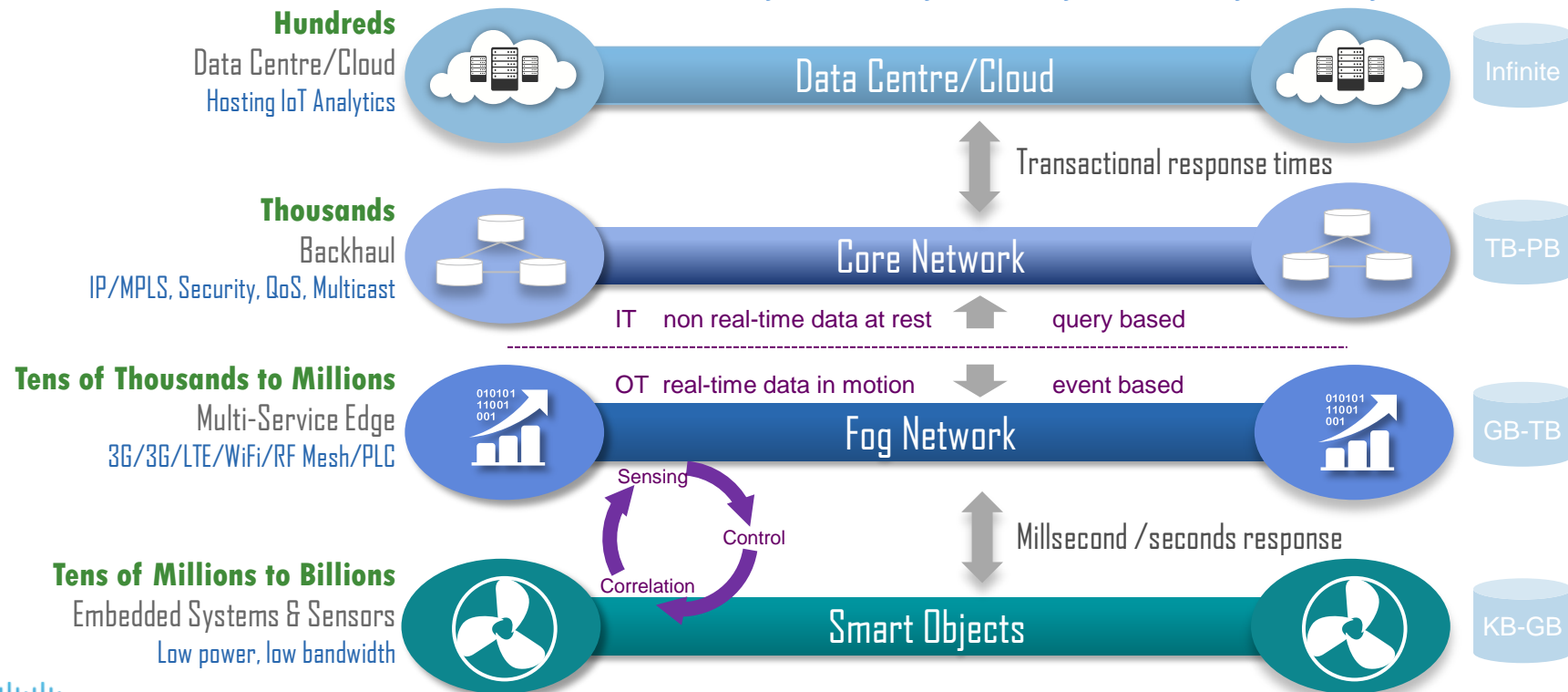
# Traditional Computing Architecture

Terminal-Mainframe, Client-Server, Web



# Fog Computing Architecture

Data Points, Variety & Velocity, Security, Resiliency, Latency



# Cisco Fog Solutions

Fog Infrastructure for Running Apps Close to Things



APIs: IOx



Platforms: CGR, 8X9 Series



Eco System Partners

## Infrastructure and Tools for Data Analytics



Fog Data Services



IOx



Real-time Analytics  
Enabled in the Fog

Cisco Connected  
Streaming Analytics

## Automation and Management at IoT Scale

Policy-based Automation



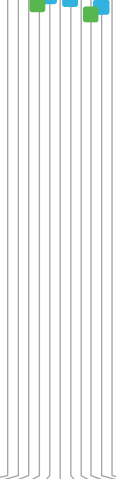
Fog Director





# Cisco IoT/IoE System

## APPLICATIONS



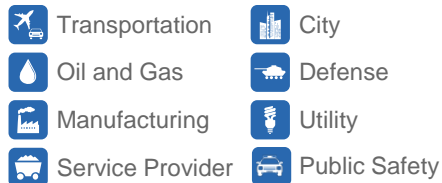
Fog



Cloud

# Fog is one Pillar in the Cisco IoT/loE System

## VERTICAL SOLUTIONS



## APPLICATIONS



## ECOSYSTEM



Fog



Network  
Connectivity



Fog  
Computing



Data  
Analytics



Security  
Cyber and  
Physical



Management  
and Automation



Application  
Enablement  
Platform



Cloud



# Energy





# Smart Connected Cities



\$28M

in value over  
10 years with  
smart buses



\$53M

in value over  
10 years with  
smart parking



44,000

new jobs created  
with startup  
innovation



# Transportation



# Conclusions

- The Internet of Everything is a huge opportunity over the next ten years
  - Intelligent connection of people, processes, data and things
- IoE networks are hierarchical
  - Intelligence in the cloud, core, edge and endpoint layers
- Scalability achieved through through Fog Computing & Intercloud
- Encourages innovation in OT and IT and between them
- Fog Computing provides a new development platform
  - A new breed of applications & services
  - New opportunities for sensor vendors and application developers

