Technologies for Internet of things(IOT)

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Motivation

"Anything that can be connected, will be connected"

- Jason Morgen

- Access to data/collection of new data
- Connectivity
- Improves efficiency
- Reducing Labour Cost
- Track & Monitor
- Improve Customer Experience

Source: https://www.capgemini.com/pl-pl/service/intelligent-industry/solutions-for-the-5g-and-iot-edge-computing-revolution/

Introduction

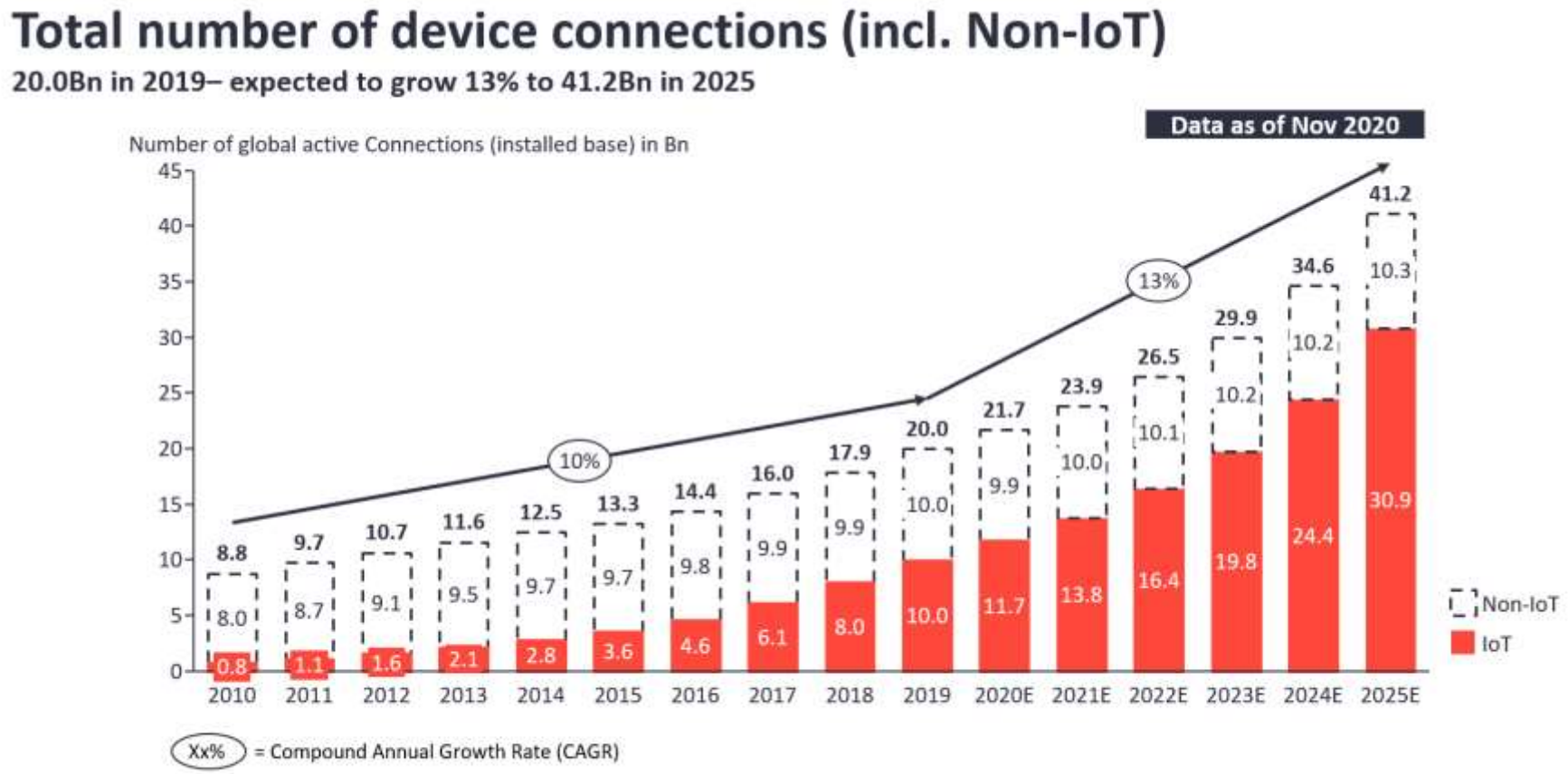


Figure: Number of Global Active connection of IOT device[1]

IOT based Ecosystem

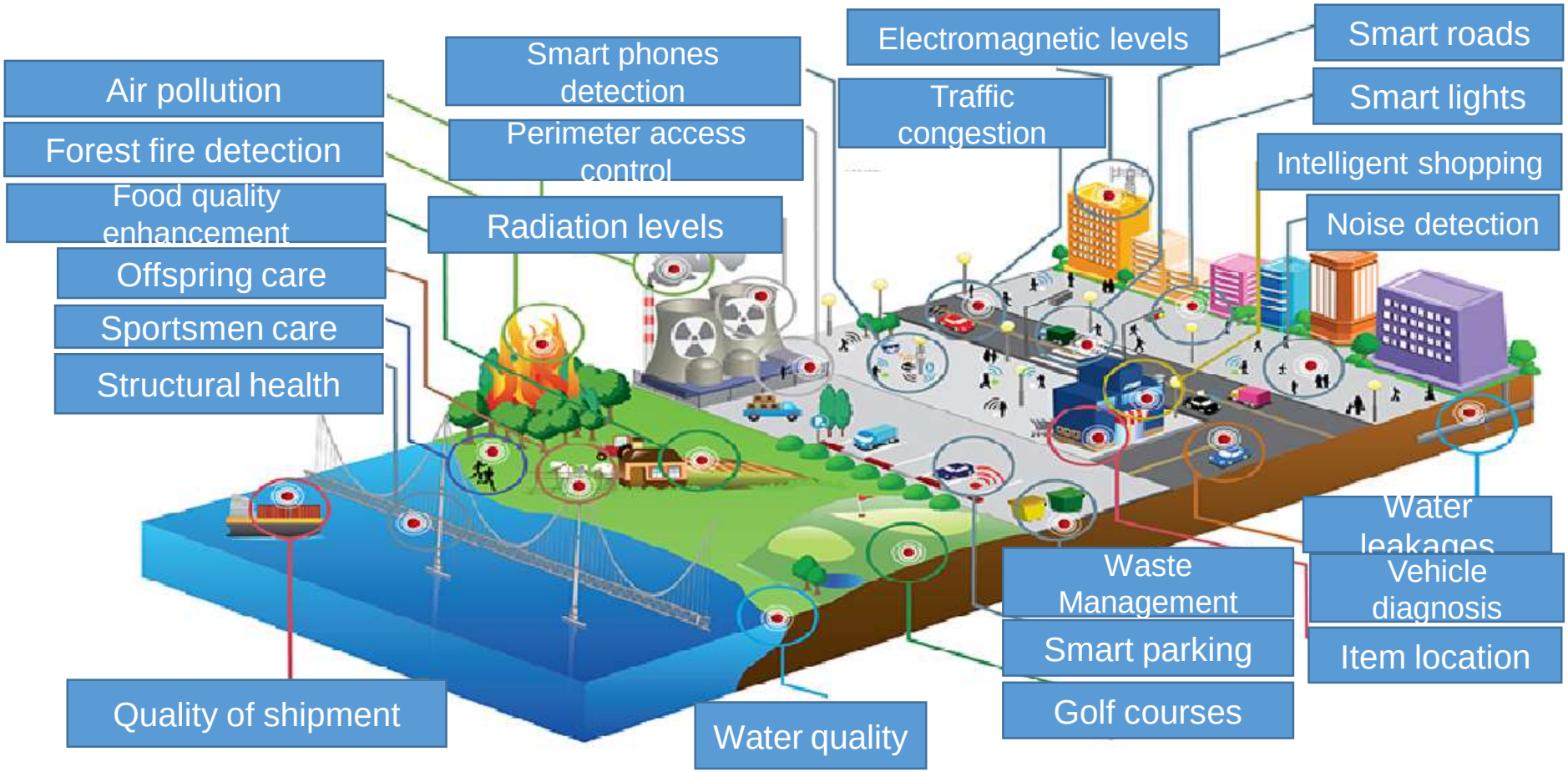


Figure: IOT based Ecosystem[2]

Cloud computing and challenges in IOT

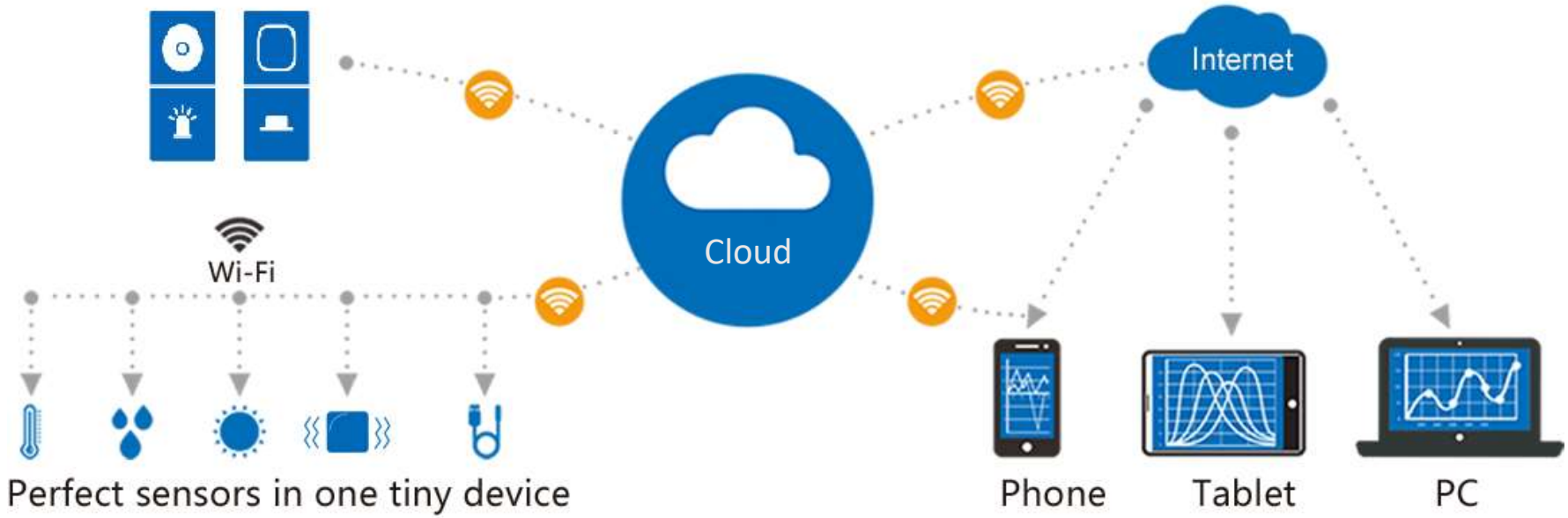


Figure: Cloud computing[3]

Source: Google

- Most of IOT data are un-structured or semi-structured
- Massive amount of quickly/emerging data – by AI(Artificial Intelligence)
- Real - time processing for Big Data

Cloud computing and challenges in IOT

Real - time

Ubiquitous accessibility and connectivity
for heterogeneous objects/ services at various volume of users

Dynamic management/orchestration
users which comes from billion devices and produces massive amount of data

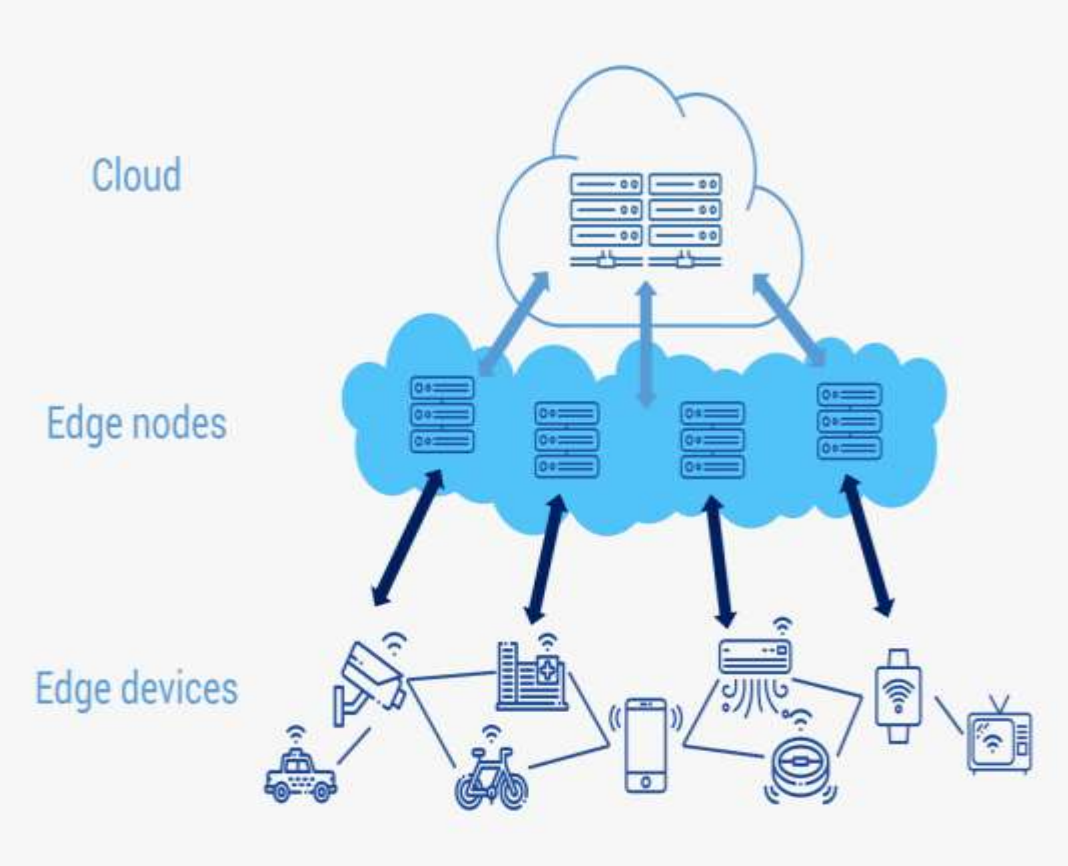
Maximum resource utilization
sharing of IOT resources such as app, objects, platform

personalization of the user and services
services based on user experience and preference

Virtualization of IOT devices
access to advanced resources/ specialized hardware, including GPUs, sensors etc.

Portability of the services, interoperability, Accountability
migration of the server to follow mobile users, cloud/IOT service infrastructure, Services and data hosted and executed on the borders

Edge computing for real time



Scalability
(Ability to scale the application through various edge controller technologies)

Governance
(Keeps all data locally, – Encrypt all user data at storage)

Security
(Infrastructure verifications, Securing secrets/keys)

Performance and Constrained Environment
Latency(L), Performance(H), resource utilization(Less)

Edge App
(Traffic Redirection, Providing contextual provisioning information)

Figure: Edge computing Architecture and its Benefits [4,13]

Comparison of Several Computing paradigms

Paradigms	Virtualization	Location for computing	Location for storage
Cloud Computing	Hypervisor and containers	Centralized cloud server	Centralized cloud server
Edge Computing	Hypervisor and containers	Edge servers	Edge servers
Transparent Computing	Meta OS	Proximal end	Transparent server

Table: Comparison of several computing paradigms[5]

- FOG & Cloudlet → processes data → nearby edge server → decrease latency
- Can not solve heterogeneous hardware & provision cross platform services

IOT based Transparent computing

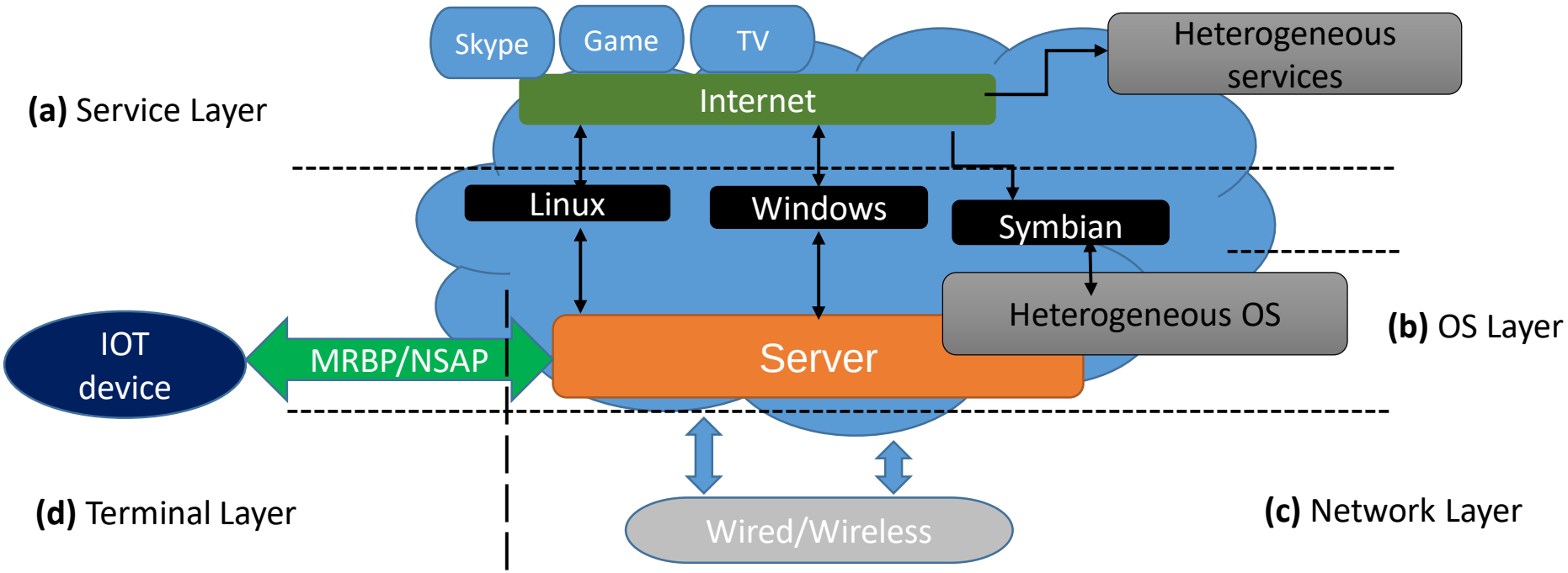


Figure: Transparent computing mechanism [6]

- Decouple the software stack from the hardware
- Client can select desired service OnDemand
- Eliminating the concerns of installation, management & upgrade of services → client devices
- No concerns about underlying OS

- **MRBP**: Multi-OS Remote Booting Protocol
- **NSAP**: Network Service Access Protocol

Spatio - Temporal Extension Von Neumann architecture

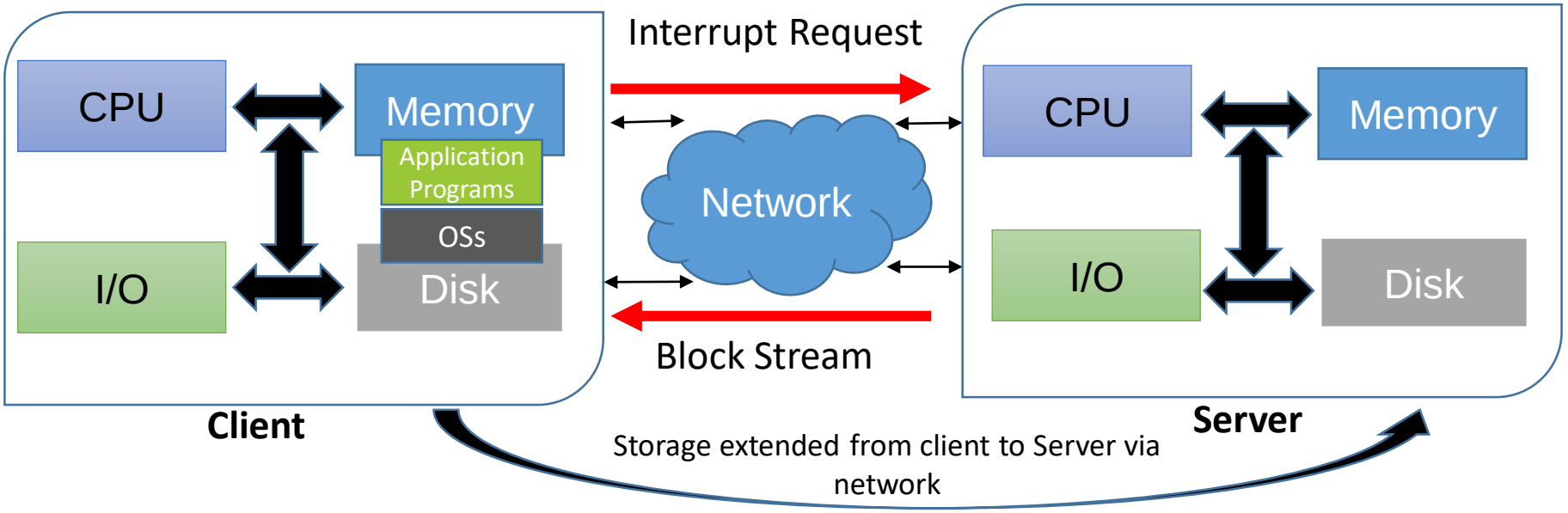


Figure: Extended von Neumann architecture [7]

Problems of Von Neumann Architecture:

- 5 main components: control unit, arithmetic logical unit, memory, input, output
- Consists only local storage, small limited size embedded device
- Maintenance of programs, malware detection, management routines
- Hard disk failure or system failure

MetaOS

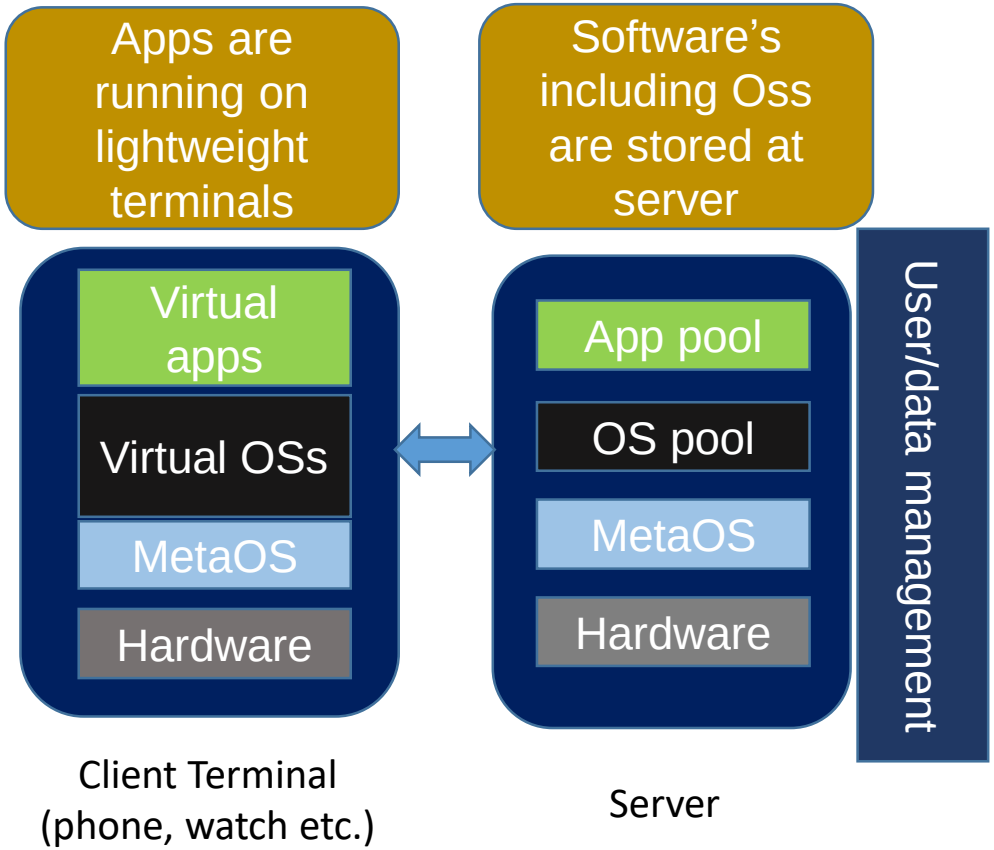


Figure: Building blocks of TC

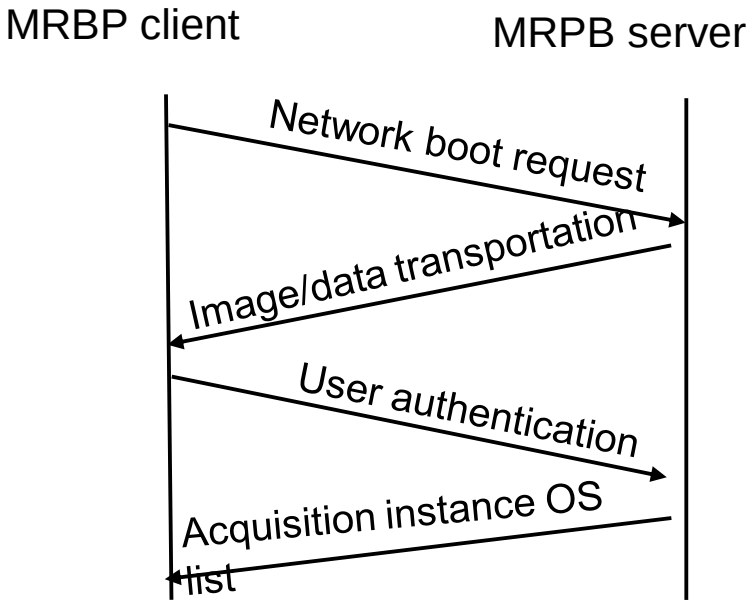


Figure: Interaction procedure of Multi - OS MRBP

MRBP: Multi - OS remote booting protocol

Functionalities of Meta OS

- Meta OS contains two protocols, i.e., MRBP and NSAP
- MRBP sends a boot request to the server
- Once it found specific OS the one which user selects it downloads and startup the NSAP (Network service access point) to enable virtual I/O for terminal.

- **4VP**: 4 Virtual Layers 2 Protocol
- **UEFI**: Unified Extensible Firmware Interface
- **MRBP**: Multi-OS Remote Booting Protocol
- **NSAP**: Network Service Access Protocol
- **UEFI**: Unified extensible Firmware interface

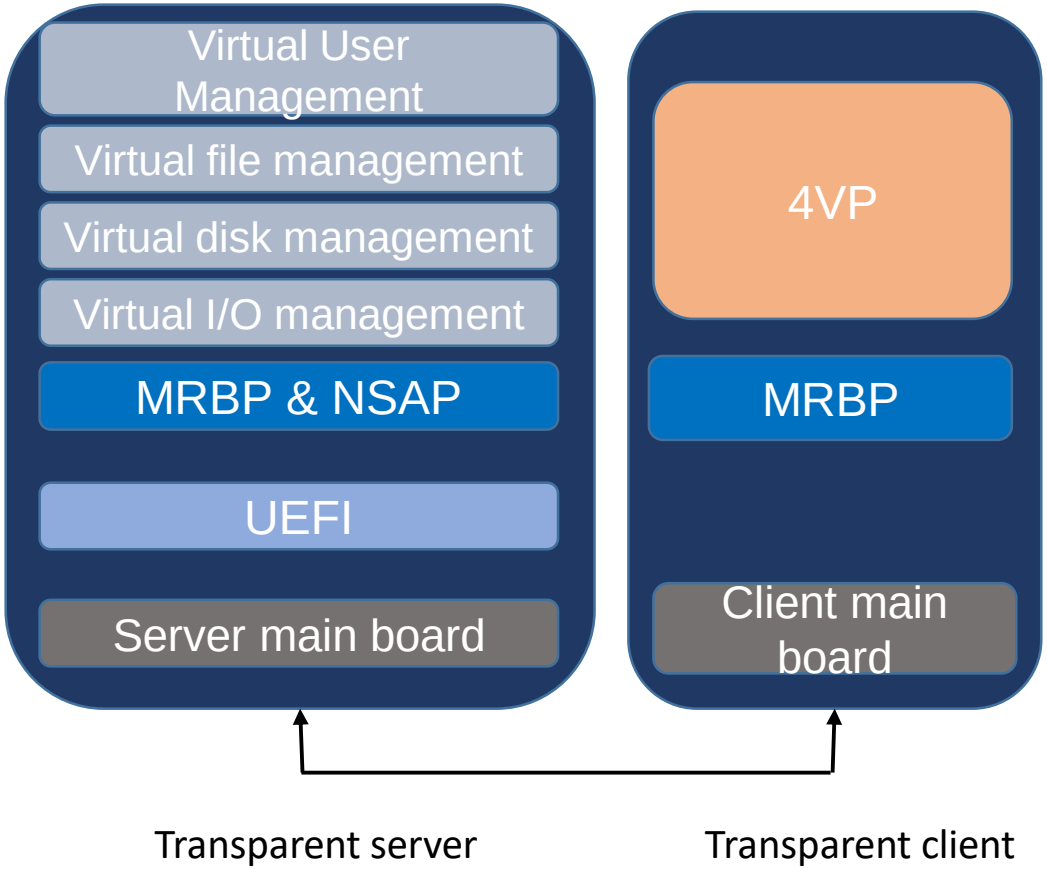


Figure: Functionalities of meta OS [5]

Transparent Computation Architecture for PCs

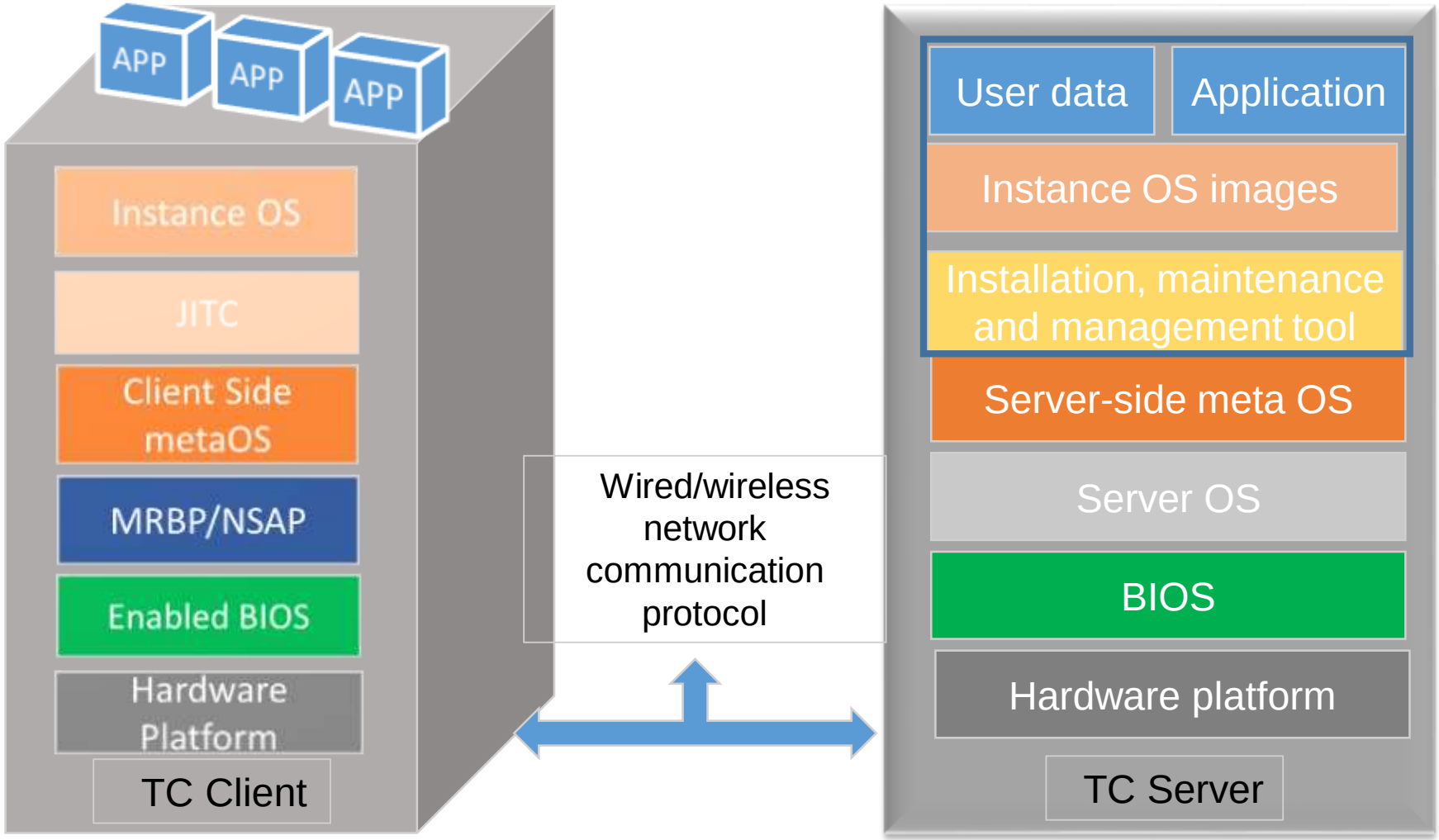


Figure: TC Architecture[5]

- **JITC**: just in time computing

Future Direction and Conclusion

- Designing an adaptive data transmission protocol while Transparent computing under high-speed network is still open issue.
- Heterogenous data collection by heterogeneous IOT devices needs to extract unstructured or semi structured data
- Security for Transparent Computing Based IoT Platforms
- Designing better battery life for IOT devices
- Cross platform integration needs well-design open API interface
- Edge servers can be used to provide enhanced security for transparent terminals.
- Transparent computing based IOT architecture is fitting for lightweight, heterogeneous, low processing IOT devices using the edge and cloud technologies.

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Thank you!