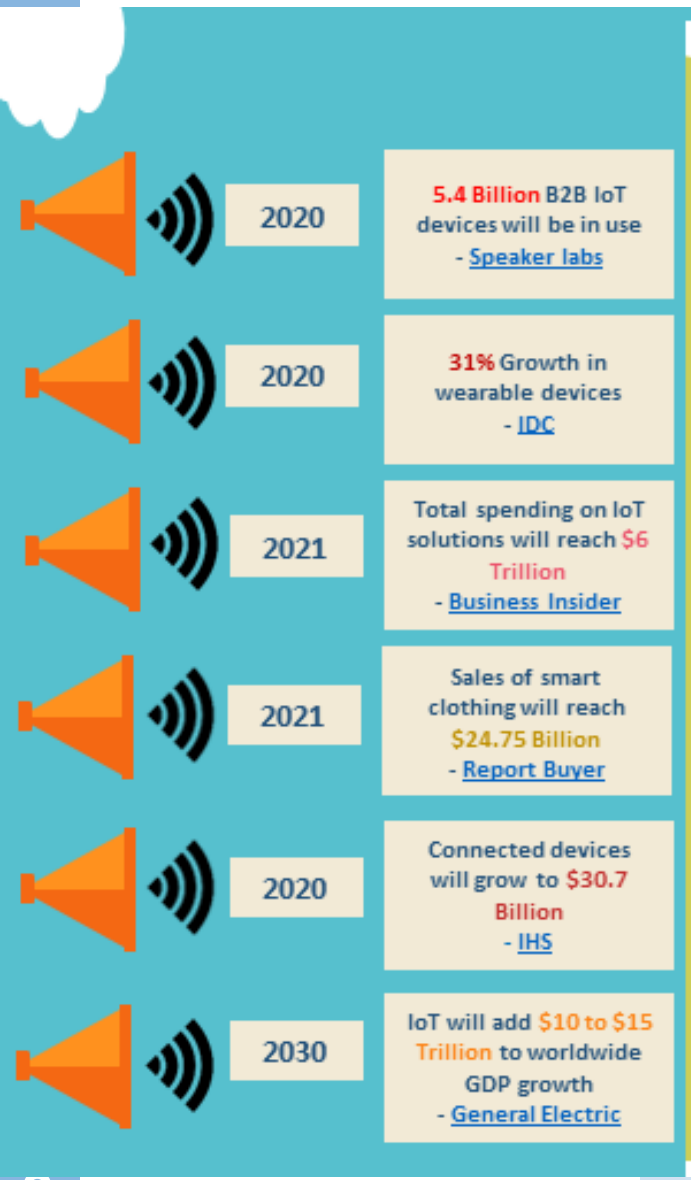
IoT Keretrendszerek és ipari alkalmazásaik

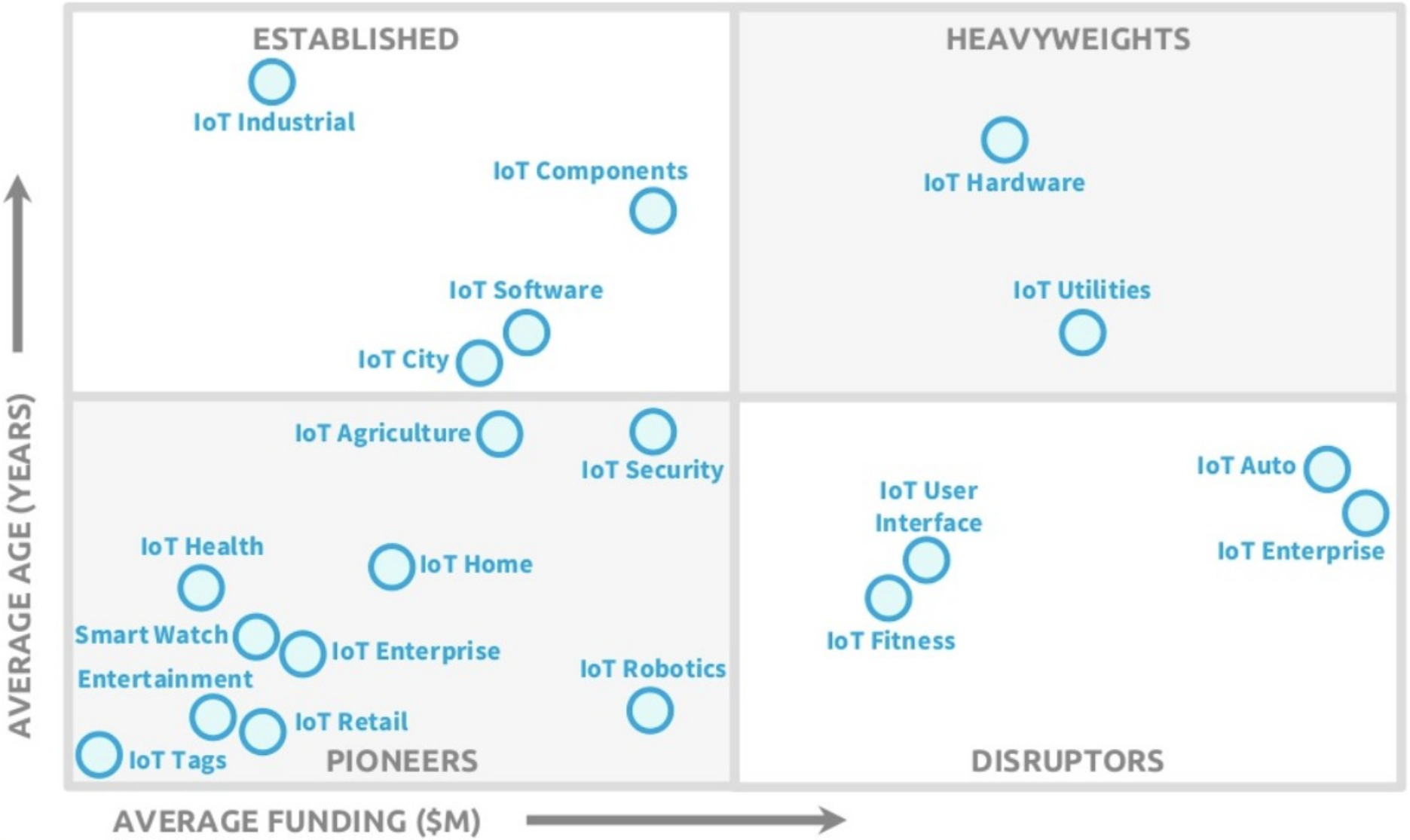
SmartComLab

IoT keretrendszerek: motivációk és trendek

Trends by *TOPS Technologies*



2017 trends by *Humanizing Tech*

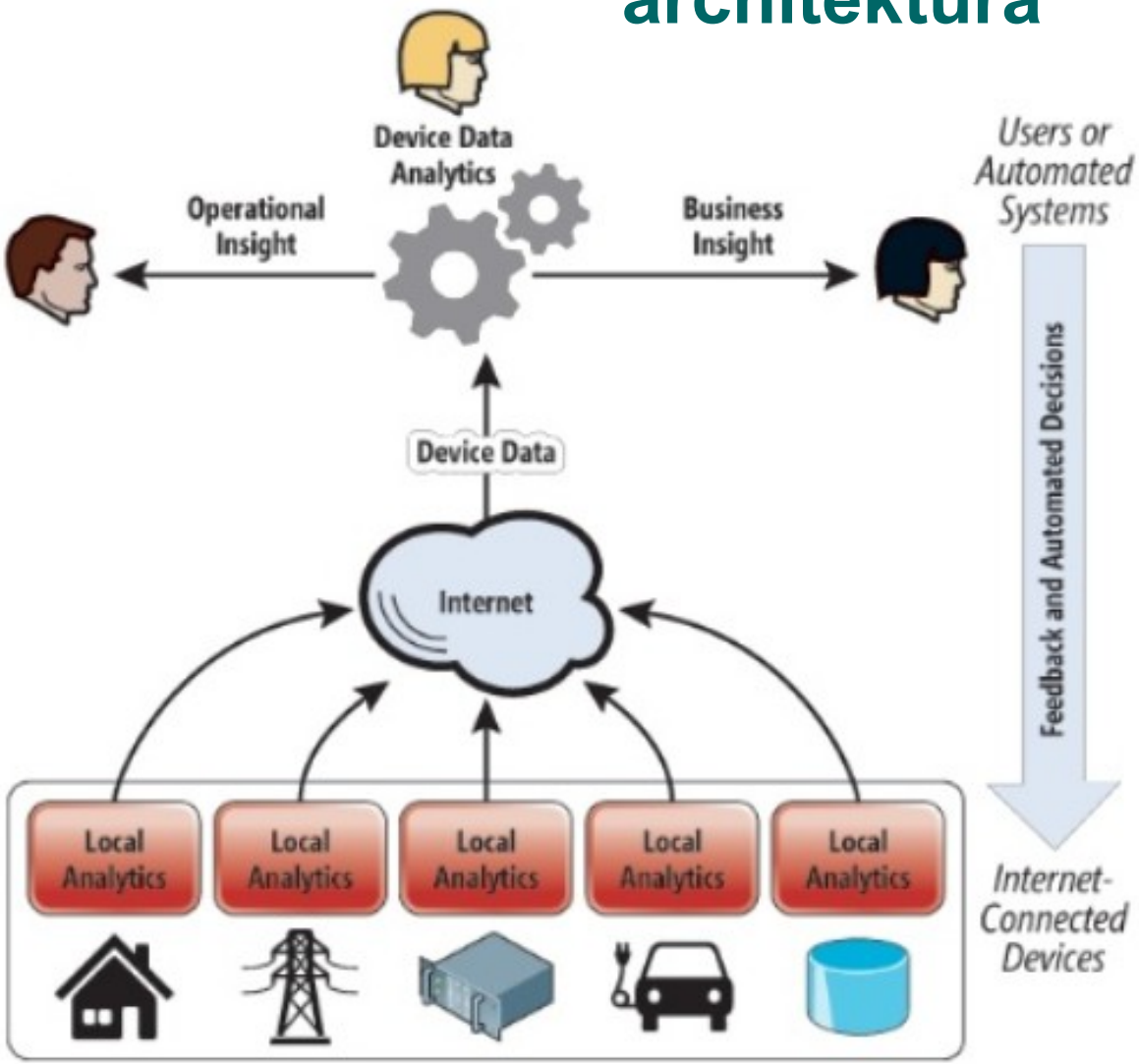


Venture Scanner

This quadrant shows a relative segmentation of the categories with respect to one another, data as of April 2017

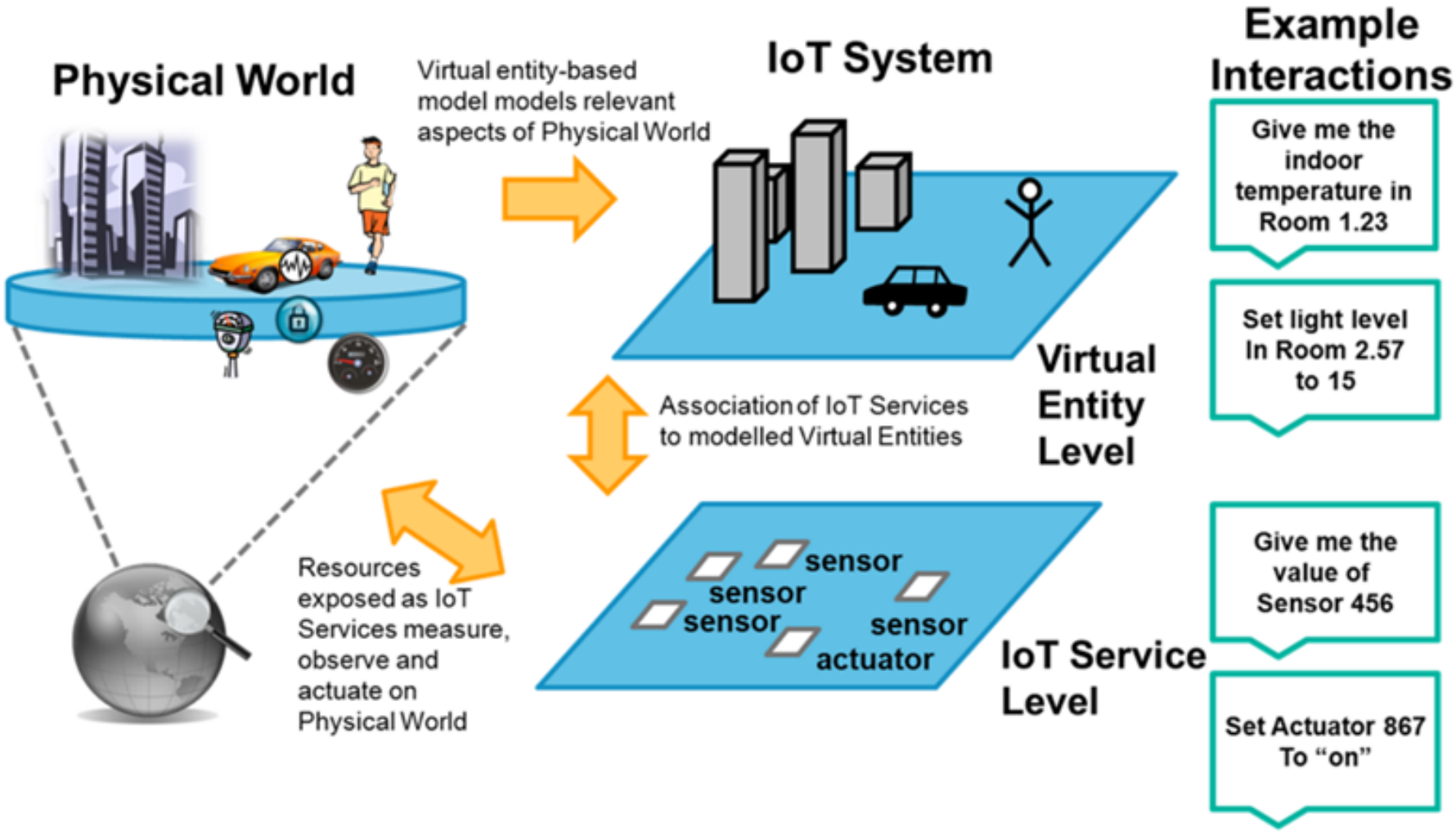
IoT architektúrák

Általános IoT architektúra



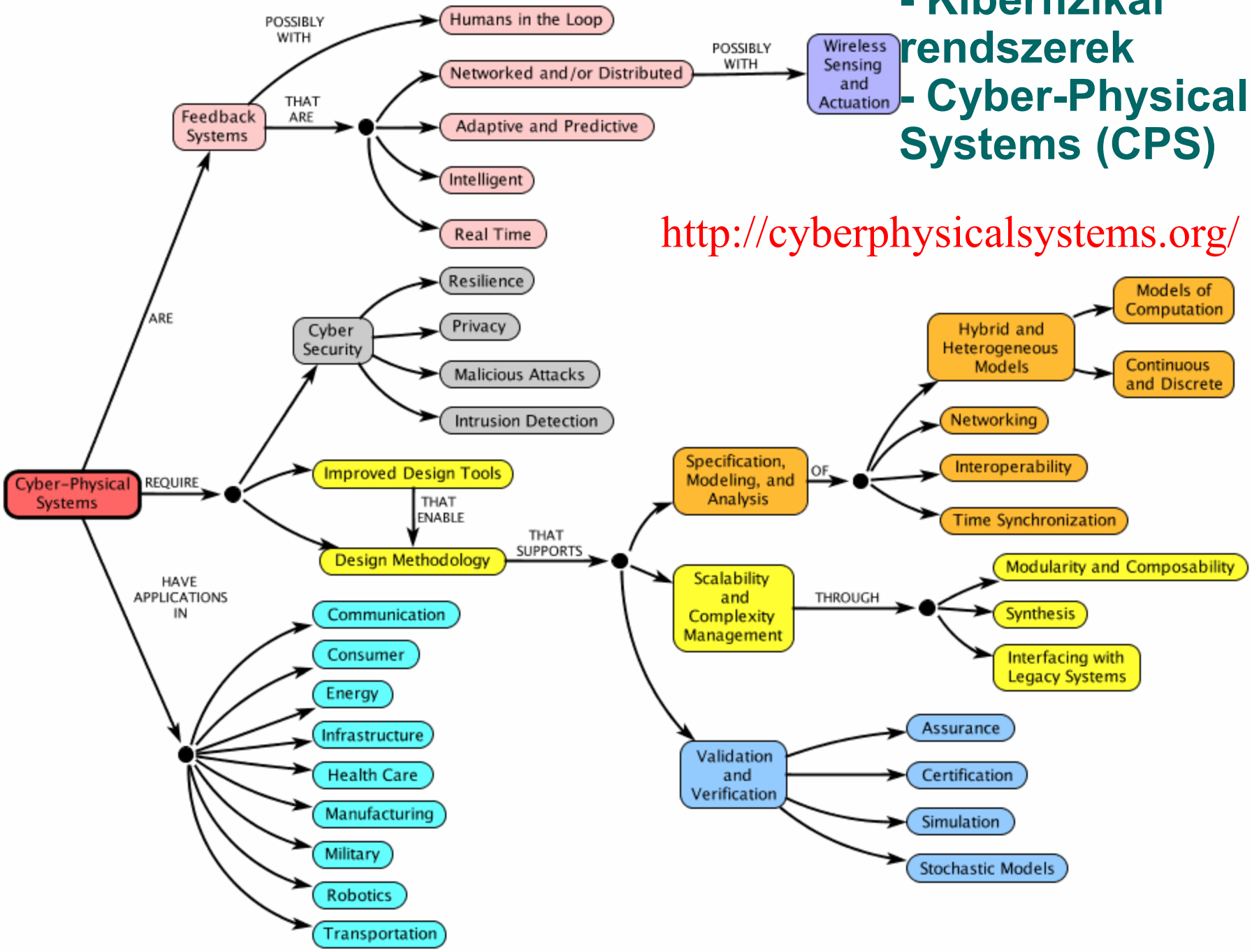
http://www.slideshare.net/Nibodha/enterprise-architecture-and-iot

Egy tipikus IoT architektúra

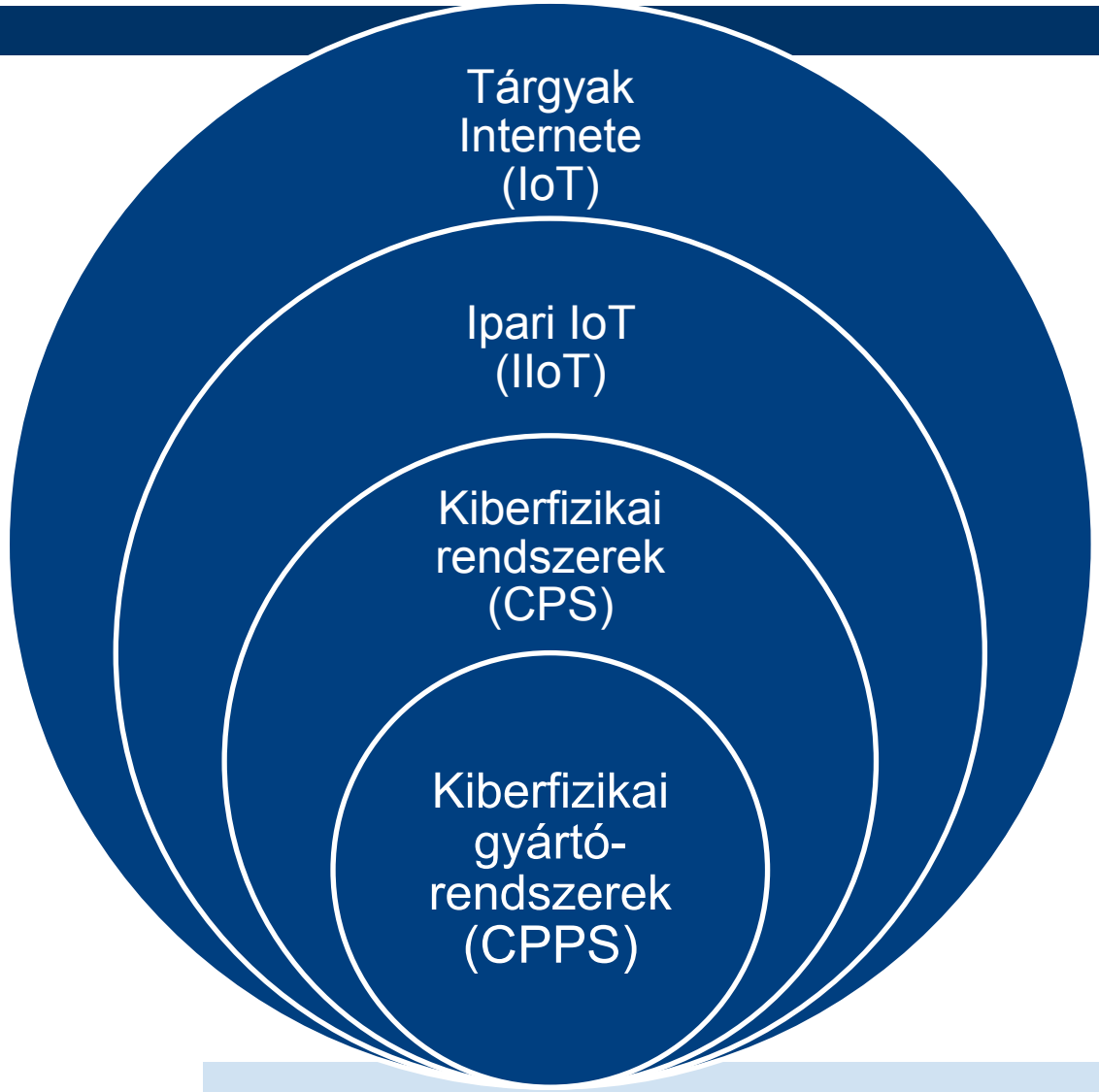


- Kiberfizikai rendszerek - Cyber-Physical Systems (CPS)

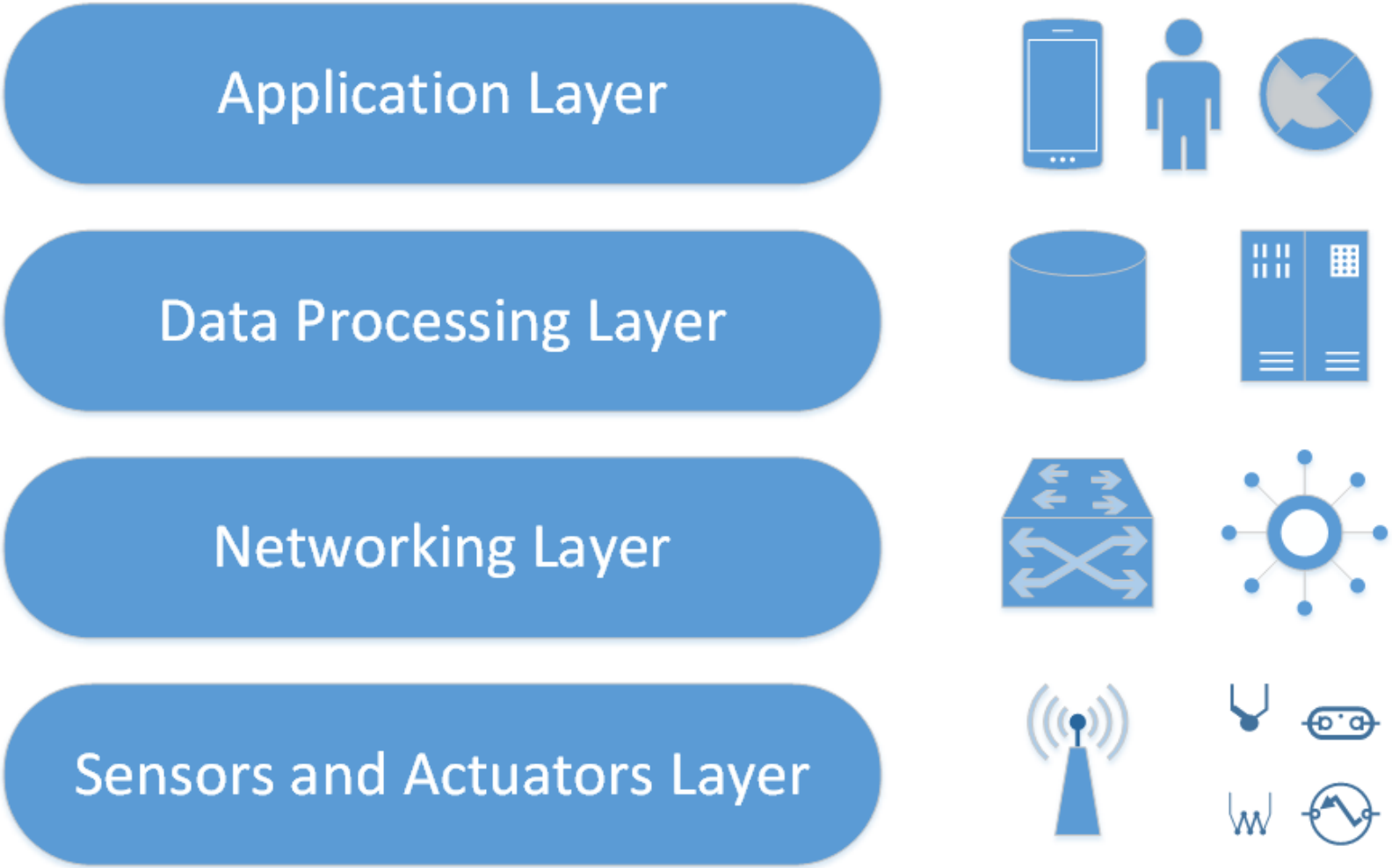
http://cyberphysicalsystems.org/



A „Smart Internet” ipari alkalmazásai



Az IoT-rendszerek rétegei – egy „vélemény” a sok közül



IoT: Biztonság és Titkosság
(Security, Safety and Privacy)

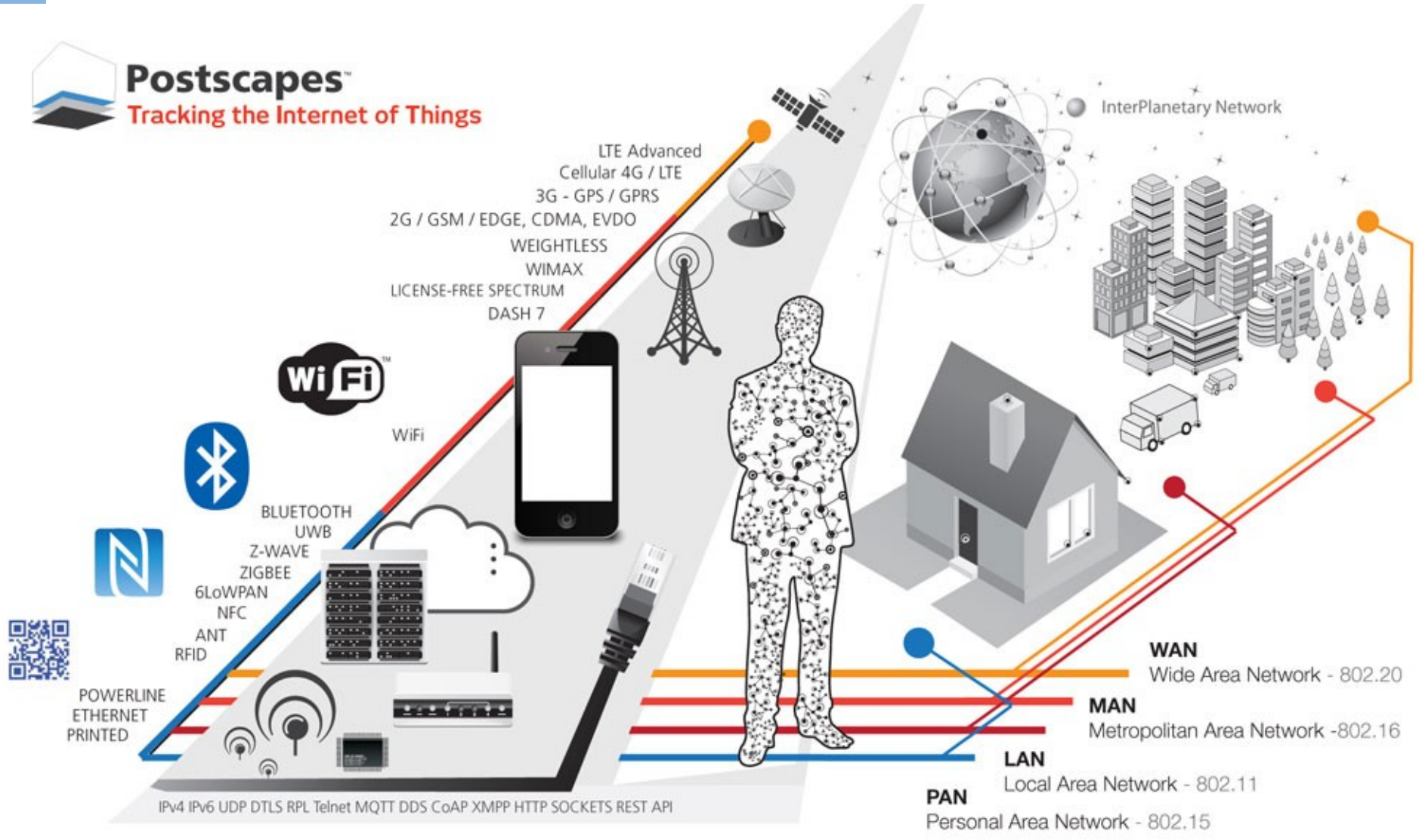
- Az IoT rendszerek titoktartási és biztonsági sajátosságai
- Azonosítási (Identification and Authentication) kérdések
- Vezetéknélküli szenzorhálózatok IoT biztonsági kérdései
- Behatolásvédelem az IoT területen
- Kriptográfia, adatbiztonság, AAA és CIA az IoT területen
- Fizikai/MAC/Hálózati támadások a Tárgyak Internete ellen
- Csatornatitkosítás a szenzorhálózatokban
- Rétegeken átívelő támadások az IoT területen
- Biztonsági, emberi biztonsági (Security and Safety), valamint QoS kérdések együttes kezelése
- Big Data és Információ-integritási kérdések IoT
- Kommunikáció-biztonság az IoT területen
- IoT biztonsági szabványok

Fenyegetések és védelmi stratégiáik

Layer	Threat type	Mitigation
Physical	Tampering	tamper-resistant packaging
	Eavesdropping	encryption, authorization
	Denial of Service	spread-spectrum techniques
Networking	Exhaustion	active firewalls, passive monitoring (probing), traffic admission control, bi-directional link autentication
	Collision	
	Unfairness	
	Spoofing	
	Selective forwarding	
	Sinkhole	
	Wormhole	
	Sybil	
	Flooding	
Data processing	Exhaustion	traffic monitoring
	Malware	malware detection
Application	Client app.	anti-virus filtering
	Communication	
	Integrity	testing
	Modifications	validation
	Multi-user access	process planning and design
	Data access	Traceability

IoT és a protokollok

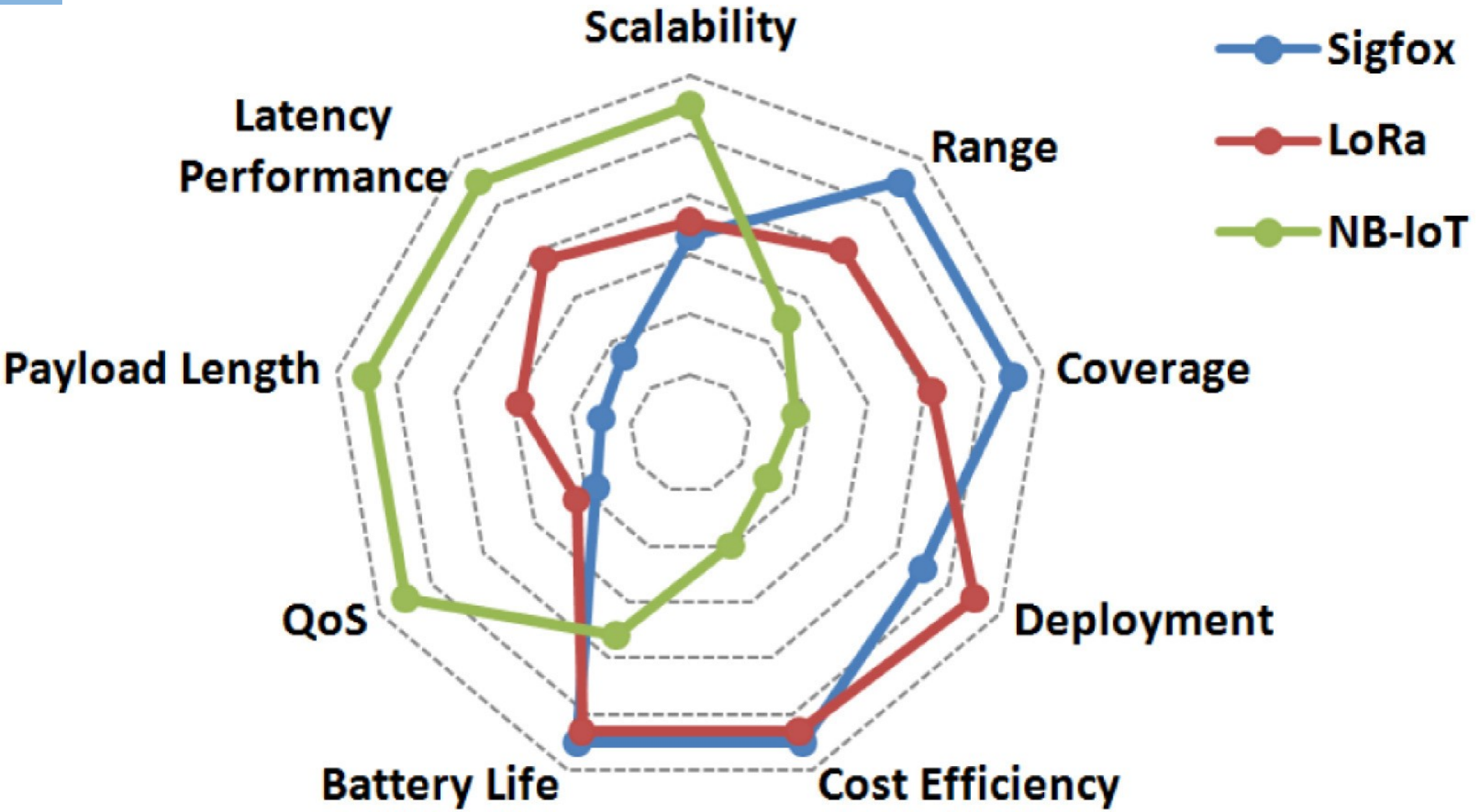
Hozzáférési technológiák - áttekintés



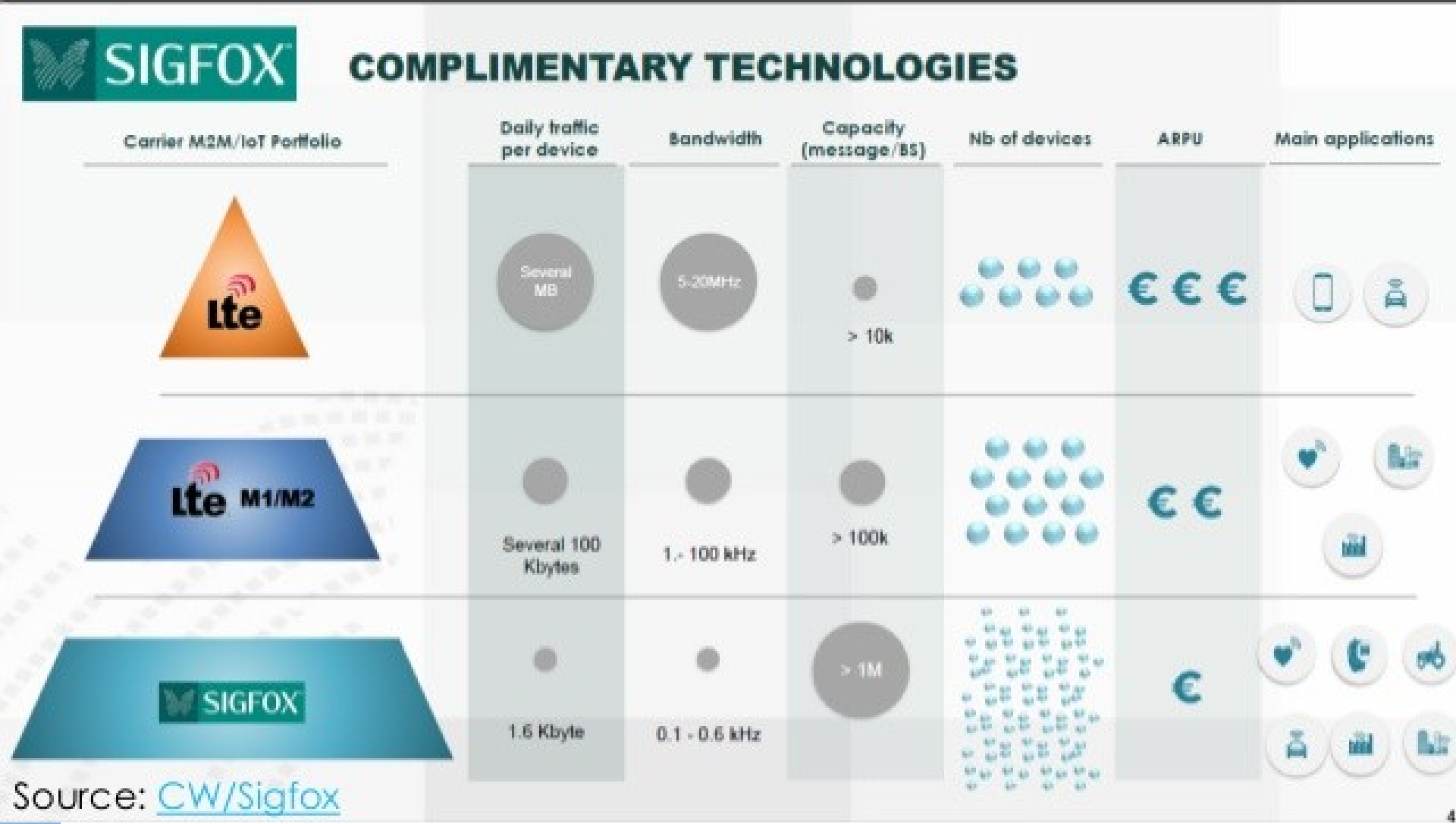
Hozzáférési technológiák - összehasonlítás

	Peripheral connectivity	Local (home) networking	Wide area networking
Typical range	<30 ft.	<300 ft.	Outdoor (miles)
Content distribution Focus on high data rates Energy consumption secondary	Bluetooth®	Wi Fi .11ah: HaLow IEEE 802. llax	GSM Lte 5G
Sense and control Low energy/long battery life Data rate is secondary	Bluetooth® SMART	ZigBee Z-Wave	GPRS LTE Cat-M NB-IoT
Proprietary solutions	ANT	Sub-GHz enocean	LoRa SIGFOX INGENU
Typical applications	**Personal appliances** (wristband, smartwatch, step counter, keyboard, mouse, pointer, etc.)	**Indoor networks** (internet, email, phone, security, energy management, smart home monitoring, etc.)	**Outdoor networks** (smartphone, internet, city, industry 4.0, agriculture, smart logistics, etc.)

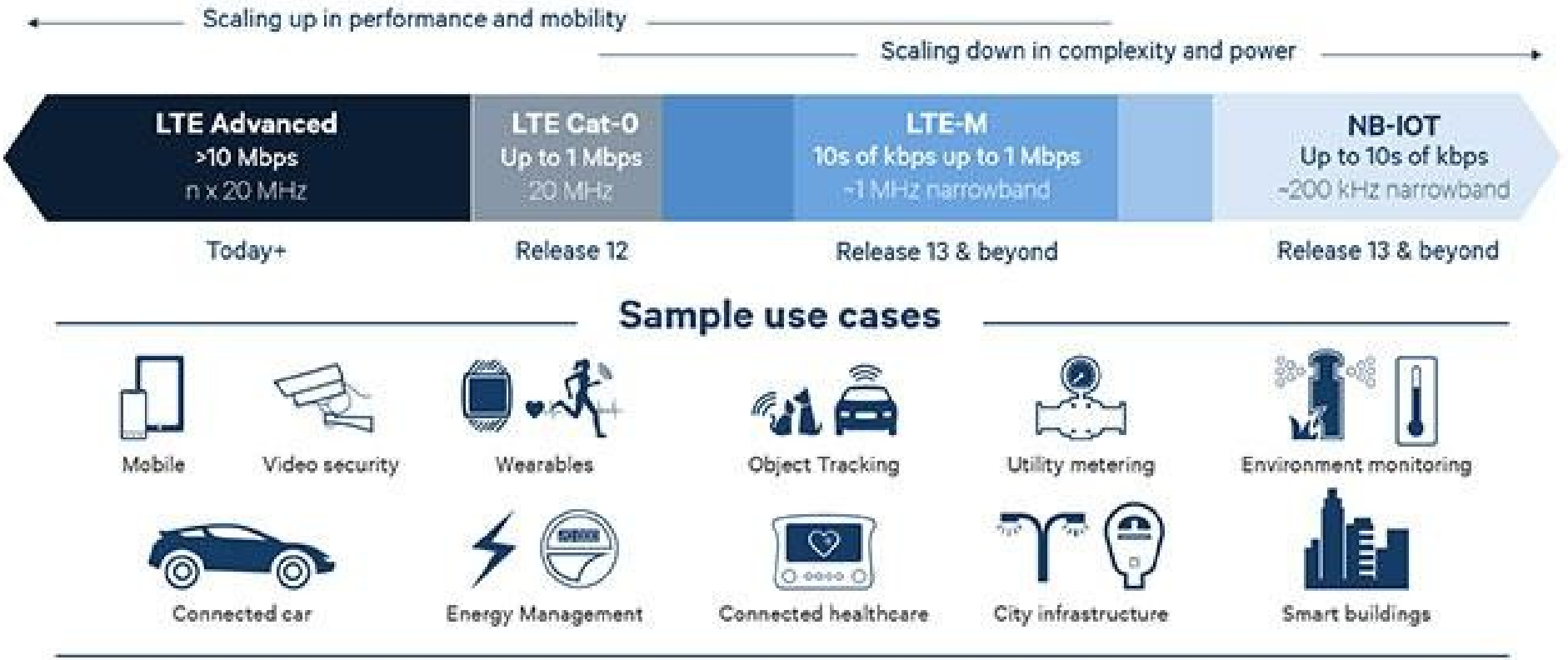
km-nagyságrendű lefedést nyújtó technológiák összehasonlítása



Sigfox vs LTE-based IoT access



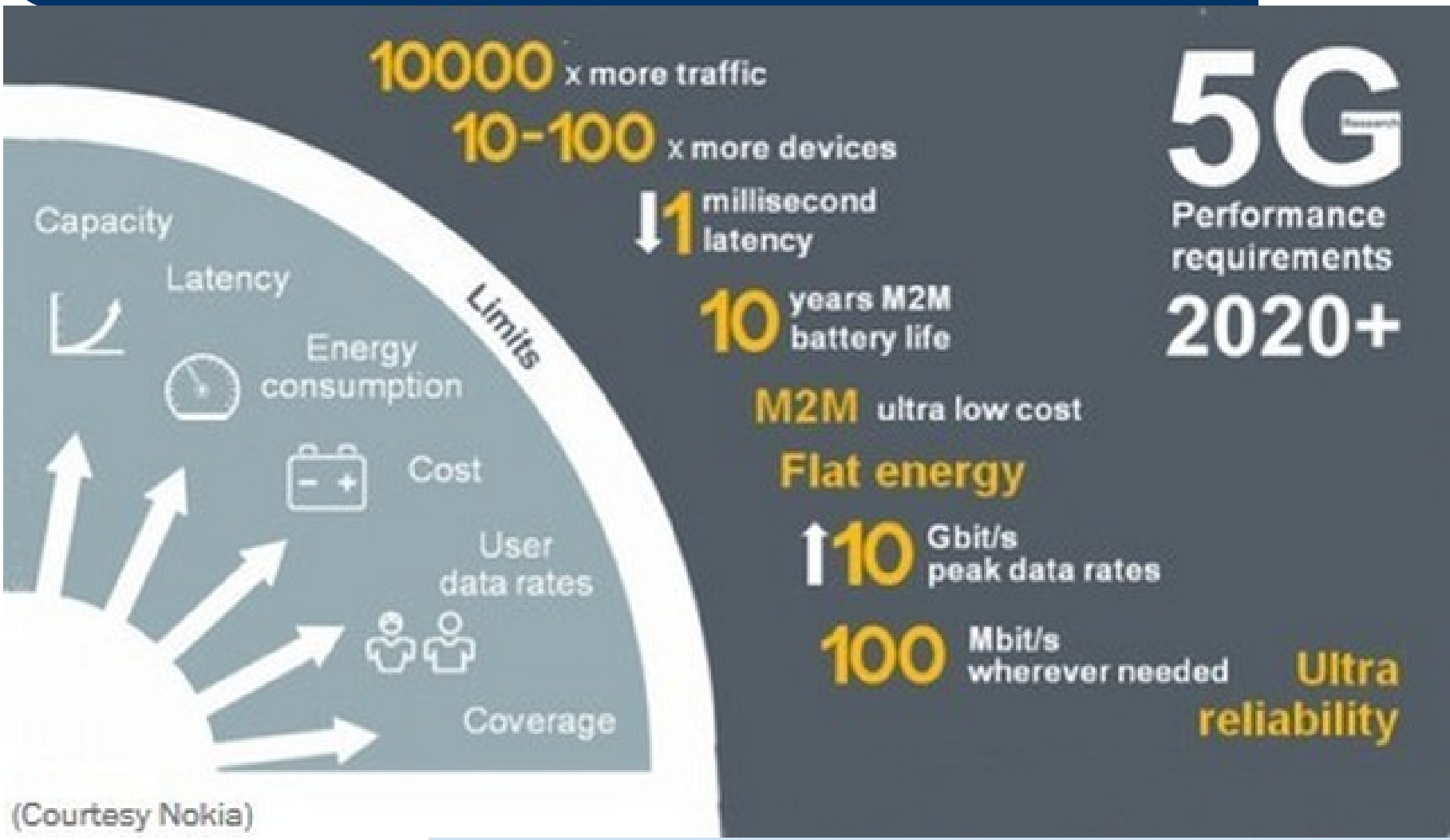
LTE-alapú technológiák



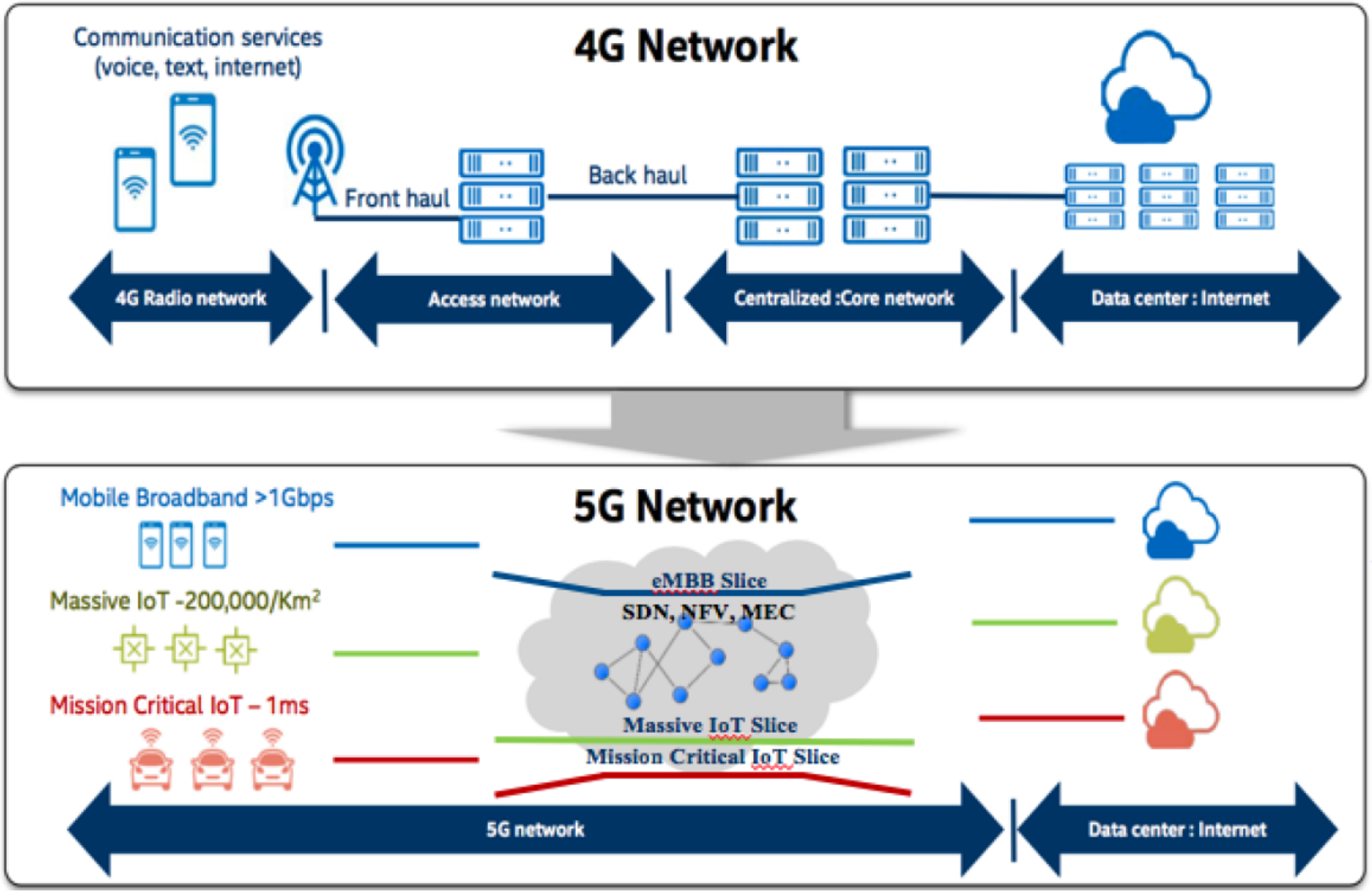
Rádiós Transzport - áttekintés

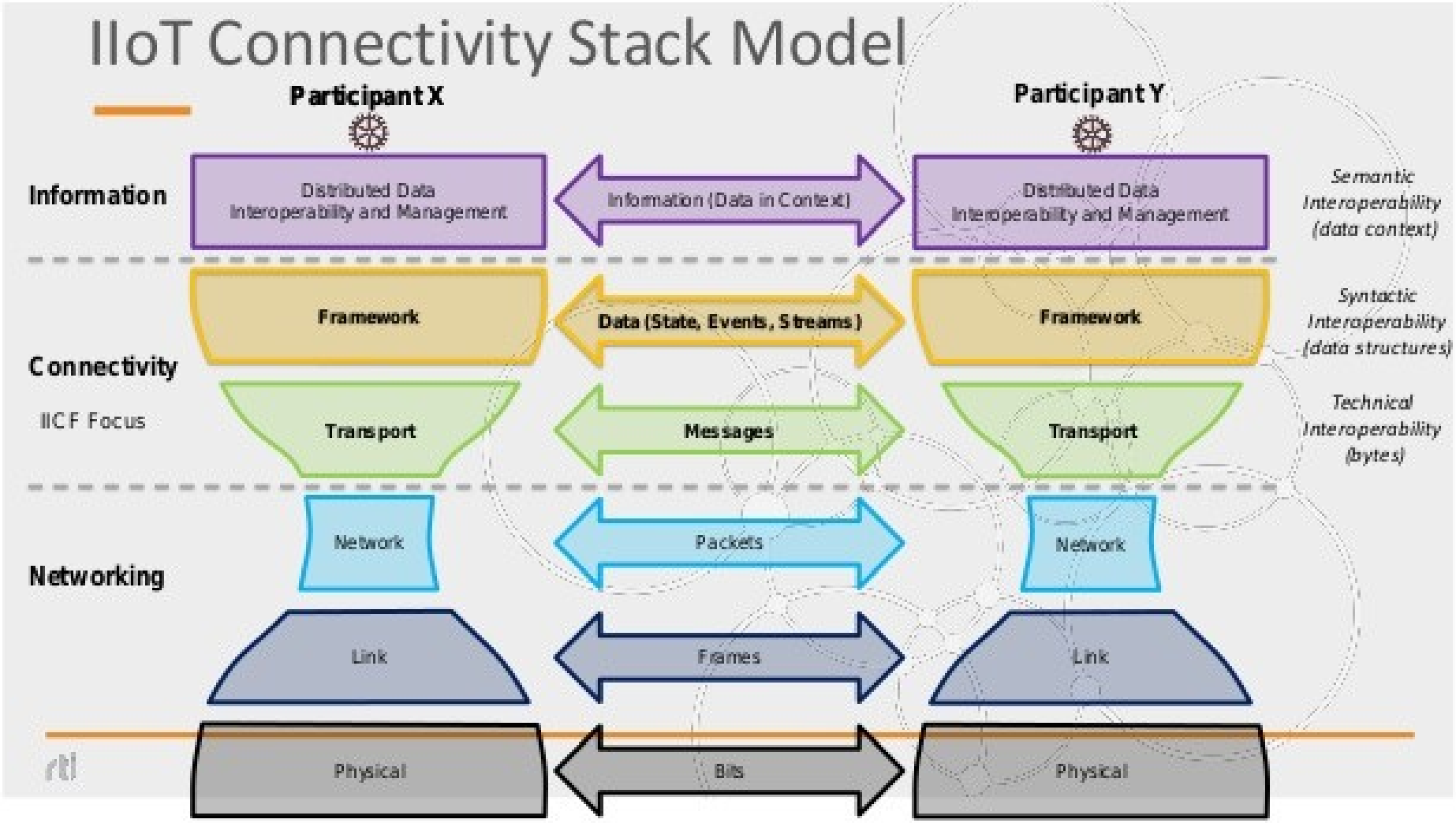
Technology	Frequency	Data Rate	Range	Power Usage	Cost
2G/3G	Cellular Bands	10 Mbps	Several Miles	High	High
Bluetooth/BLE	2.4Ghz	1, 2, 3 Mbps	~300 feet	Low	Low
802.15.4	subGhz, 2.4GHz	40, 250 kbps	> 100 square miles	Low	Low
LoRa	subGhz	< 50 kbps	1-3 miles	Low	Medium
LTE Cat 0/1	Cellular Bands	1-10 Mbps	Several Miles	Medium	High
NB-IoT	Cellular Bands	0.1-1 Mbps	Several Miles	Medium	High
SigFox	subGhz	< 1 kbps	Several Miles	Low	Medium
Weightless	subGhz	0.1-24 Mbps	Several Miles	Low	Low
Wi-Fi	subGhz, 2.4Ghz, 5Ghz	0.1-54 Mbps	< 300 feet	Medium	Low
WirelessHART	2.4Ghz	250 kbps	~300 feet	Medium	Medium
ZigBee	2.4Ghz	250 kbps	~300 feet	Low	Medium
Z-Wave	subGhz	40 kbps	~100 feet	Low	Medium

A nyilvánvaló megoldás pedig ☺

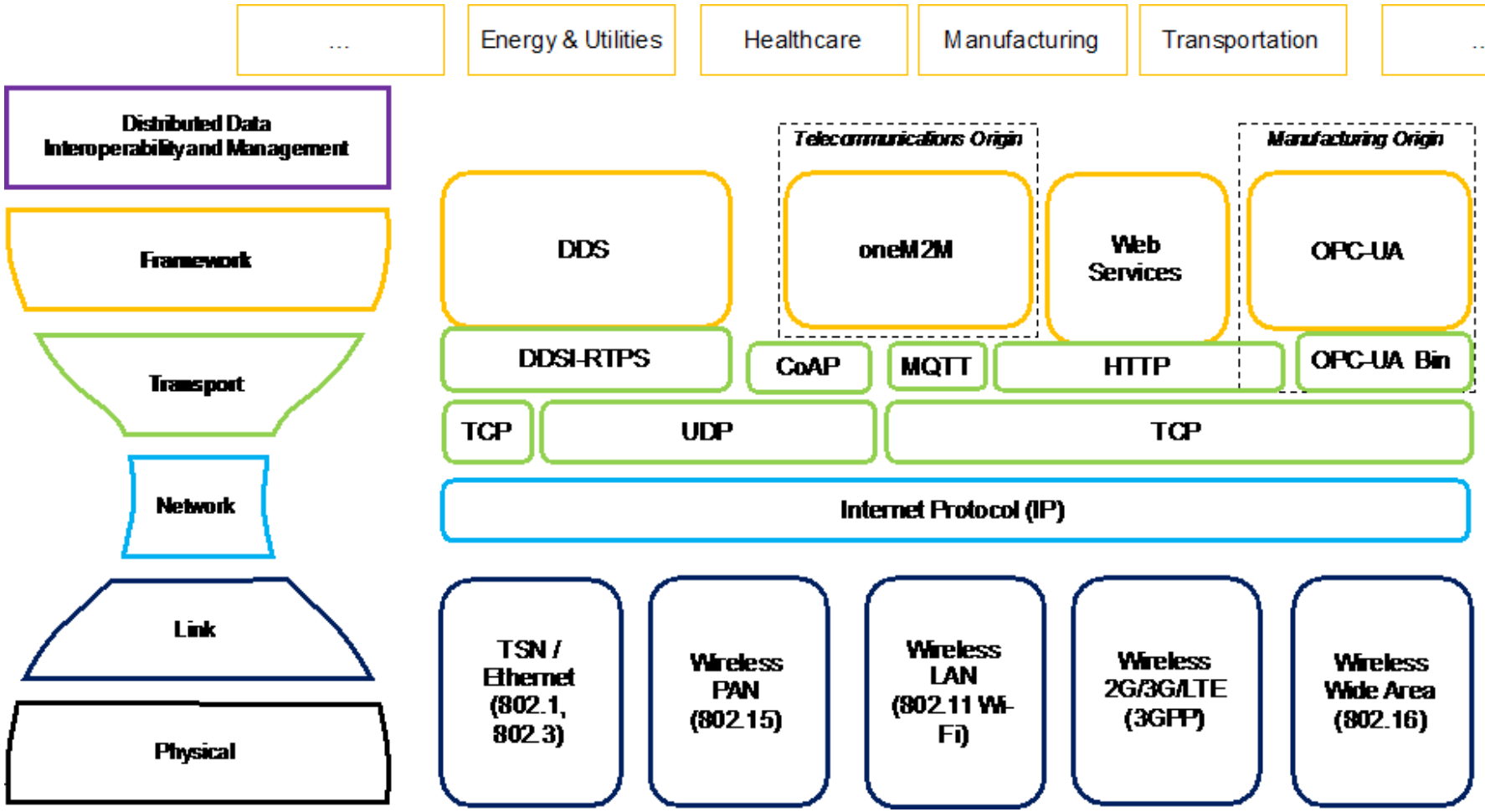


4G vs. 5G


Communication services
(voice, text, internet)
4G Network
Front haul
Back haul
4G Radio network
Access network
Centralized :Core network
Data center : Internet
Mobile Broadband >1Gbps
Massive IoT -200,000/Km²
Mission Critical IoT – 1ms
5G Network
eMBB Slice
SDN, NFV, MEC
Massive IoT Slice
Mission Critical IoT Slice
5G network
Data center : Internet


IIoT Connectivity Stack Model
Participant X
Participant Y
Information
Connectivity
IICF Focus
Networking
Distributed Data Interoperability and Management
Information (Data in Context)
Distributed Data Interoperability and Management
Framework
Data (State, Events, Streams)
Framework
Transport
Messages
Transport
Network
Packets
Network
Link
Frames
Link
Physical
Bits
Physical
Semantic Interoperability (data context)
Syntactic Interoperability (data structures)
Technical Interoperability (bytes)
rti

Jellemző protokollok



Transzport (/Session) opciók

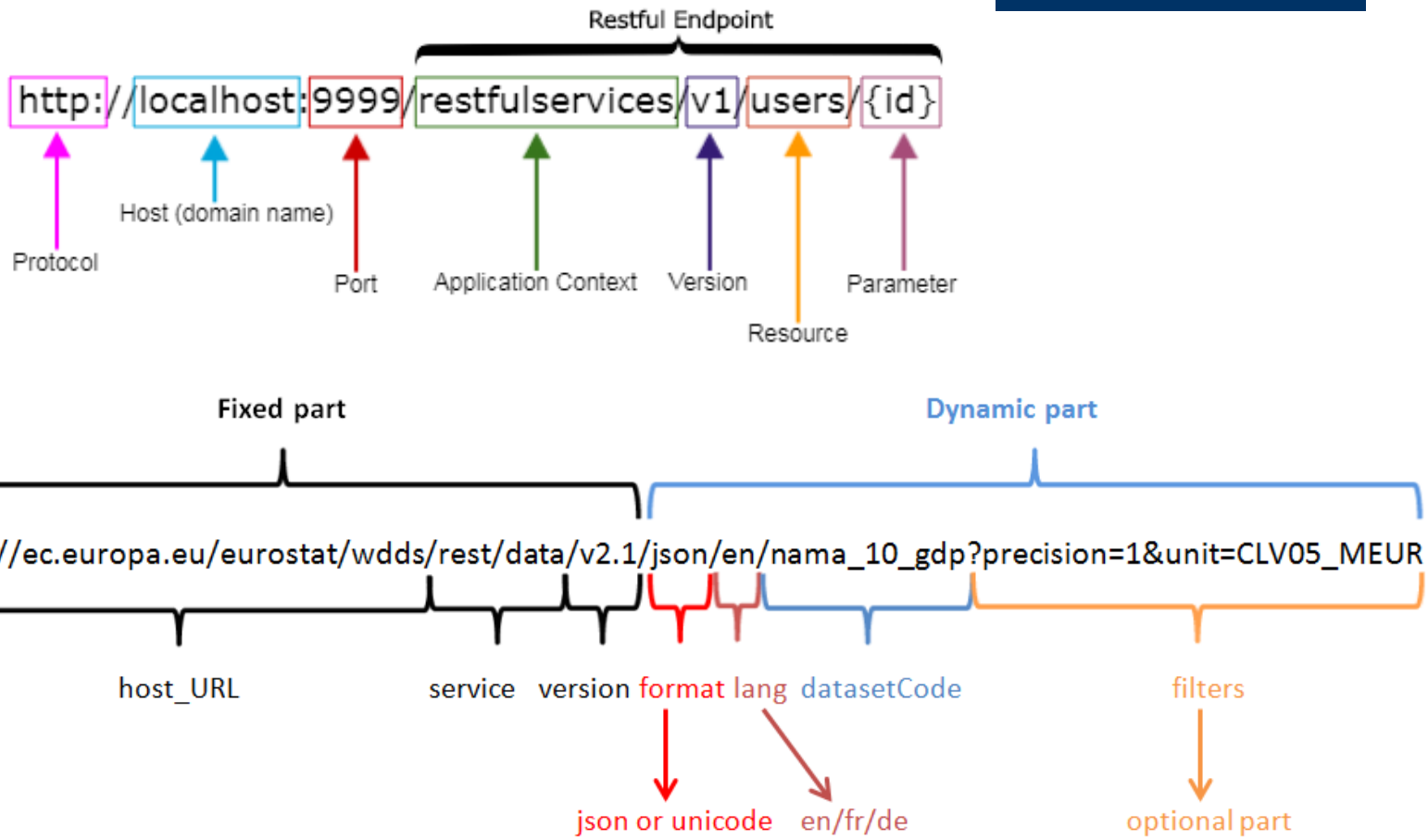
- UDP – datagram, kis overhead, garanciák nélküli átvitel
- **TCP** – garantált átvitel, nagy overhead, torlódásvezérlés, stb.

- Request Response
  - **OPC-UA** – OPC Unified Architecture
  - **HTTP REST** – Representational State Transfer
  - CoAP – Constrained Application Protocol
- Publish-Subscribe
  - **MQTT** – Message Queue Transport Protocol
  - **AMQP** – Advanced Message Queuing Protocol
  - **DDS** – Data Distribution Service

REST sajátosságok

- **Erőforrás**: az applikáció állapota és funkciója absztrakt „erőforrás”-ként szerepel
- **URI**: minden erőforrás egyedileg címezhető URI-val
- **Uniform interface**: minden erőforrás az uiform interface-t használja az *állapot* átvitelére a kliens és az erőforrás között
  - Methods: csak HTTP method-ok: GET, PUT, POST, DELETE, HEAD
  - Representation
- **Protokoll alapelvek**
  - Kliens-szerver
  - Állapotmentesség
  - Cache-elhető
  - Rétegelt

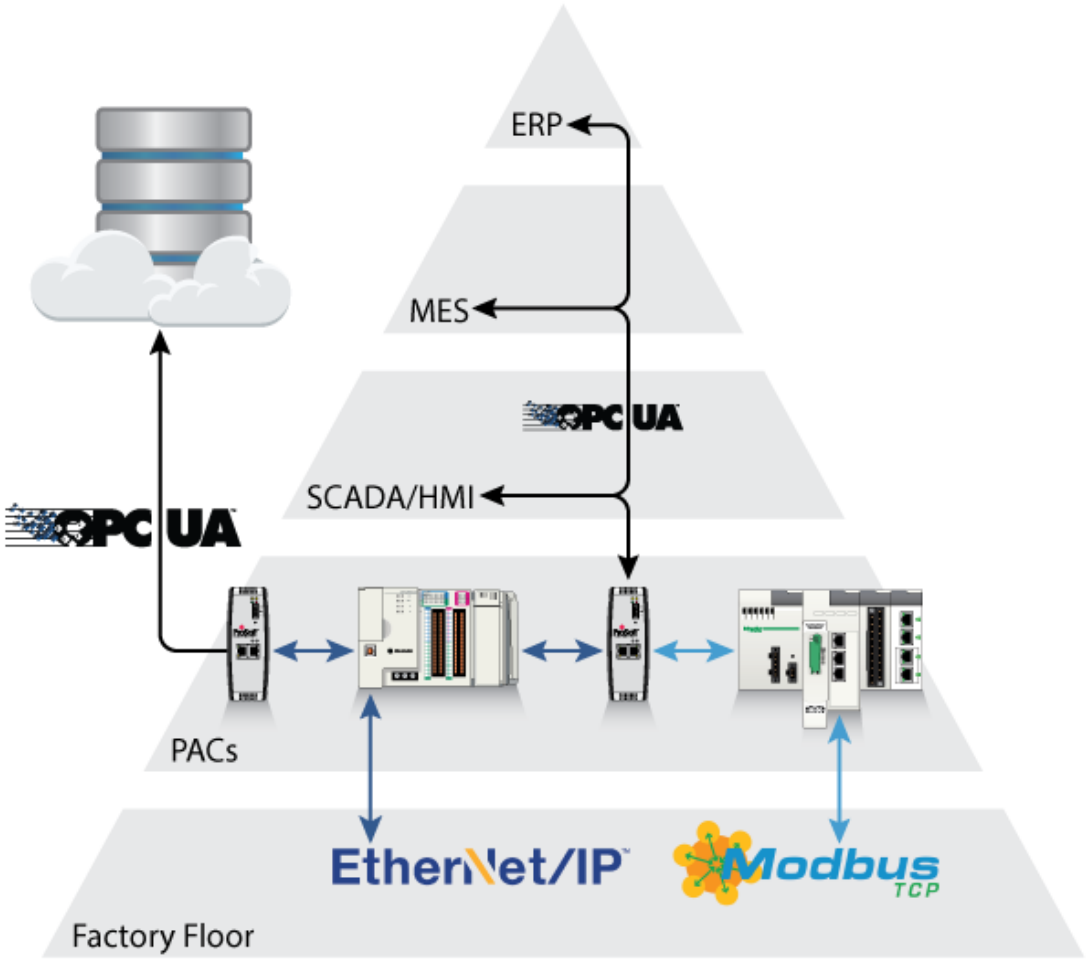
RESTful HTTP – URI felépítés példák



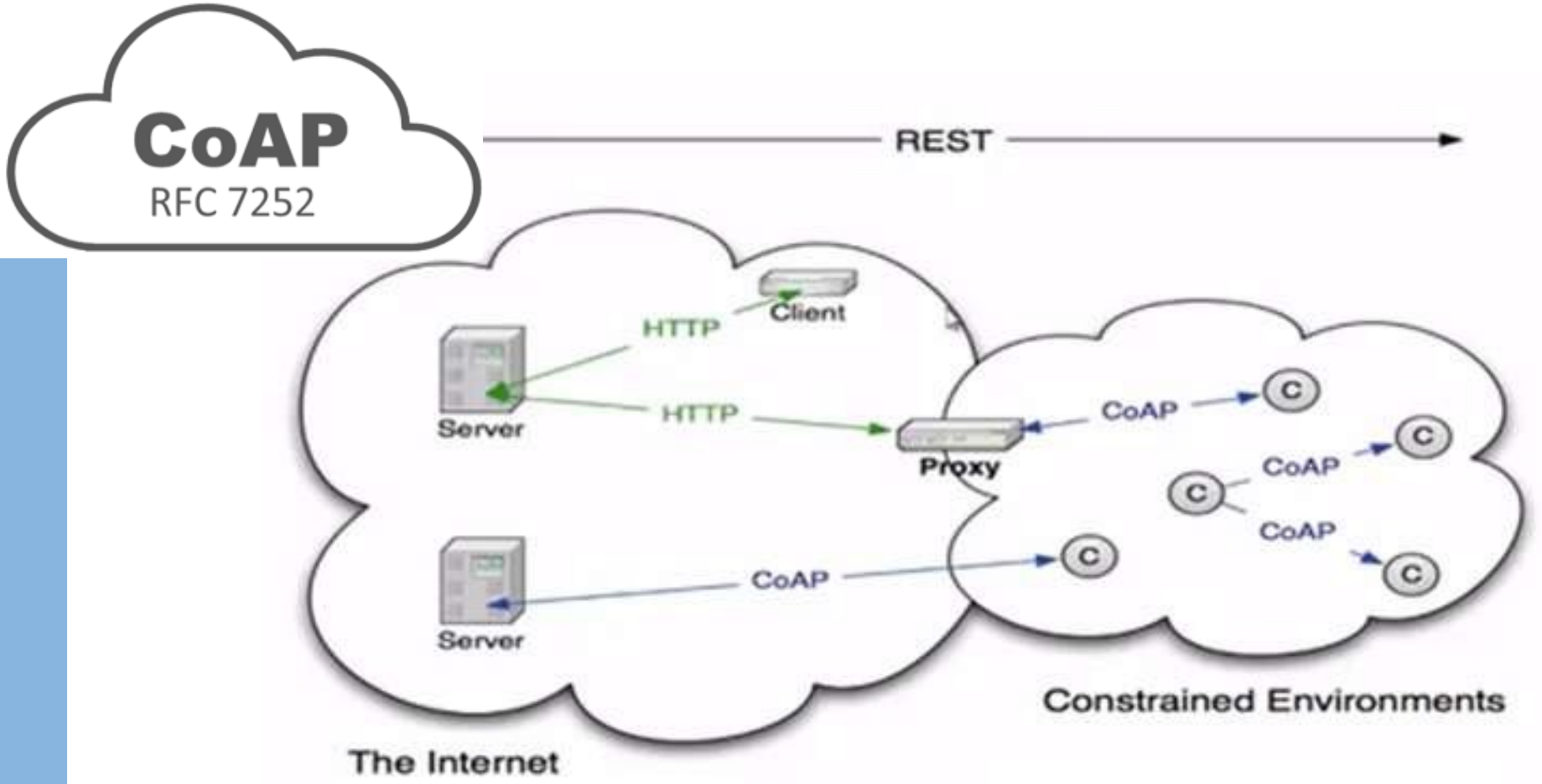
CRUD: Create, Read, Update, Delete

Operation	SQL	HTTP	DDS
Create	INSERT	PUT / POST	write
Read (Retrieve)	SELECT	GET	read / take
Update (Modify)	UPDATE	PUT / PATCH	write
Delete (Destroy)	DELETE	DELETE	dispose

OPC-UA – cél: legyen használható az ISA-95 piramison

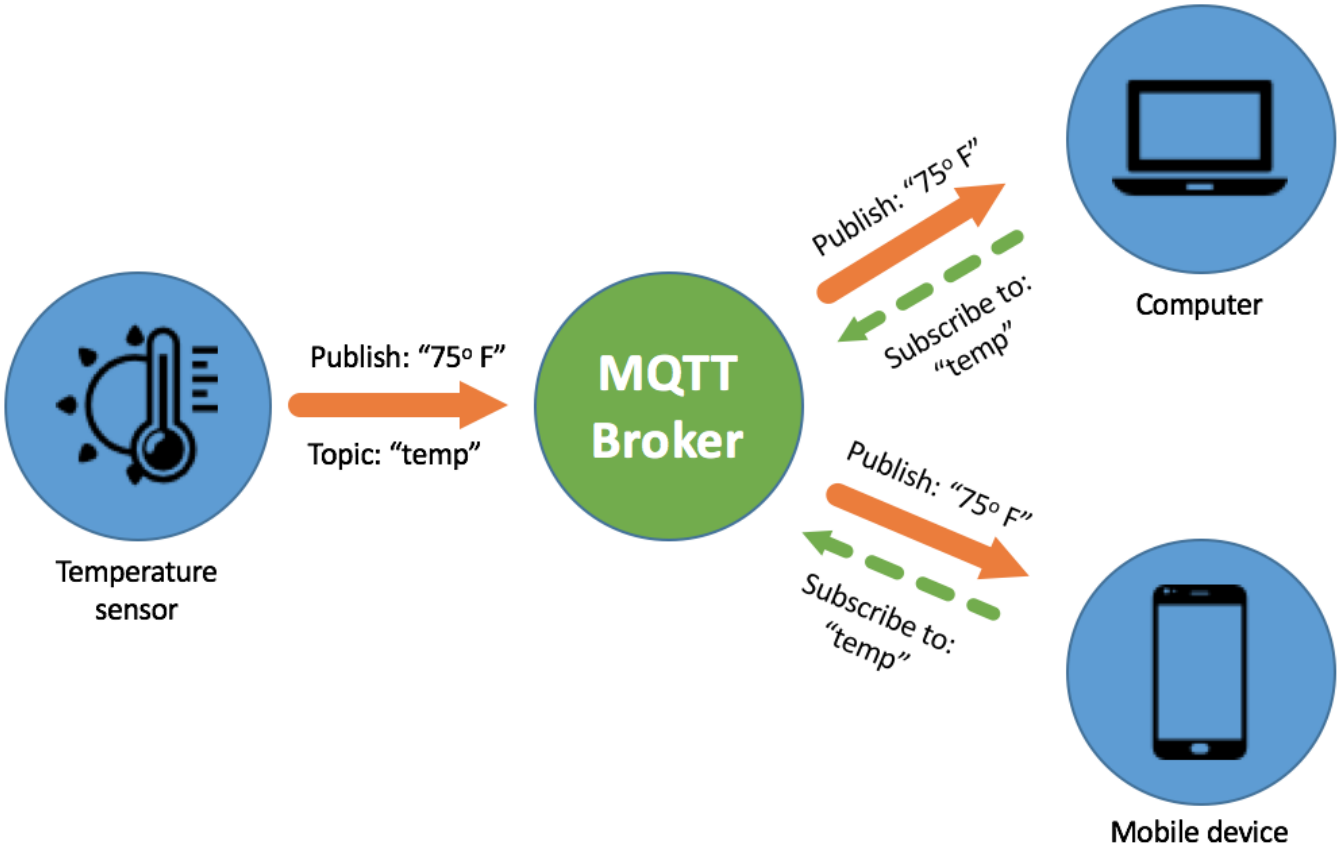


Constrained Application Protocol

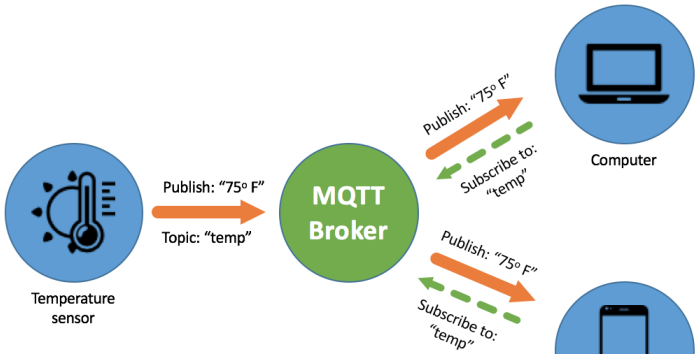


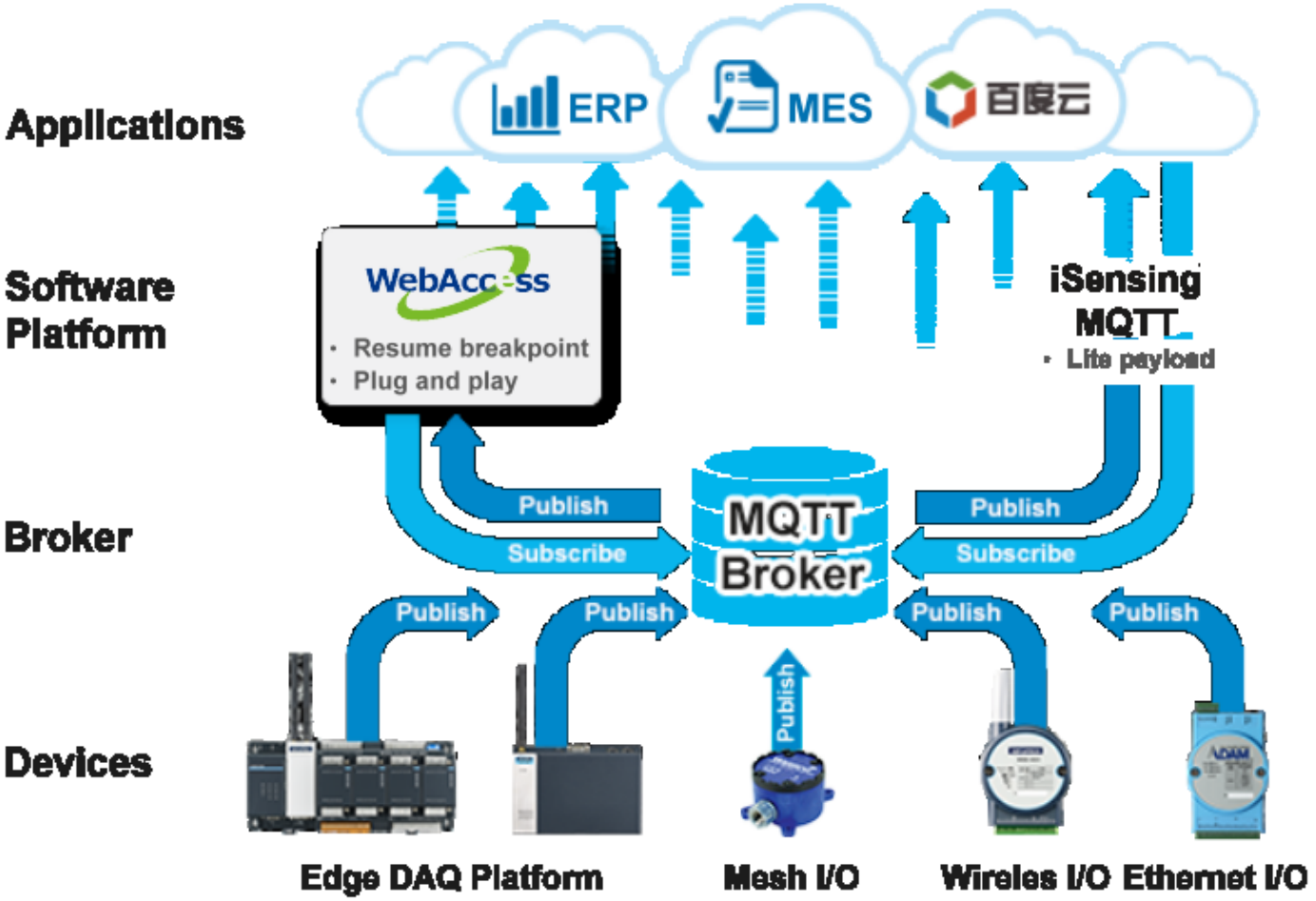
CoAP Architecture

Publish-Subscribe - MQTT

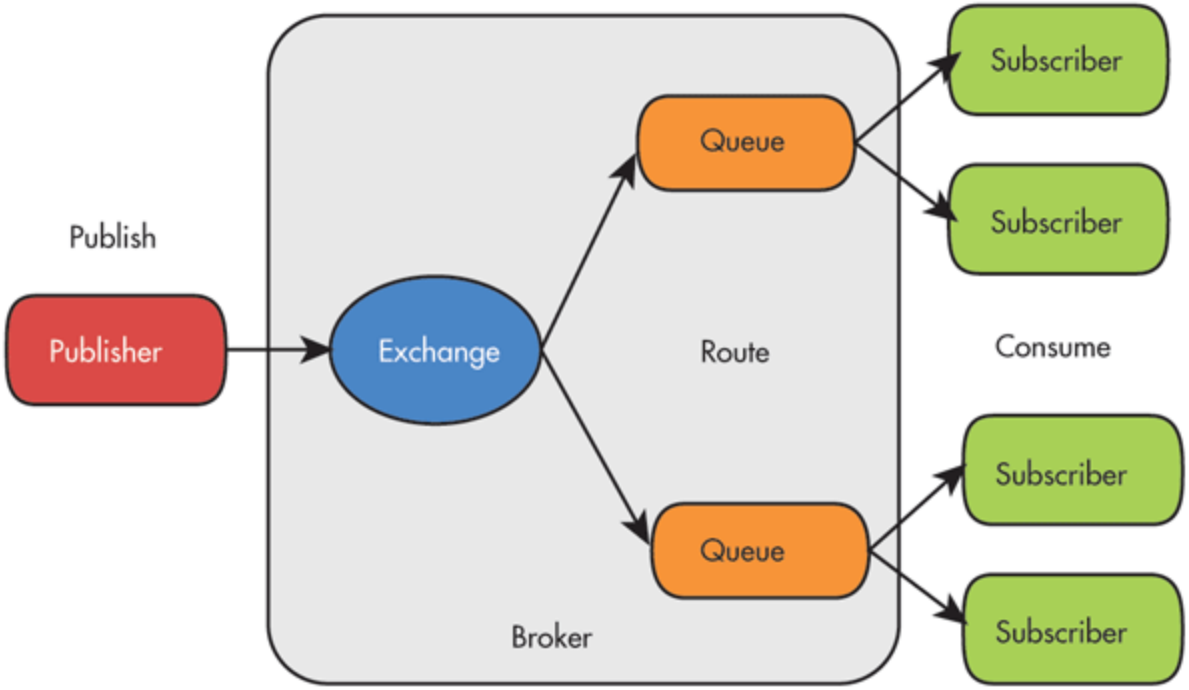


MQTT az iparban

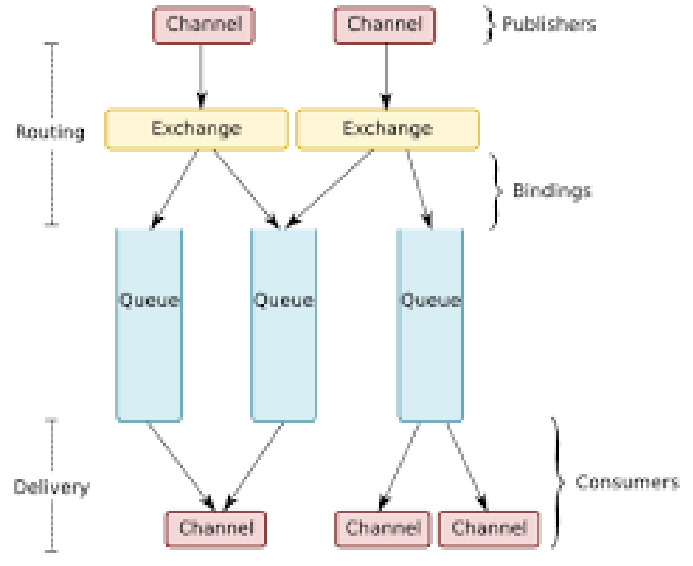




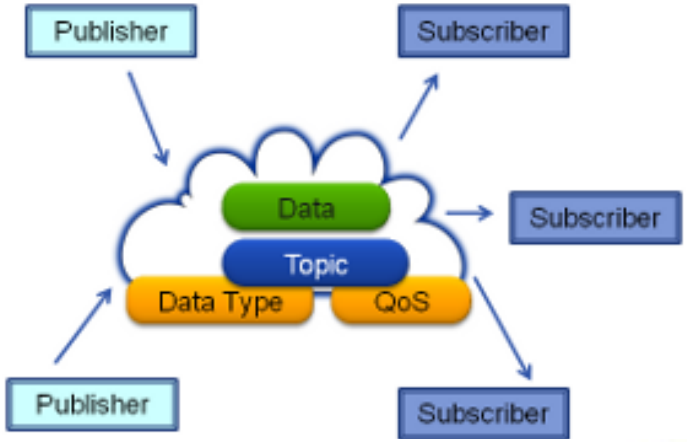
Publish-Subscribe

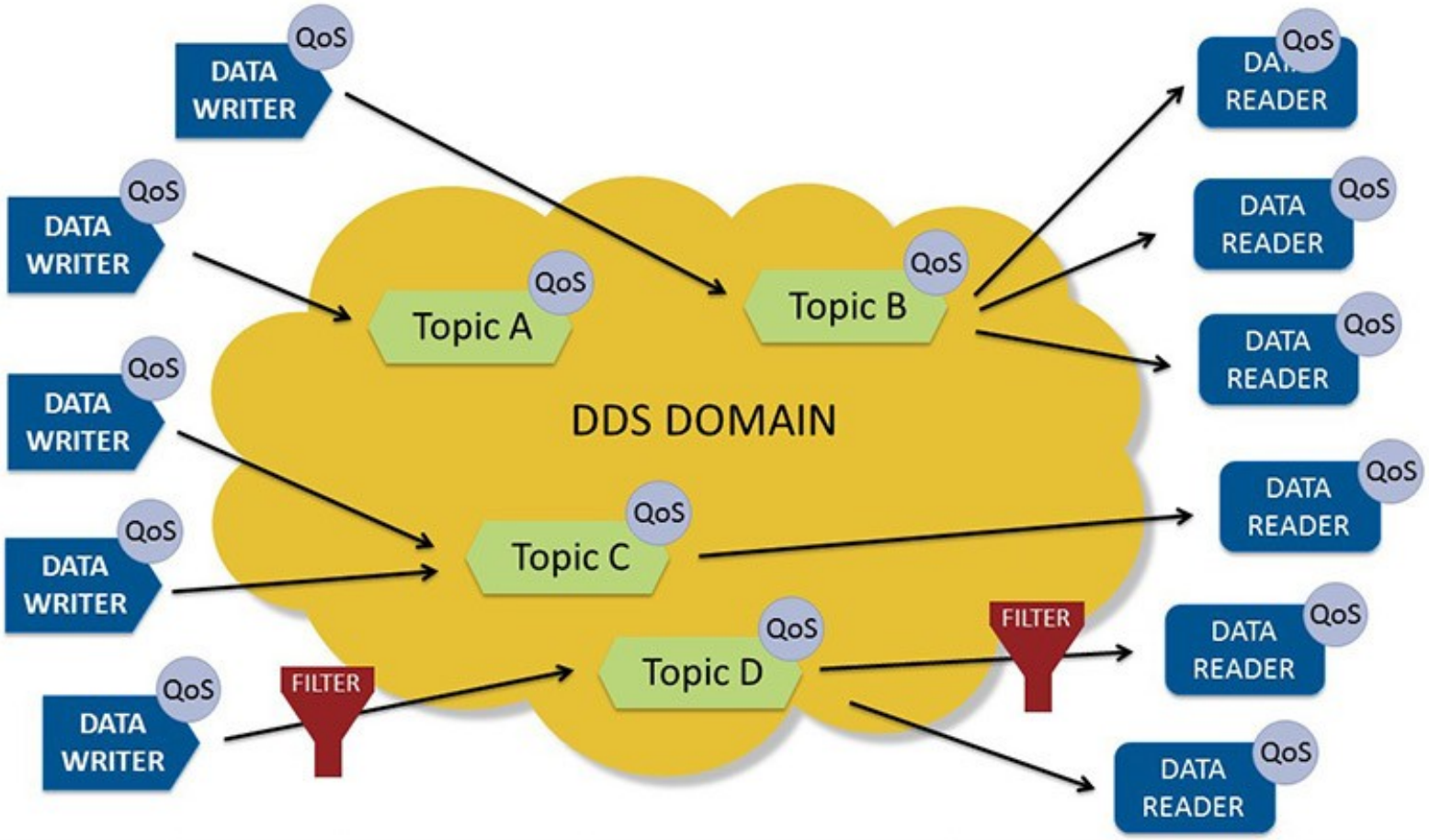


extrákkal: AMQP

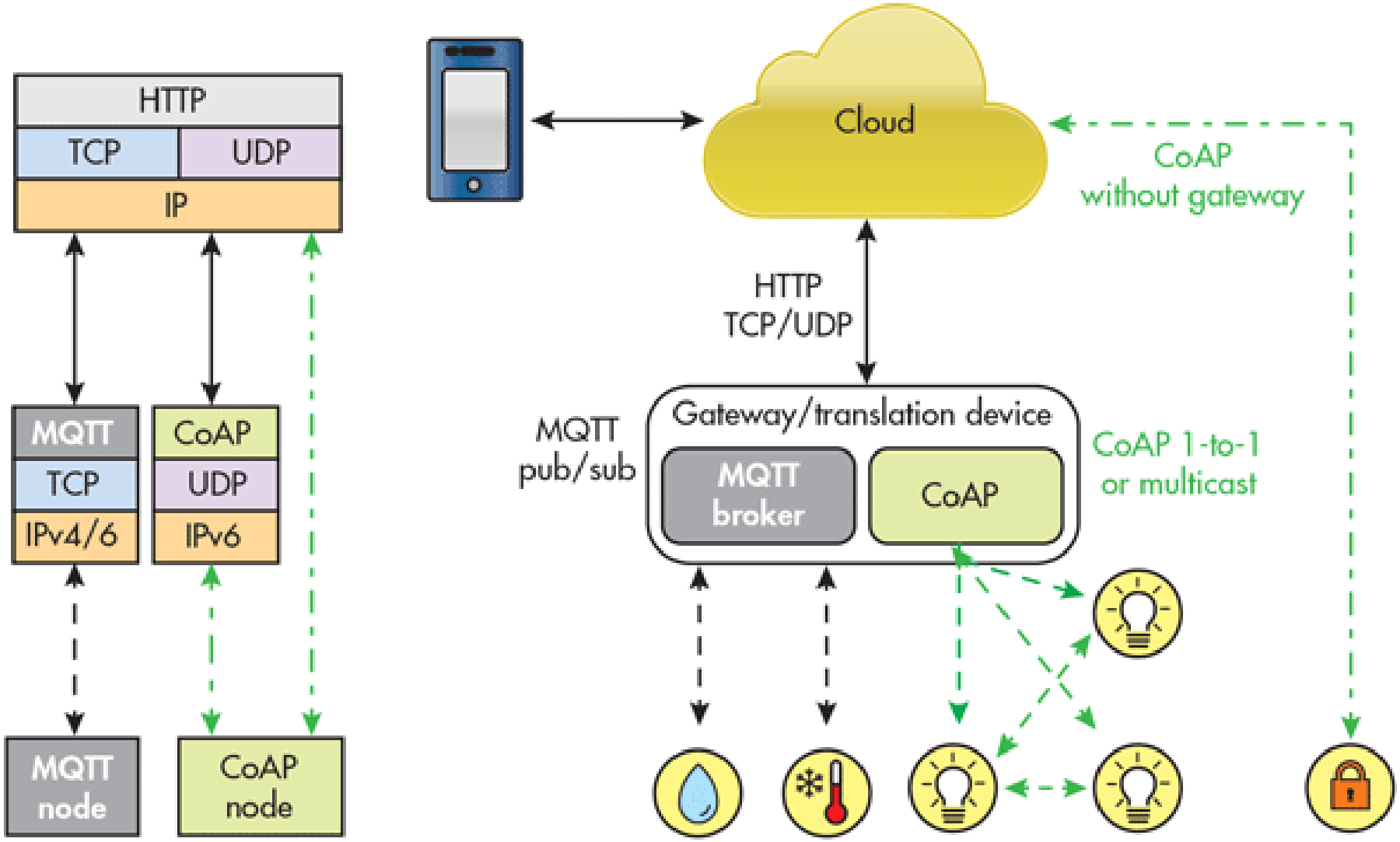


DDS – Data Distribution Service





Coexistence of Publish-Subscribe and Request-Response



Szemantikai leíró keretek – xml vs. JSON

```xml
<empinfo>
  <employees>
    <employee>
      <name>Scott Philip</name>
      <salary>£44k</salary>
      <age>27</age>
    </employee>
    <employee>
      <name>Tim Henn</name>
      <salary>£40k</salary>
      <age>27</age>
    </employee>
    <employee>
      <name>Long yong</name>
      <salary>£40k</salary>
      <age>28</age>
    </employee>
  </employees>
</empinfo>
```

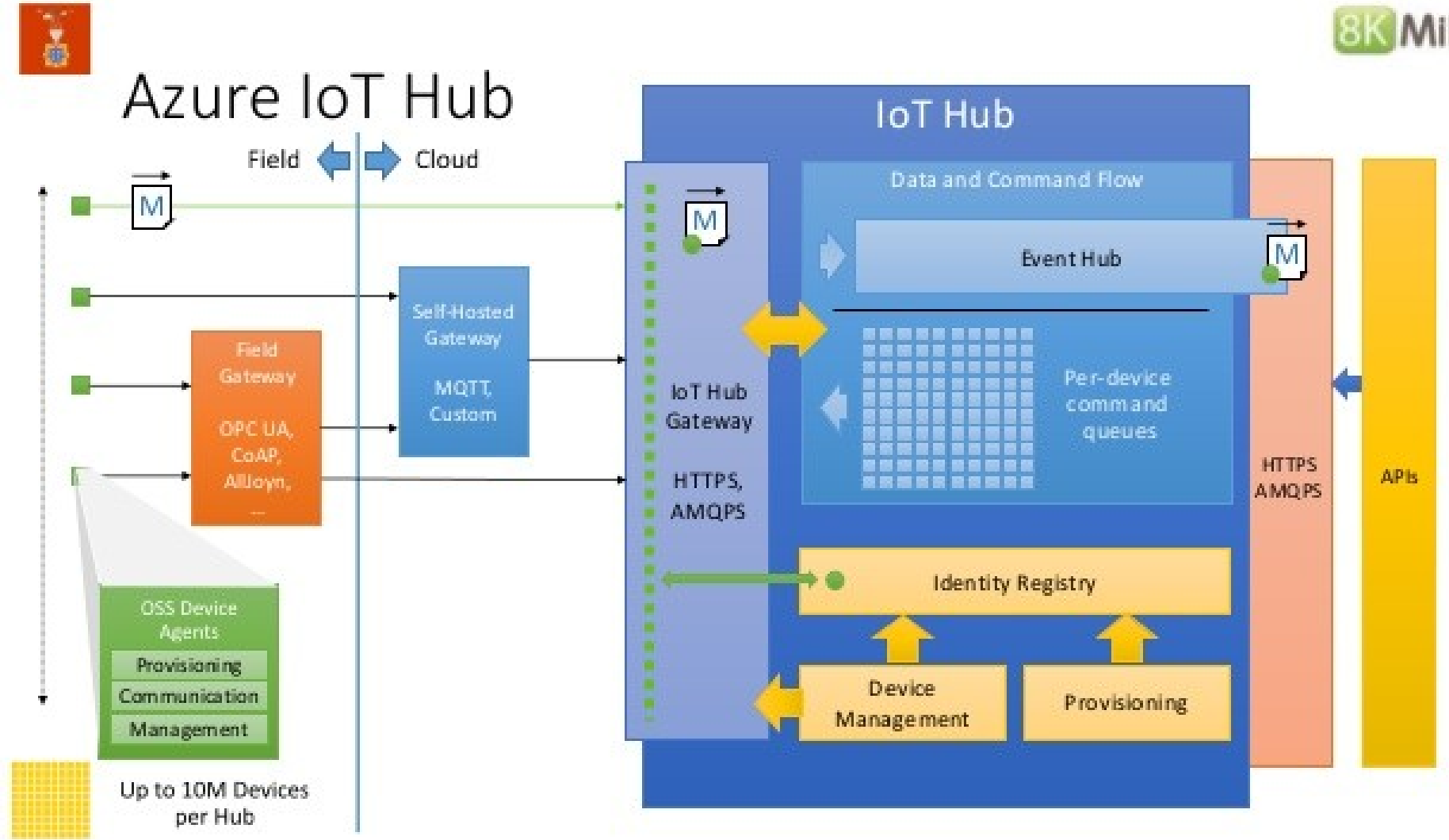
```json
{ "empinfo" :
    {
        "employees" : [
        {
          "name" : "Scott Philip",
          "salary" : £44k,
          "age" : 27,

        },

        {
          "name" : "Tim Henn",
          "salary" : £40k,
          "age" : 27,
        },

        {
         "name" : "Long Yong",
         "salary" : £40k,
         "age" : 28,

        }
                    ]
    }
}
```

xml vs. JSON

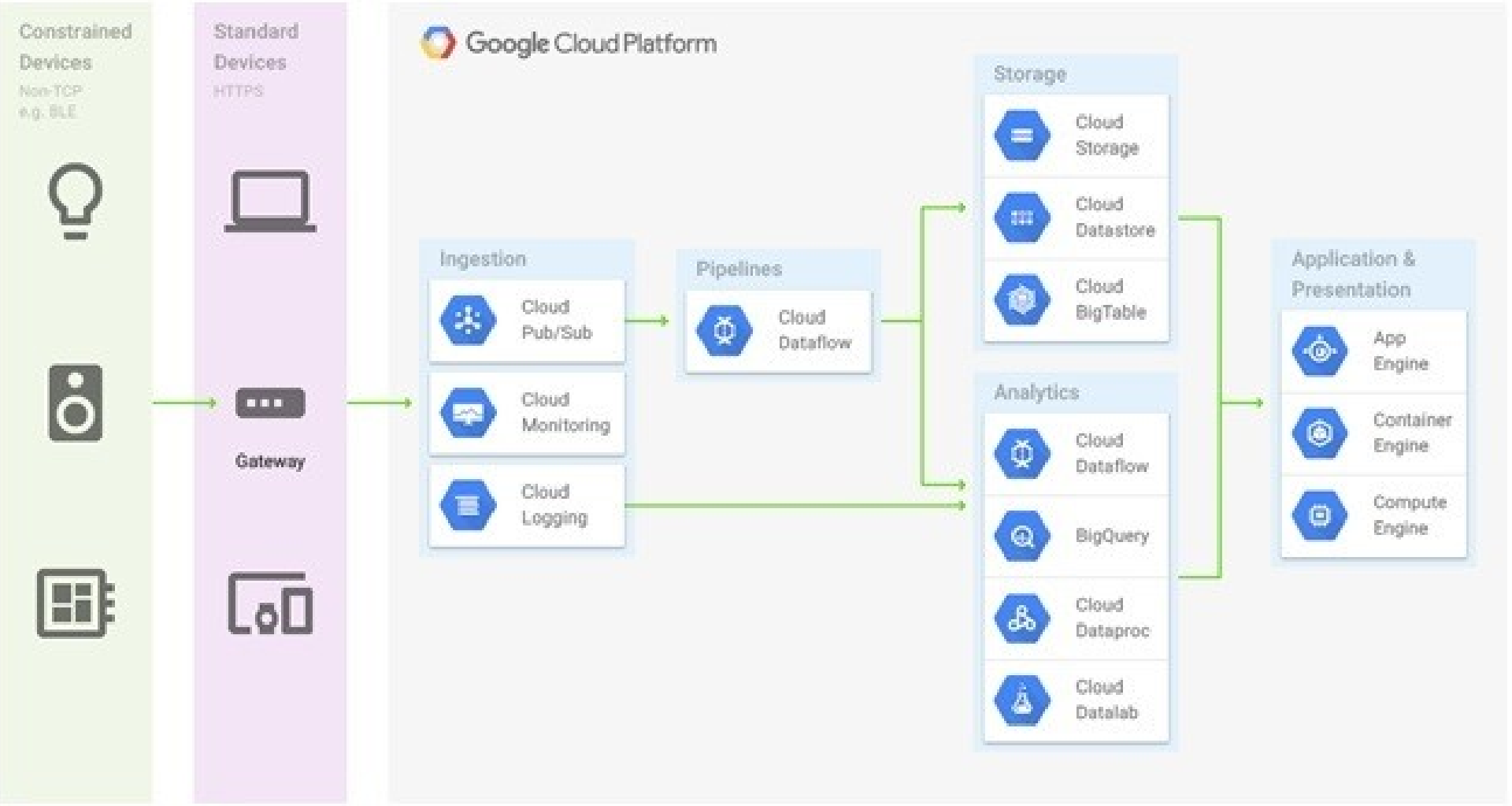
	xml	JSON
AJAX	Több könyvtár kell	Javascript utánérzés
Namespace	Igen	Nem
Input validation	Igen	Nem
Átviteli idő	Több	Kevesebb
Szószátyárság	Több	Kevesebb
Web Services	SOAP (ami megbízhatóbb üzleti alkalmazásoknál)	REST (elterjedtebb a nem-kritikus alkalmazások esetén)

IoT keretrendszerek

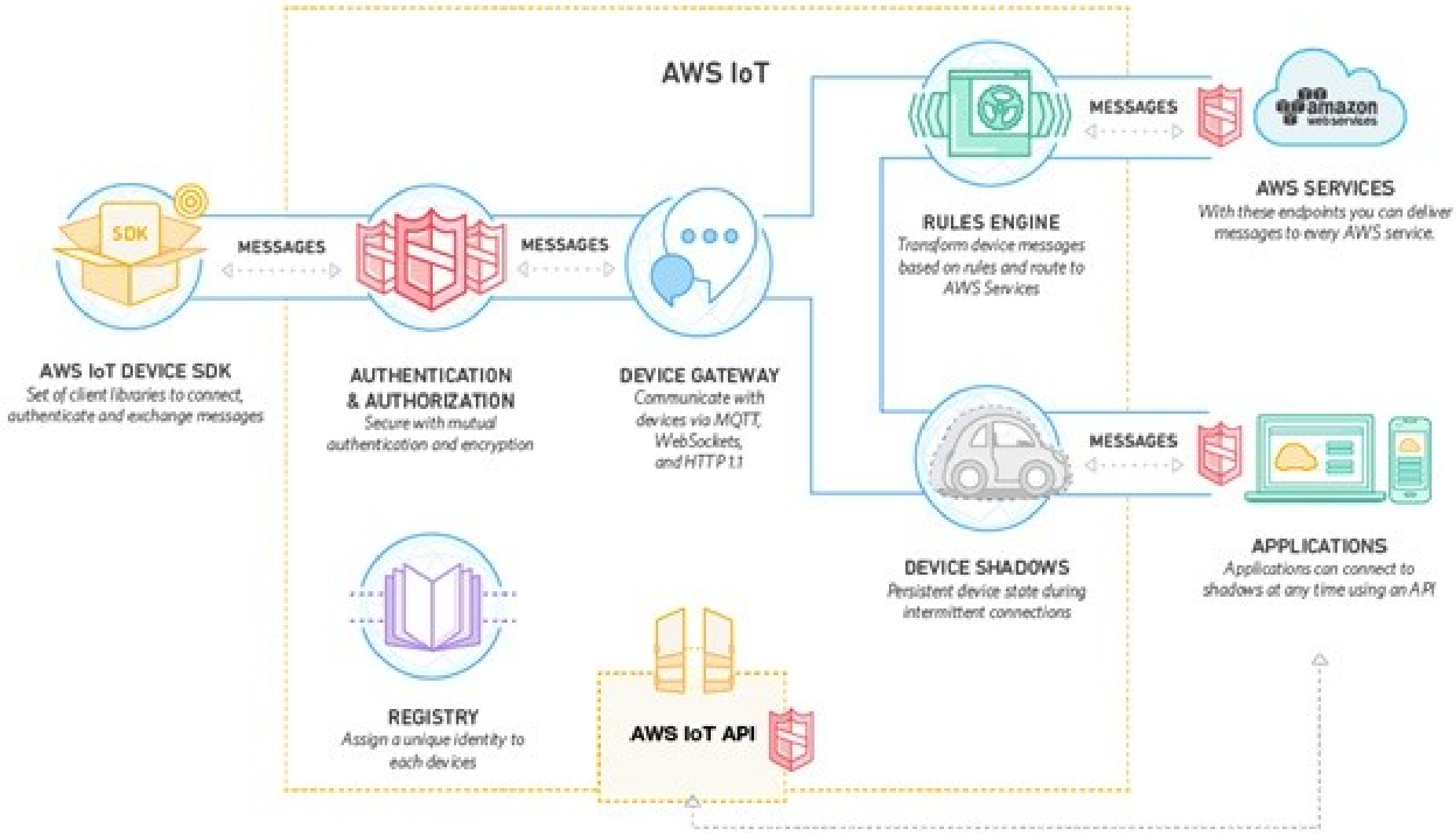
Adat-aggregátor és feldolgozó – I
Azure IoT Hub



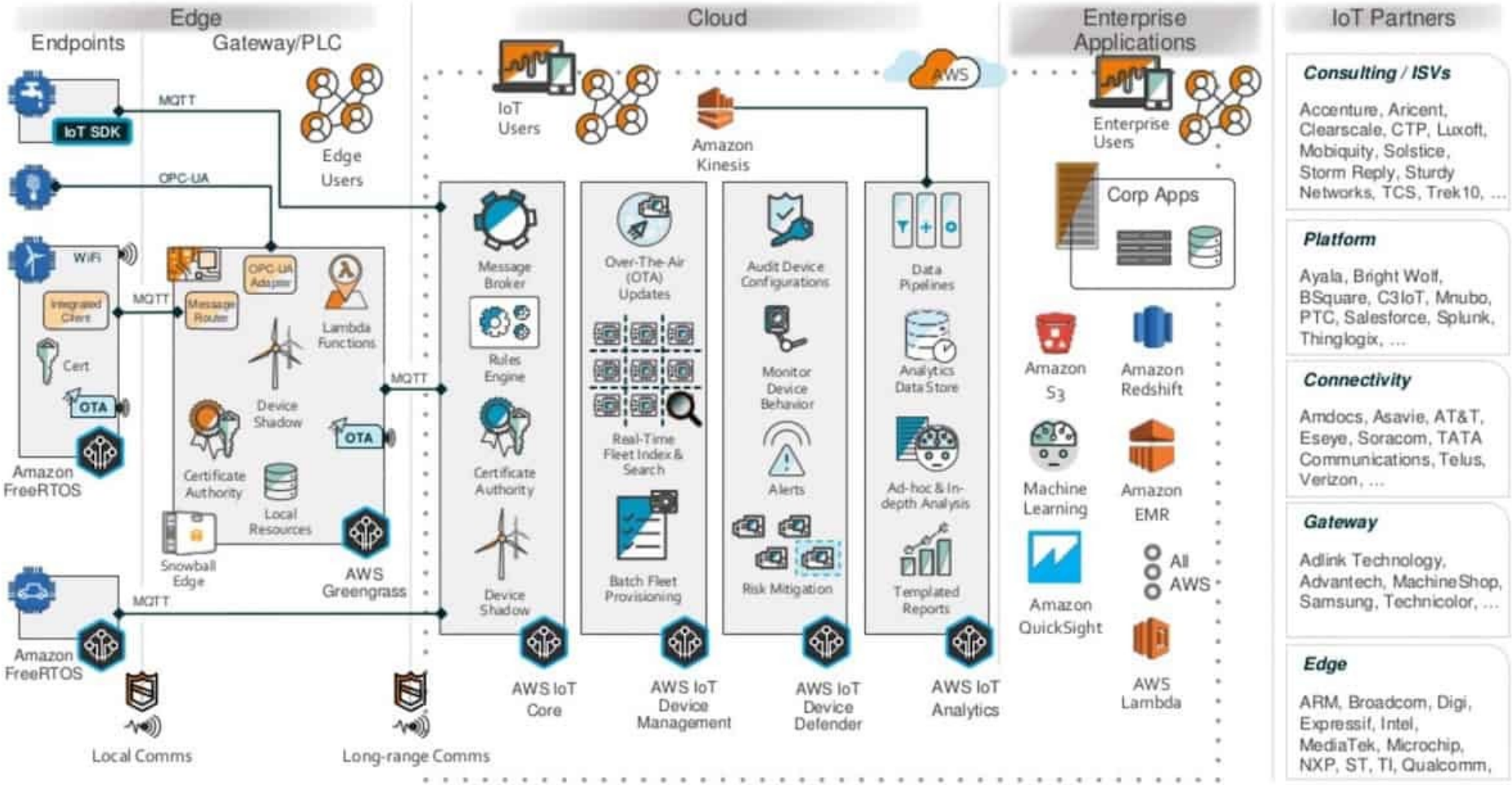
Adat-aggregátor és feldolgozó - II
Google Cloud Platform



Adat-aggregátor és feldolgozó - III
Amazon Web Services - IoT



IoT with AWS

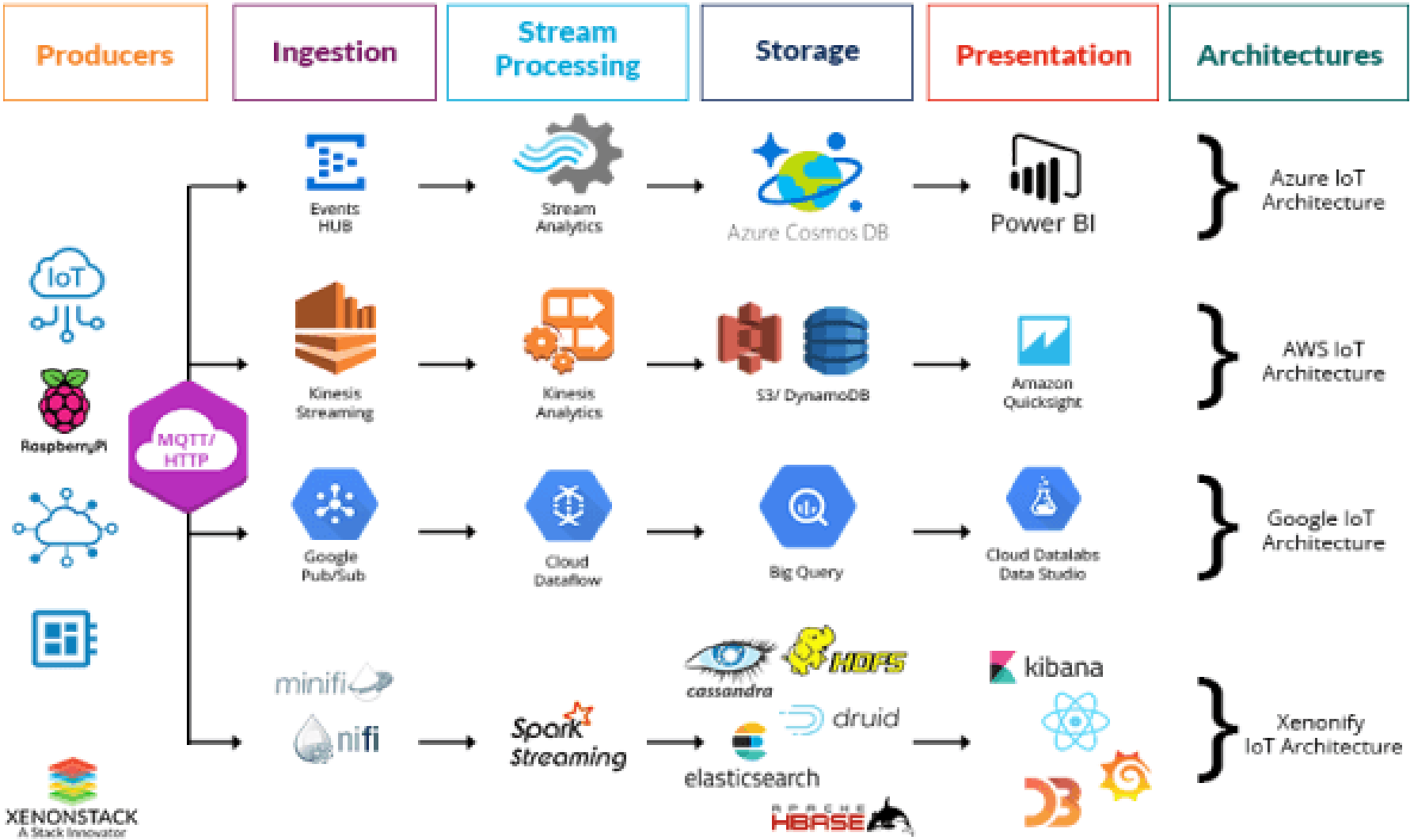

Edge
Endpoints
Gateway/PLC
Cloud
Enterprise Applications
IoT Partners
IoT SDK
MQTT
OPC-UA
Edge Users
WiFi
Integrated Client
Cert
OTA
Amazon FreeRTOS
OPC-UA Adapter
Message Router
Lambda Functions
Device Shadow
Certificate Authority
Local Resources
Snowball Edge
AWS Greengrass
Amazon FreeRTOS
Local Comms
Long-range Comms
IoT Users
Amazon Kinesis
AWS
Message Broker
Rules Engine
Certificate Authority
Device Shadow
Over-The-Air (OTA) Updates
Real-Time Fleet Index & Search
Batch Fleet Provisioning
Audit Device Configurations
Monitor Device Behavior
Alerts
Risk Mitigation
Data Pipelines
Analytics Data Store
Ad-hoc & In-depth Analysis
Templated Reports
AWS IoT Core
AWS IoT Device Management
AWS IoT Device Defender
AWS IoT Analytics
Enterprise Users
Corp Apps
Amazon S3
Amazon Redshift
Machine Learning
Amazon EMR
Amazon QuickSight
All AWS
AWS Lambda
Consulting / ISVs
Accenture, Aricent, Clearscale, CTP, Luxoft, Mobiquity, Solstice, Storm Reply, Sturdy Networks, TCS, Trek10, ...
Platform
Ayala, Bright Wolf, BSquare, C3IoT, Mnubo, PTC, Salesforce, Splunk, Thinglogix, ...
Connectivity
Amdocs, Asavie, AT&T, Eseye, Soracom, TATA Communications, Telus, Verizon, ...
Gateway
Adlink Technology, Advantech, MachineShop, Samsung, Technicolor, ...
Edge
ARM, Broadcom, Digi, Expressif, Intel, MediaTek, Microchip, NXP, ST, TI, Qualcomm, ...

Két összehasonlítás

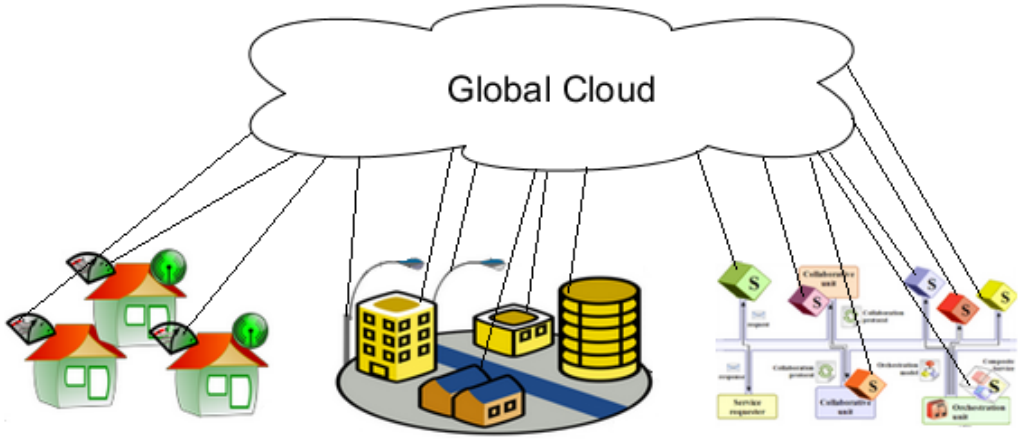
	Microsoft Azure IoT Hub	Amazon AWS IoT	IBM IoT Foundation
Protocols	HTTP, AMQP, MQTT and custom protocols using protocol gateway project)	HTTP, MQTT	HTTP, MQTT
Communication Patterns	Telemetry, Command	Telemetry, Command (state change)	Telemetry, Command
Certified Platforms	Intel, Raspberry Pi 2, Freescale, Texas Instruments, MinnowBoard, BeagleBoard, Seeed, resin.io	Broadcom, Marvell, Renesas, Texas Instruments, Microchip, Intel, Mediatek, Qualcomm, Seeed, BeagleBoard	ARM mbed, Texas Instruments, Intel, Rasppberry Pi, Arduino Uno
SDK / Language	.Net and UWP, Java, C, NodeJS	C, NodeJS	C#, C, Python, Java, NodeJS
Security	TLS (only server authentication)	TLS (mutual authentication)	TLS
Authentication	Per-device with SAS token	X.509 certificate client authentication, IAM service, Cognito service	Per-device with token
Pricing	Paying for IoT Hub unit related to number of devices and messages per days	Paying million messages traffic (published from devices + delivered to devices)	Paying related to number of devices, data traffic and data storage

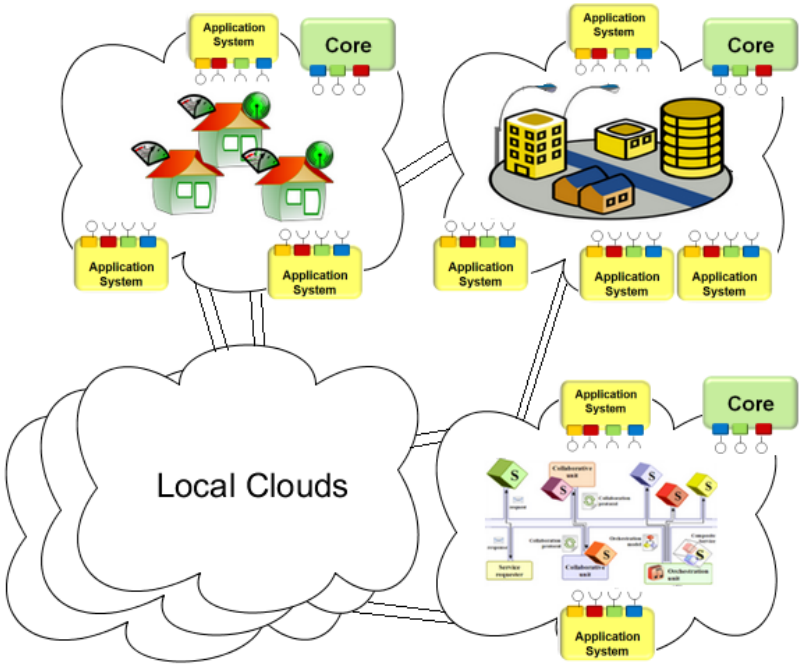
Protocol	Azure	AWS	Google
HTTP/HTTPS	Supported	Supported	Supported
MQTT	Supported	Supported	-
MQTT + WebSocket	Supported	Supported	-
AMQP	Supported	-	-
CoAP	Trough gateway	-	-

Egy másik összehasonlítás…



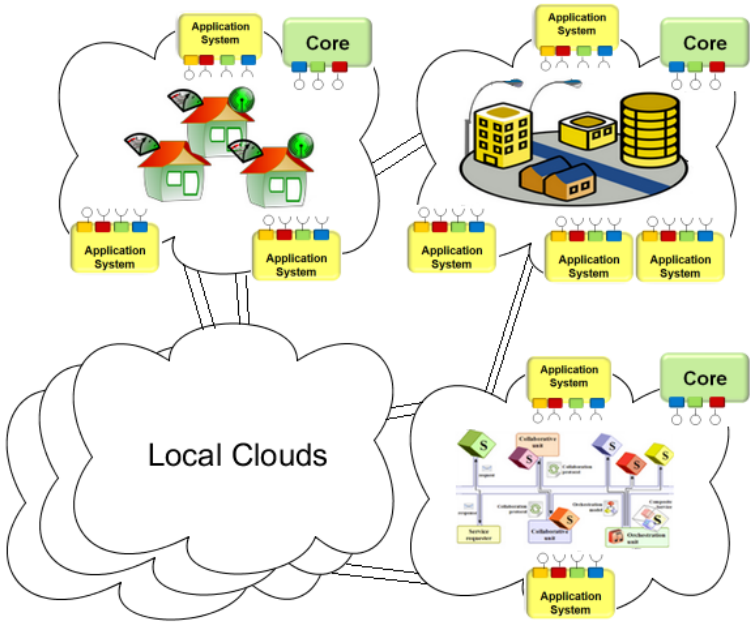
Együttműködés: globális és lokális megközelítések



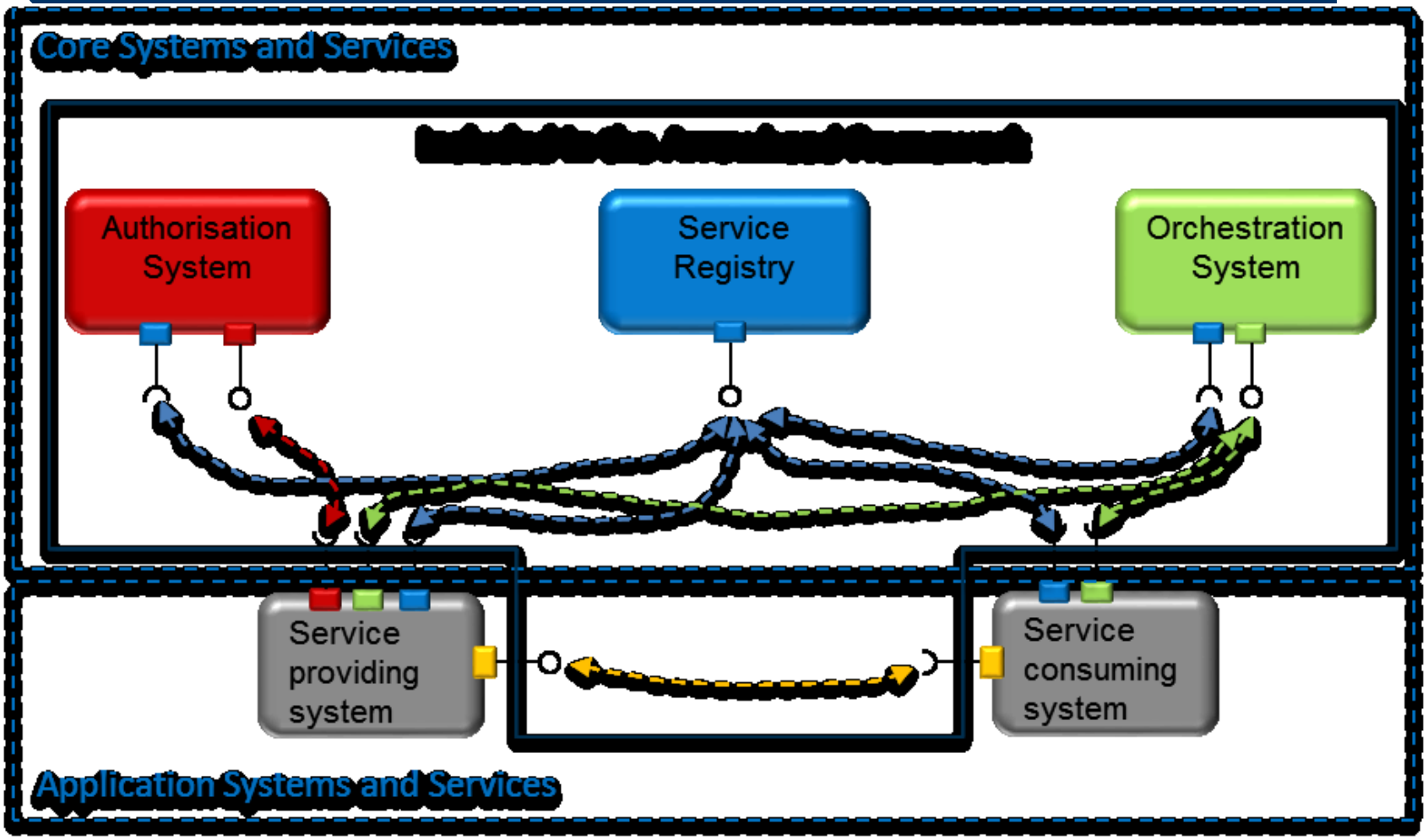


Együttműködő rendszerek a lokális automatizálási felhő támogatásával

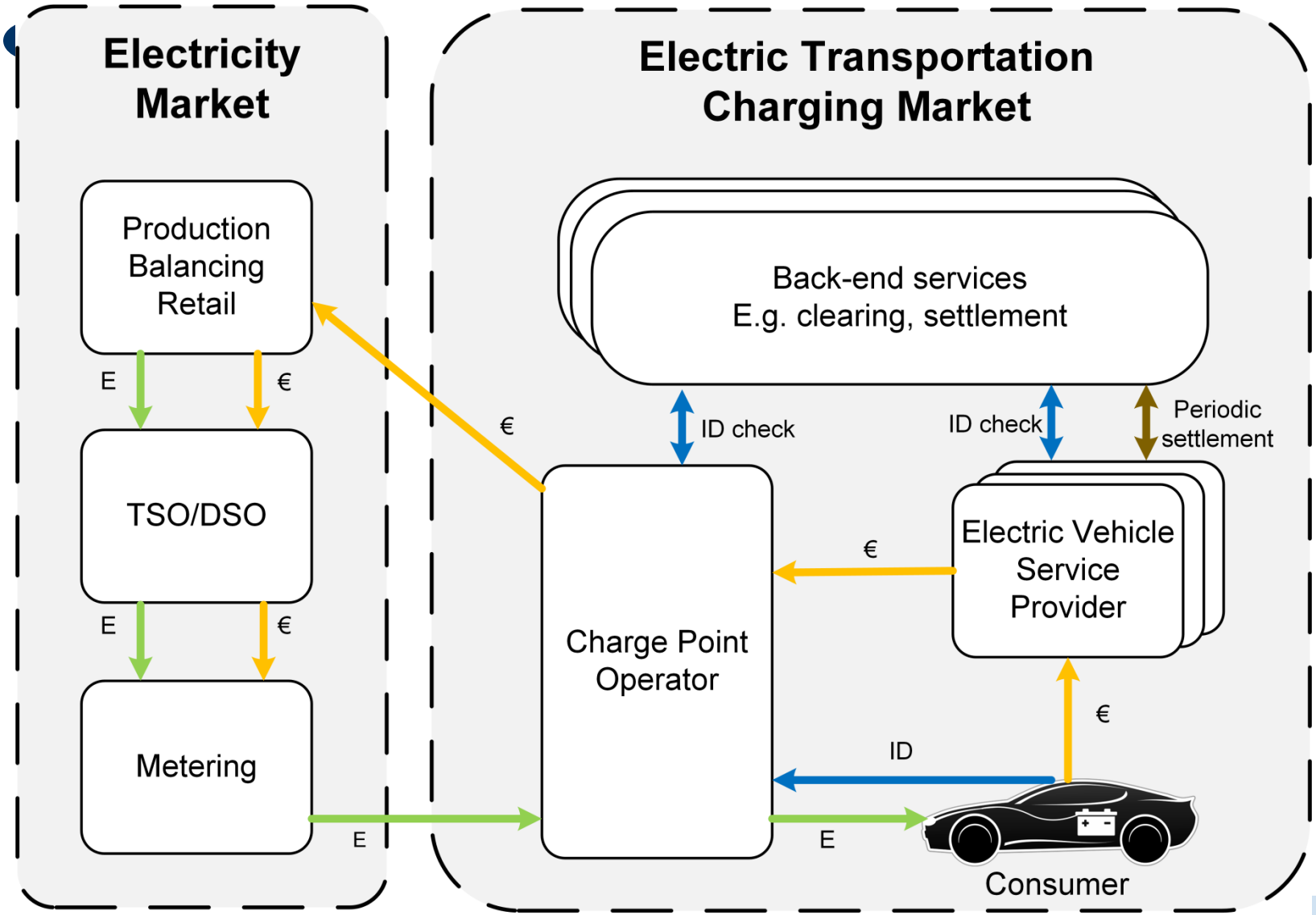
- Az automatizálás lokális követelményei:
  - (Valós-idejűség) Real time
  - Biztonság (Security and saf
  - Folyamatos üzembe helyez
    és konfigurálási igén
  - Skálázhatóság



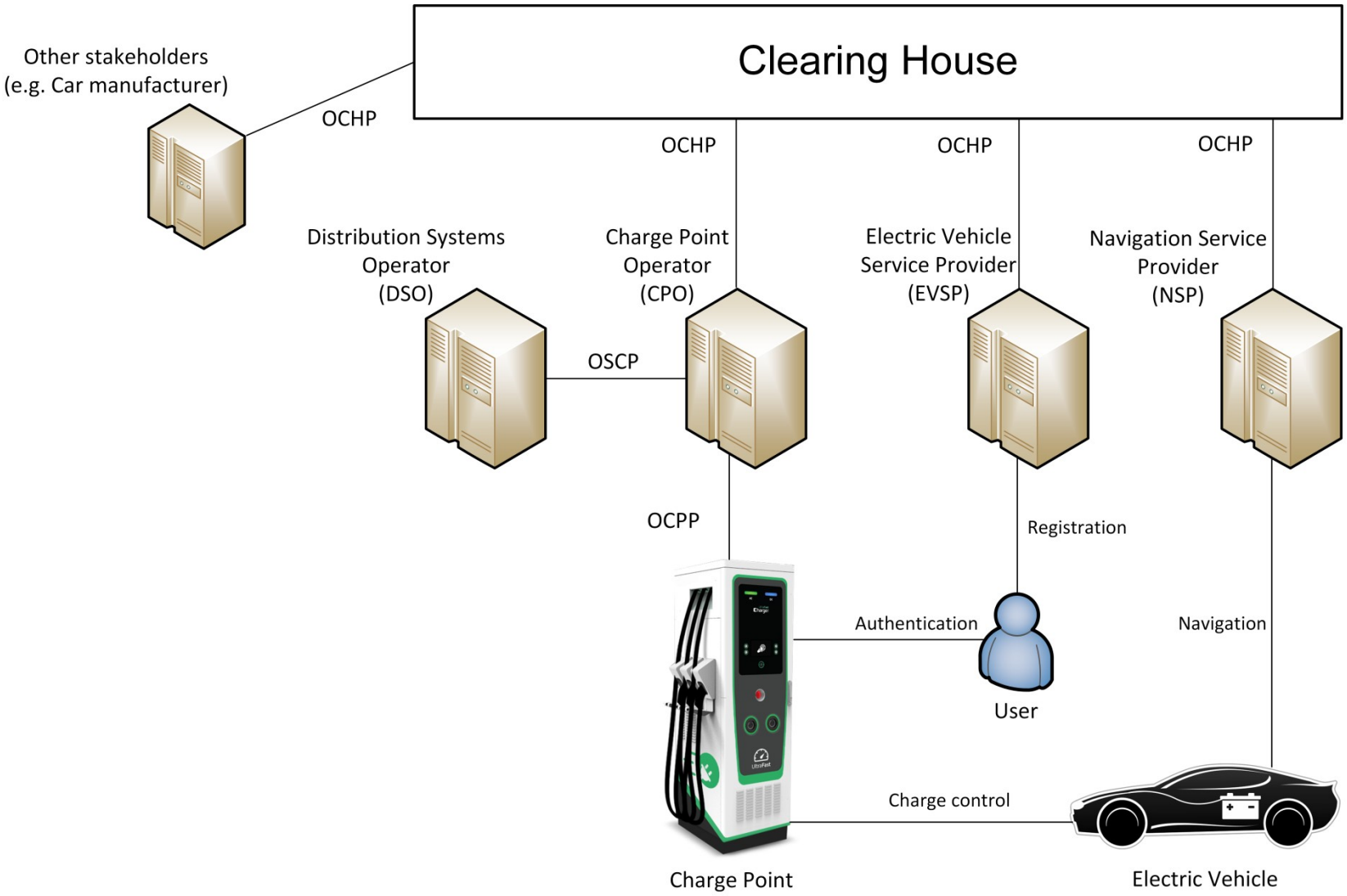
Szolgáltatás-alapú architektúra – és az Arrowhead keretrendszer



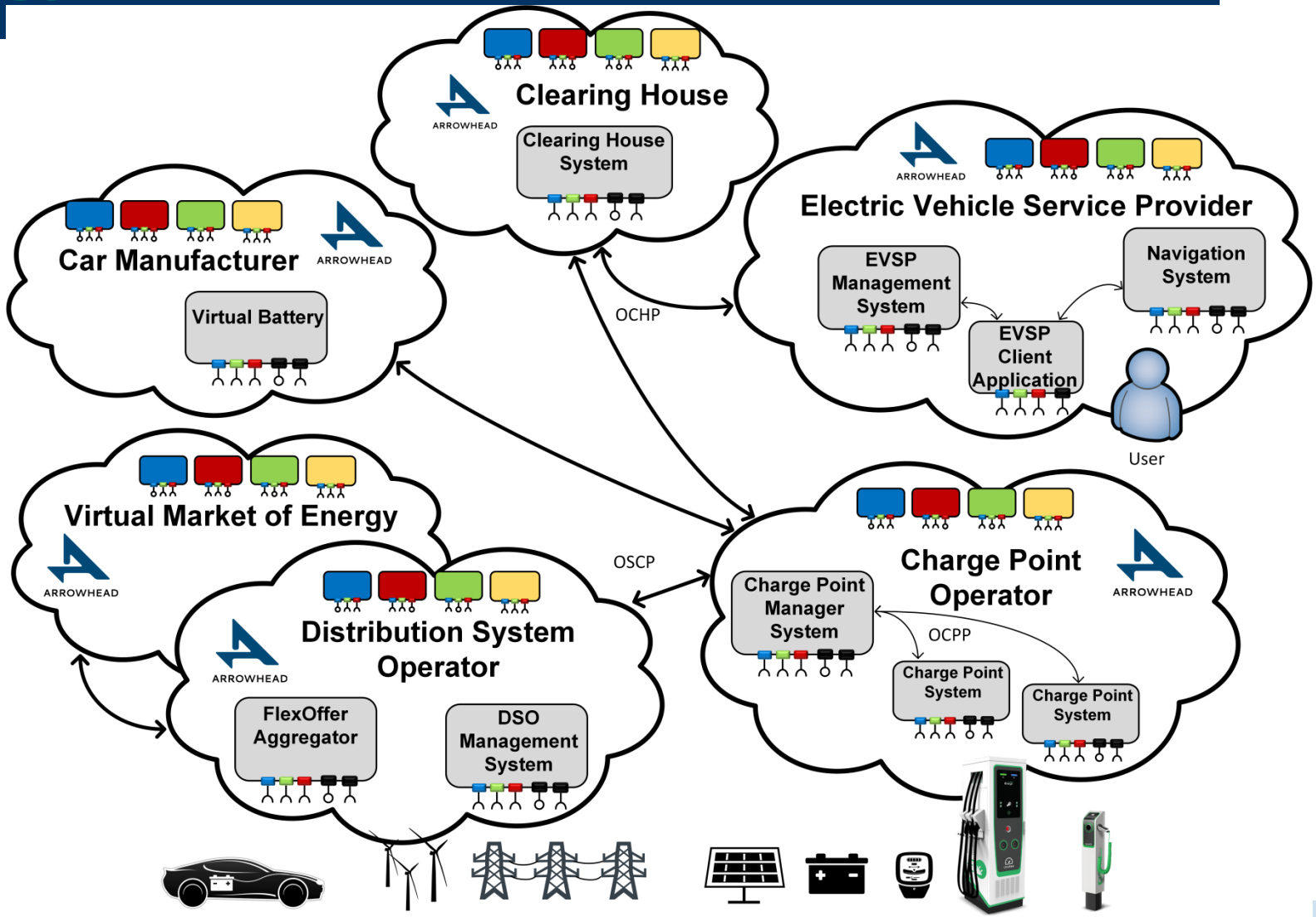
Elektro-mobilitás – a piac szereplői



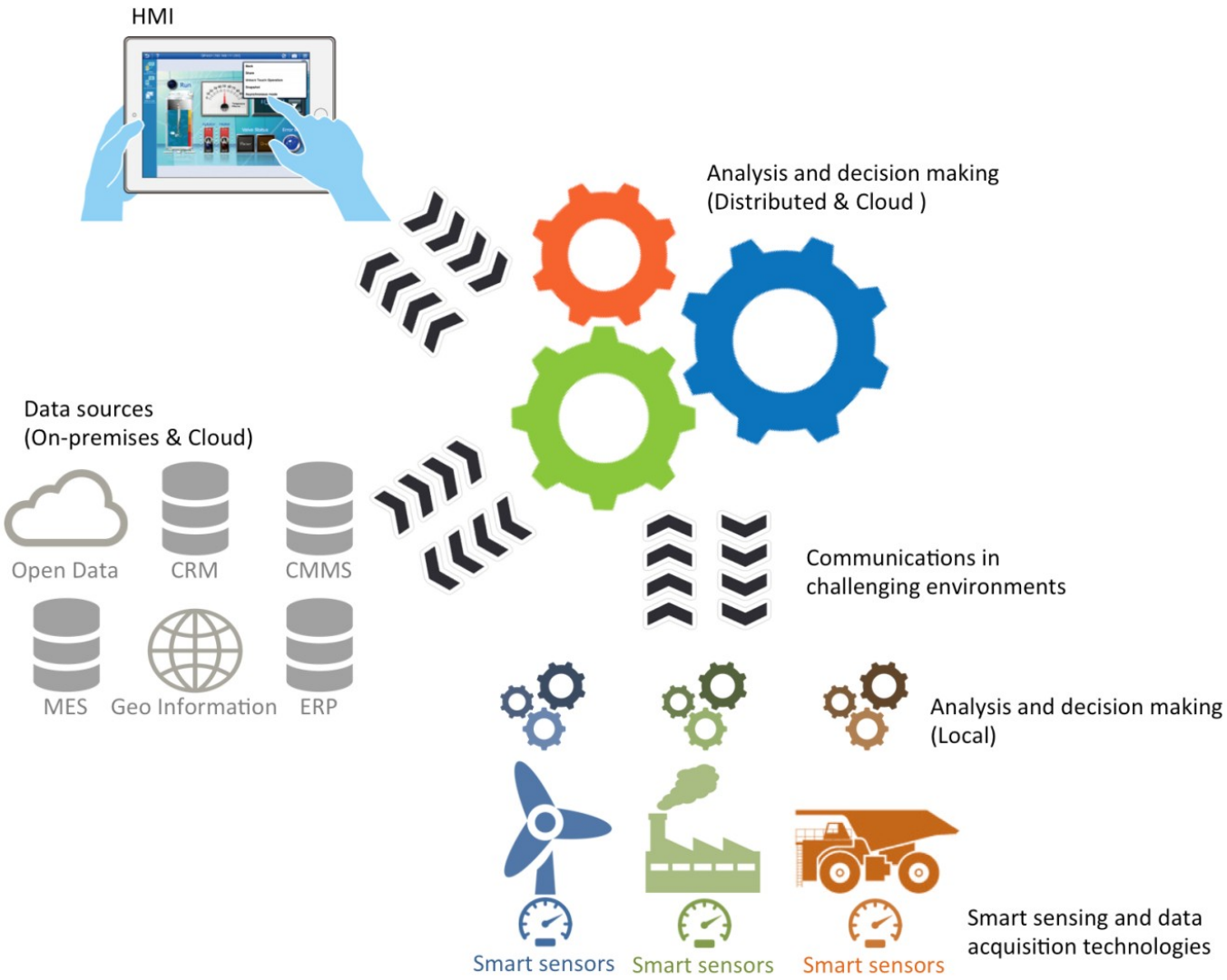
Elektro-mobilitás – a piaci elszámolás



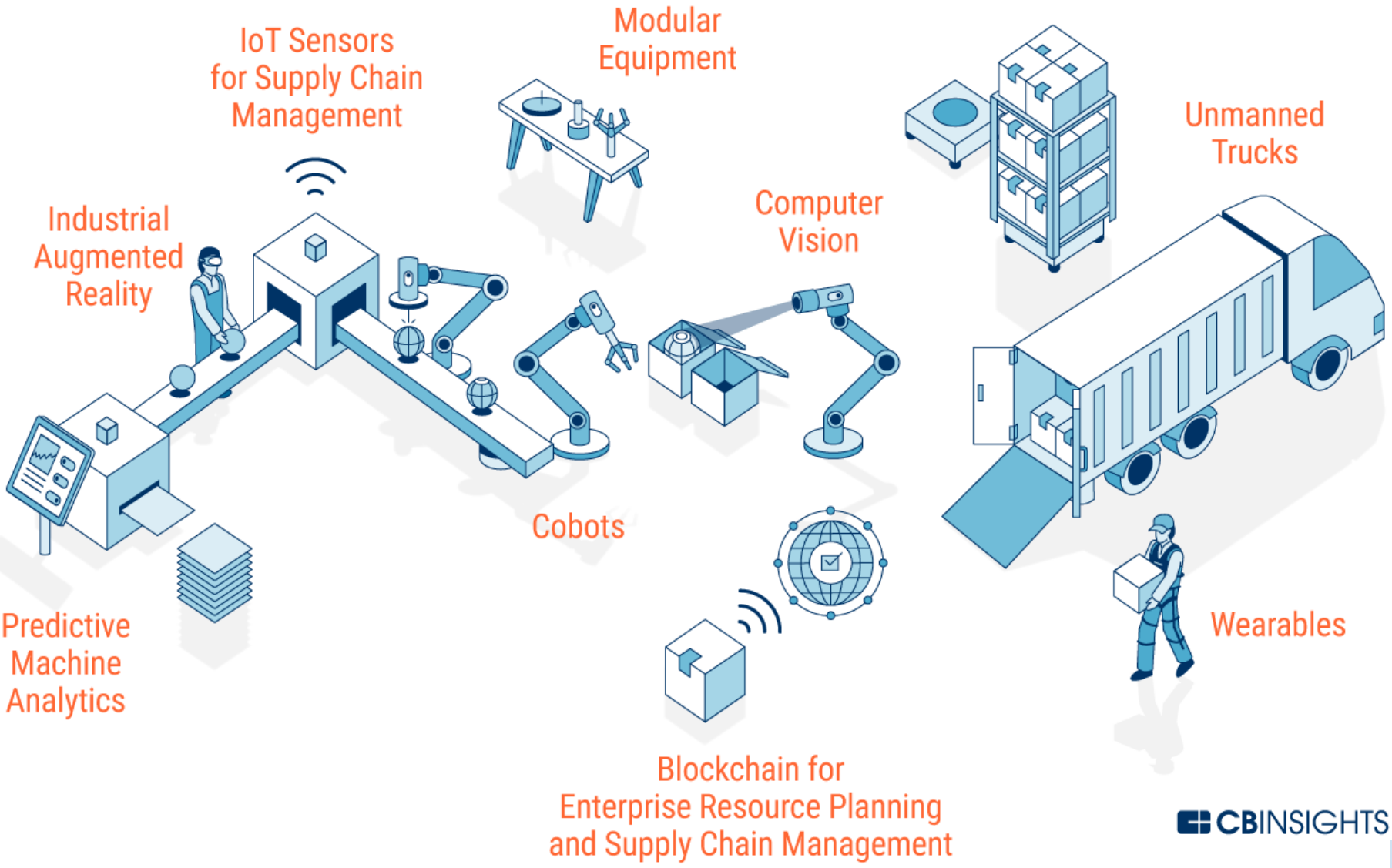
Elektro-mobilitás – IoT rendszerek együttműködése



Prediktív üzemeltetés és karbantartás



FACTORY OF THE FUTURE



CBINSIGHTS

Összefoglalás

Konklúziók

- Az IoT világa folyamatosan bővül alkalmazásokkal és megoldásokkal is
- Az új rádiós technológiák igyekszenek lefedni az igényeket
- Az applikációk követelményeihez választunk transzport protokollt…
- …de az ezek közötti fordítás nem triviális
- IoT „keretrendszerek” jelen vannak minden szinten, a kapcsolati szinttől az adatfeldolgozásig
- Az ipari esettanulmányok java még előttünk áll: Ipar4.0

Köszönöm a figyelmet!

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