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INTERNATIONAL

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# Creating Sustainable Buildings with Smart Spaces and Open Web Services

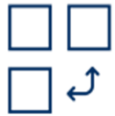


# Motivation for Smart Spaces



# Building Operation

For building owners, operation represents 42% of total building cost over its lifetime (IBM Research 2016)



Flexibility



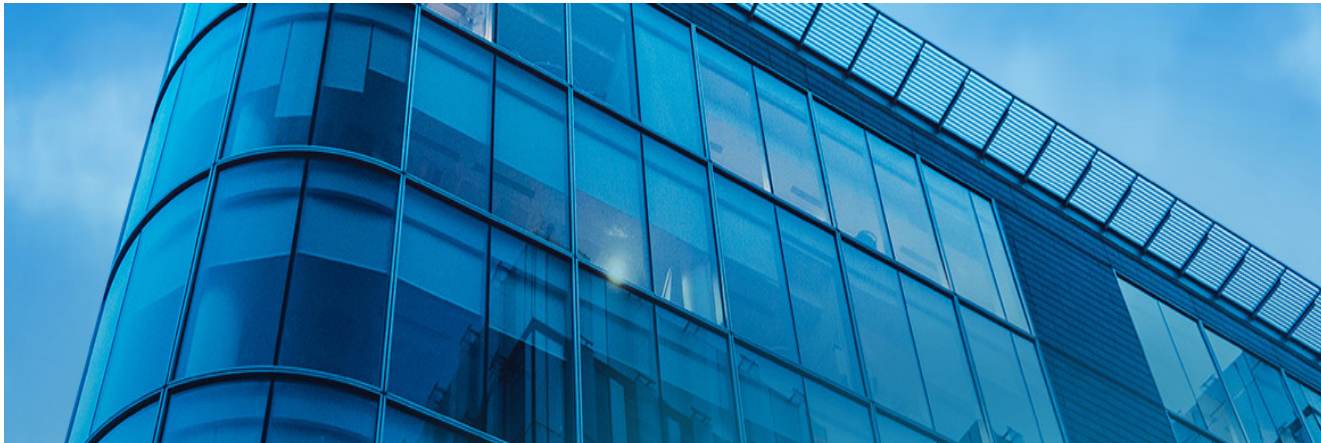
Energy-efficiency



Time savings



Cost savings



- Smart Space solutions make buildings flexible and adaptable
- Smart Space solutions make employees more effective
- Smart Space solutions increase energy efficiency and sustainability
- Smart Space solutions provide significant cost savings

# Building Operation

**Smart spaces provide a healthy work environment and enable flexible working schemes – they make employees more effective, improve satisfaction and allow optimized utilization of buildings**



- Space utilization monitoring for optimizing area usage
- Healthy work environments for employee comfort
- Service on demand (instead of on schedule) for highest work efficiency

# Workplace Trends

8 out of 10

respondents would like to work from home at least one day a week

Collier, 2021

87%

of large companies want to rely on hybrid work in the future

ICRE Office Occupier Sentiment Survey, 2021

60%

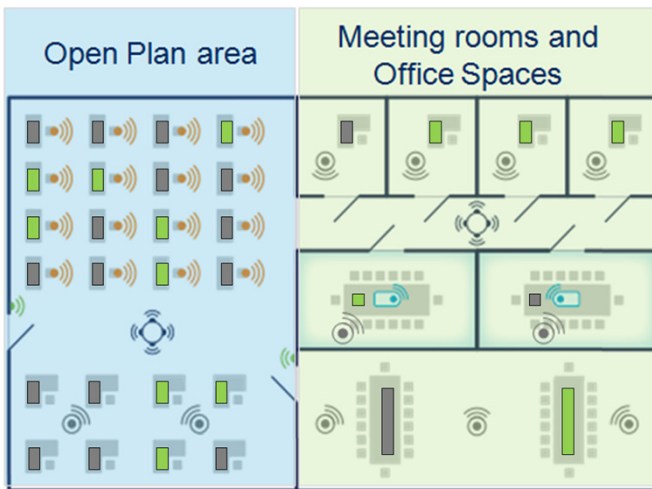
of companies want to switch to desk sharing

CBRE, Future of the Office, 2020



# Example: Shared Spaces with Utilization Monitoring

Office space is expensive and limited – shared, flexible usage maximizes the value of the available office space



EnOcean Conference Room Booking System		11:28 08.07.2019
Besprechung 1	10:00 – 12:00	Andreas Schneider I have a dream
Besprechung 2	Next: 14:00 – 16:00	Graham Martin Green is the new black
Besprechung 3	09:00 – 23:00	Frank Schmidt ECO 500

- Most new office buildings contain shared working environments
- Utilization monitoring identifies available working and meeting areas
- Space utilization metrics allow optimization of area usage

# Economic and Ecologic Benefits of Shared Spaces

Shared office models with utilization monitoring allow reduction of required office space by up to 25% – EnOcean desk utilization sensors provide the required data

**€ 8140 p.a.  
operational cost  
of a single desk**

space rent, equipment,  
utility costs, operation 1)

**25% of all desks  
can be saved 2)**

**ROI 2 weeks**

IoT cost €8/sqm/a,  
1 desk /13 sqm 3)

- Highest economic benefit of all smart space applications
- Return on investment within a few weeks
- Positive ecological impact due to reduced space and energy utilization

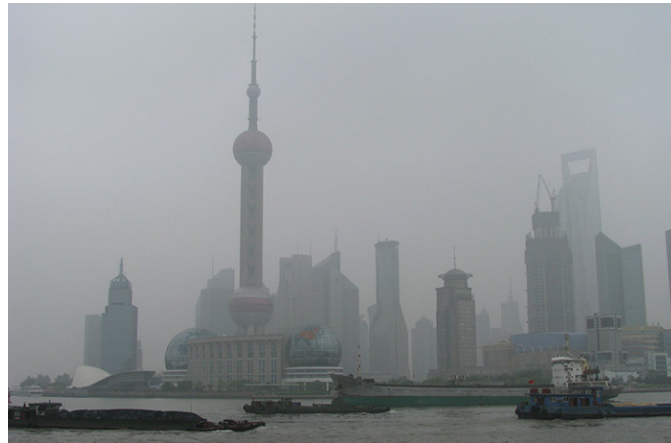
<sup>1</sup> European average, see "Bürokostenreport 2019", [www.facility-management.de](http://www.facility-management.de)

<sup>2</sup> E-Shelter 2021, [www.e-shelter.io](http://www.e-shelter.io)

<sup>3</sup> Cost estimate, strongly depends on system provider (application, desk [sensor](#), infrastructure, [operation](#)):  
13 [sqm](#) /employee according to [www.servcorp.com.au](http://www.servcorp.com.au), 50% of desks are shared and equipped with a sensor.

# Example: Healthy Environments

**Healthy environments are a key concern for employees – Information and control of temperature, humidity and air quality improves employee efficiency**



- Temperature is one of the most common cause for service calls in office areas
- Air quality directly affects work efficiency
- Continuous monitoring and control required for employee satisfaction and efficiency



# Economic and Health Benefits of Air Quality Monitoring

Healthy and comfortable environments make employees more effective and reduce absence – employee awareness and expectation has strongly increased during the Covid pandemic

**49,000€**

Average annual cost per office employee (1)

**1 sick day Less per year**

Current rate of absence is 11 out of 223 working days (2)

**6 months ROI (excl. productivity)**

IoT cost €8/sqm/a, 13 sqm /employee (3)

**8% higher productivity**

Productivity increase (4) will sharply reduce ROI to weeks

- Healthy work environments are a requirement and a differentiator to attract top talent
- Regulatory compliance can easily be demonstrated
- Reduction in absence and increase in productivity provide rapid ROI

<sup>1</sup> €37,900 average salary of an office employee ([www.stepstone.de](http://www.stepstone.de)) x 1.3 total cost factor for the employer ([www.sba.gov](http://www.sba.gov))

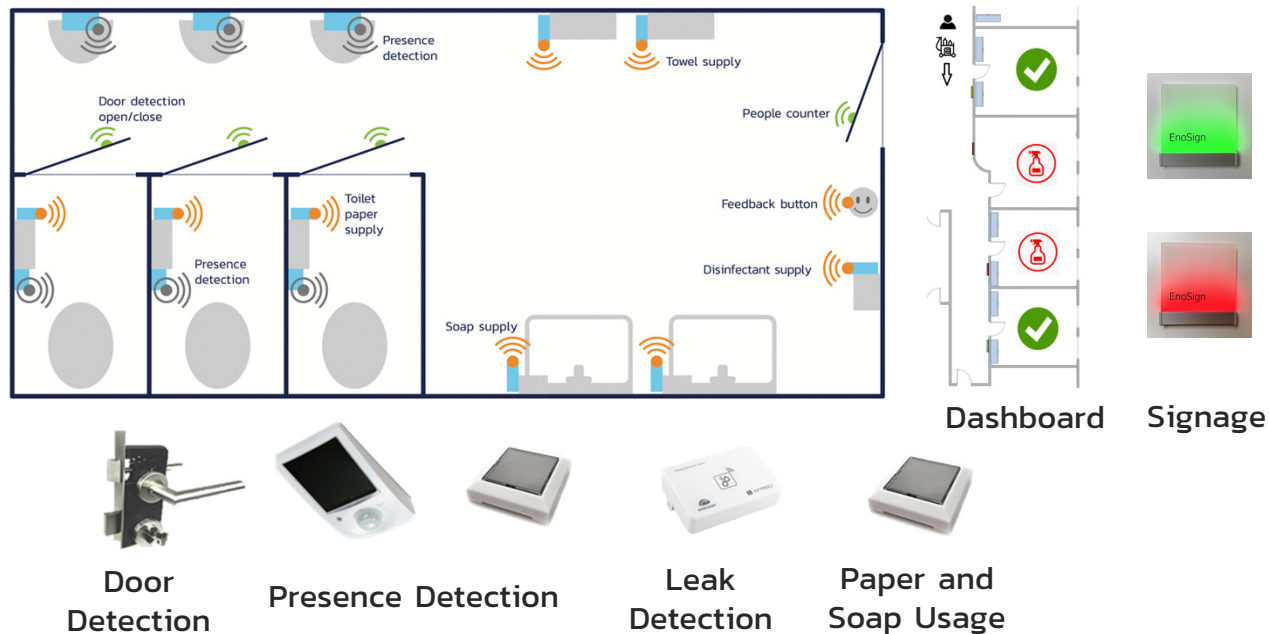
<sup>2</sup> Current average [www.destatis.de](http://www.destatis.de)

<sup>3</sup> Cost estimate, strongly depends on system provider (application, CO2 sensors, infrastructure, operation), 13 sqm /employee ([www.servcorp.com.au](http://www.servcorp.com.au))

<sup>4</sup> WGBC 2021

# Example: Smart Cleaning

Customers perceive cleanliness as most important sign of a well managed building – cleaning service is labor-intensive and should be optimized according to actual demand



- Cleaning is still largely executed according to agreed schedules
- Variations of actual usage (events, holidays, etc.) are often not considered
- Cleaning according to actual demand can significantly improve customer satisfaction and reduce cost

# Economic and Ecologic Benefits of Smart Cleaning

**Demand-based cleaning enables cost reduction and ensures compliance with agreed service levels – savings of water, plastics and detergents increase sustainability**



<sup>1</sup> € 8,080 /4,000 sqm /month (5x per week, [www.desomax.de](http://www.desomax.de)) x 13 sqm /employee ([www.servcorp.com.au](http://www.servcorp.com.au))

<sup>2</sup> See APPENDIX, based on numbers from [www.soobr.com](http://www.soobr.com)

<sup>3</sup> See APPENDIX, €13,639 IoT cost / €36,820 time savings x 12 months (Soobr 2022)

- Demand-based cleaning provides a consistent and transparent service level
- Clean environments are a key indicator for well managed buildings
- Positive ecological impact due to reduced utilization of water and detergent
- ROI achieved within months

# Example: Building Energy Usage Optimization

Building energy consumption can be reduced using building analytics applications that combine HVAC system usage information with office space usage information



- 28% of global carbon emissions are from buildings
- 40% of office space is unused in offices daily but energy use remains consistent
- 5% improvement in energy efficiency is possible by optimizing HVAC control using information from Smart Spaces

# Smart Spaces Benefits Summary

Economic  
Benefit



Based on  
100,000  
employees

## **DESK SHARING - € 200m p.a. - ROI 2 weeks**

The killer application because of awesome monetary & ecological benefits (space & resource savings) – energy harvesting desk sensors are essential for sustainable solutions

## **AIR QUALITY IMPROVEMENT - € 13m p.a. - ROI 6 months**

Air quality monitoring reduces employee sick leave and ensures pandemic compliance (CO2 indicates possible virus load) – improving employee efficiency further decreases ROI time

## **SMART CLEANING - € 3m p.a. - ROI 4 months**

Cost reduction, service transparency and resource savings (water, plastics and detergents)

## **CO2 REDUCTION - € 2.6m p.a. - ROI 4 years**

40% of global CO2 emissions are caused by buildings – energy harvesting sensors are essential for energy saving and provide better ROI time that replacing the building envelope



# Sensor Data for Smart Spaces

# Sensor Data Required for Smart Spaces

Smart Spaces require relevant data in real time and with minimum setup and maintenance effort – energy harvesting sensors can provide this data



- Relevant information on utilization and operation
- Quick installation and retrofit by tenants into existing buildings
- Maintenance-free operation

# Wireless Sensor Solutions for Smart Spaces

**Smart spaces must be flexible and easily adaptable to changing usage conditions – wireless sensor solutions can be easily deployed and quickly relocated**



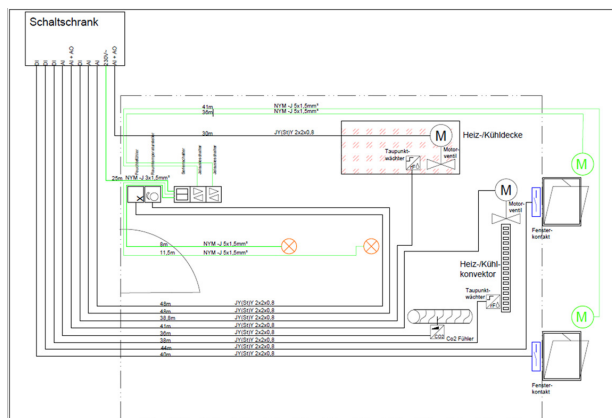
- Offices are increasingly designed for shared usage
- Support for different usage scenarios is required
- Quick and easy adaption is essential



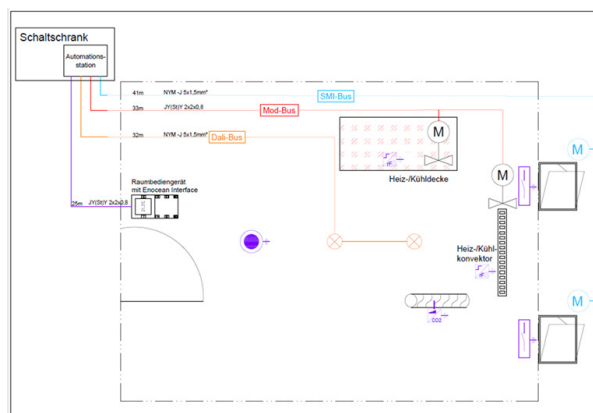
# Benefits of Wireless Infrastructure for Smart Spaces

Smart spaces require a data infrastructure to transport sensor data to the energy optimization and space allocation applications – wireless transport reduces overhead

## Conventional (fully-wired) Infrastructure



## Wireless Infrastructure

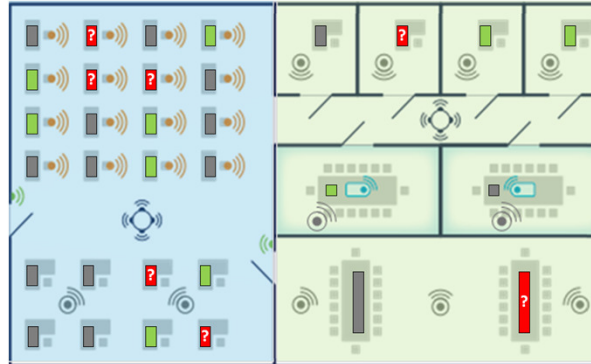


## Wireless Infrastructure Benefits

- 80% less cabling
- 20% less system cost
- Quick setup and adaption

# Reliable Sensors are Required

Wireless sensors must operate reliably – sensor failure results in reduced office area usability



# Energy Harvesting

Energy harvesting sensors deliver flexibility and reliability



Ideal For Retrofit



Maintenance Free

## Kinetic Energy

Electrodynamic generator



## Solar Energy

Module with energy store



## Thermal Energy

Energy via temperature differences



## Magnetic Field Energy

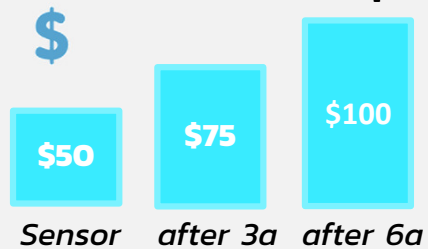


# The Value of Energy Harvesting

## Energy harvesting enables universal adoption of wireless solutions

- Batteries are inexpensive, replacing them is not (labor to access, replace, test, and document plus service margin)
- Early failures are very annoying
- Batteries cause environmental harm and create safety risk

### COST of Battery Replacement



Service cost: \$25 /sensor  
Service interval: 3 years

Based on 10 min/sensor + battery  
+ service margin

\$293 if a single battery has to be replaced,  
source [www.mouser.com/pdfDocs/Xidas\\_WP.pdf](http://www.mouser.com/pdfDocs/Xidas_WP.pdf)

### TIME for Battery Replacement



**10,000 sensors project = 1 person-year**

(typ. 10 min/sensor: access, replace, test, document)



ENTIRE UK EMPLOYEES  
**32 MILLION**



**Trillion Sensors Vision:** Entire UK working population will  
be required for battery service (100 Mio man-years /3a)

# Example Energy-Harvesting Sensors for Smart Spaces

A wide range of energy-harvesting sensors is available for Smart Space applications

## SMART WORKPLACE

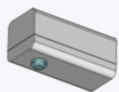
(Room Booking, Desk Sharing, Space Utilization)



Room Occupancy, People Activity



Desk Utilization



People Counting



Desk / Room Status

## HEALTH & CLEANING

(Environmental Monitoring)



Air Quality: CO<sub>2</sub>, VOC, PM, Noise



Utilization of Room / Table / Device



Cleaning required Service Call

## ENERGY SAVING

(CO<sub>2</sub> Reduction)



Heating Valve (thermal powered)



Presence, Window Status



Room Thermostat

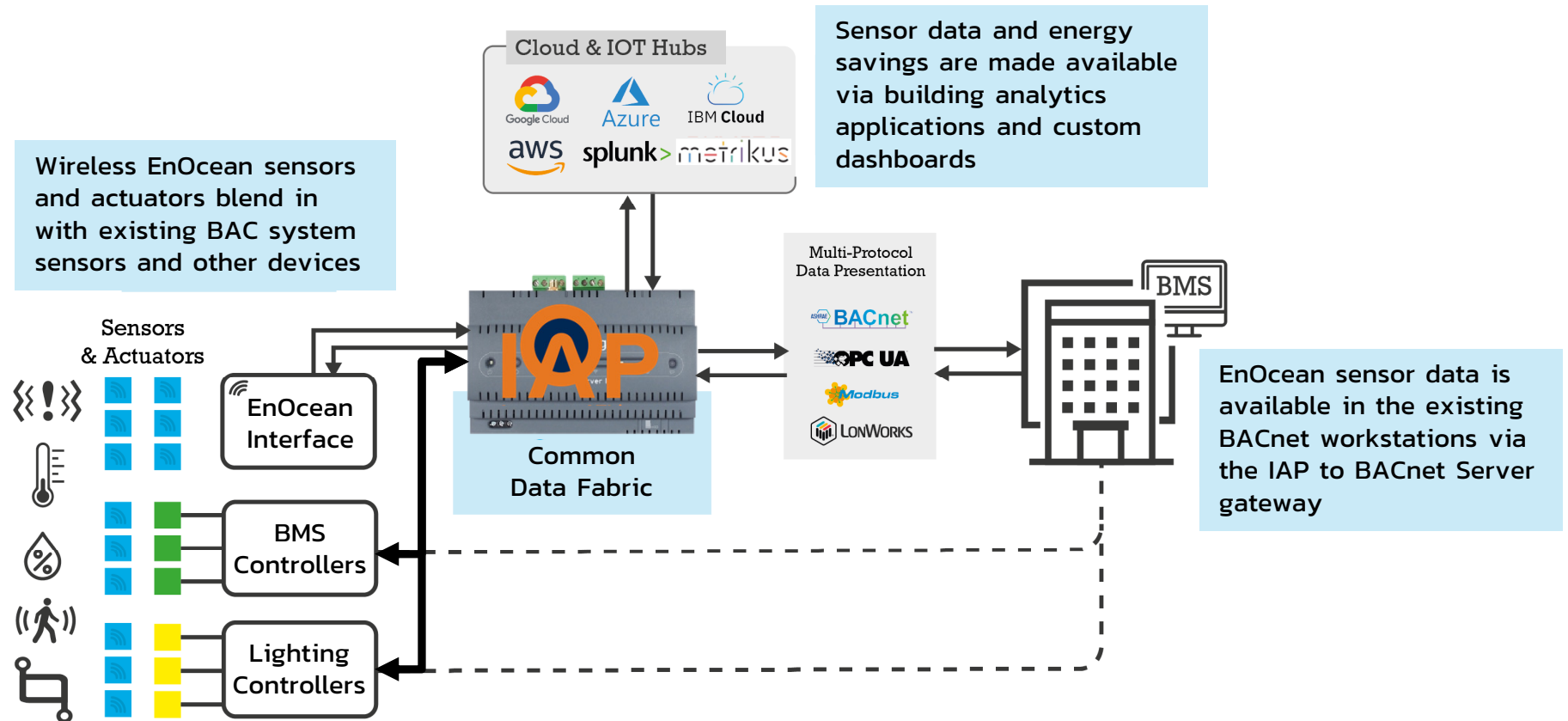


Switching, Dimming, Power Measurement

# Smart Spaces and Building Controls Integration

# Integrate Smart Spaces with BAC Systems

Example of EnOcean and BAC system integration using IAP



# IAP Open Web Services Information

Consumer  
Technology  
Association



[https://shop.cta.tech/products/https-cdn-cta-tech-cta-media-media-shop-standards-2020-ansi-cta-709-10-final\\_1-pdf](https://shop.cta.tech/products/https-cdn-cta-tech-cta-media-media-shop-standards-2020-ansi-cta-709-10-final_1-pdf)

- IAP is an open ANSI/CTA standard – ANSI/CTA-709.10
- IAP documentation is available at <https://edgedocs.enocean.com/>
- Open-source IAP application examples: <https://github.com/izot/smartserver-iot>
- Edge Server information: <https://www.enocean.com/en/product/smartserver-iot/>

Consumer Technology Association

CES

TOPICS WHO WE ARE RESOURCES GET INVOLVED JOIN CTA

Consumer Technology Association

ANSI/CTA-709.10

September 2021

ANSI

## Web Services for Control Networking Protocol (ANSI/CTA-709.10)

This standard is for software developers and web-page authors. It documents two APIs: IoT Access Protocols (IAP)/MQ, which uses MQTT (Message Queuing Telemetry Transport) as the transport protocol, and IAP/REST (Representational State Transfer), which uses REST over HTTP or HTTPS.

Available to Everyone \$0

ADD TO CART



# Questions & Answers

EnOcean

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