THE BIG 5

International Building & Construction Show

5 - 8 DECEMBER 2022
DUBAI WORLD TRADE CENTRE

**The Future of IoT
in Home and Building Automation**

Buildings have become IP driven

Heinz Lux, CEO
KNX Association

Talks

Technology

Internet of Things Landscape 2016

Applications (Verticals)

Personal

Wearables
Apple WATCH, Samsung Gear 2, pebble, moto g, LG, TORY BURCH, HUAWEI, misfit, WeON, CAEDEN, MOTIV, textronics, D3O, ORION, Jewelbots, nymi, RINGLY

Fitness
JAWBONE, fitbit, TOMTOM, NIKE, UNDER ARMOUR, MISFIT, BASIS, Mi, huami, Microsoft Band, ATLAS, mapmyfitness, RunKeeper, OM, LUMO, amiigo, LifeBEAM, ATHOS, lark, senSoria, WHOOP, striiv

Health
SLEEP, Withings, kinsa, TELCARE, NeuroSky, halo, Thync, beam, QUANTTUS, proteus, Ginger.io, iHealth, EarlySense, XETHRU, nanowear, vessyl, beddit, sano, hello, CHRONO, eyesmart, GLOBAL KINETIC, AdhereTech, AliveCor, PROPELLER HEALTH, Sensor, Dx

Entertainment
SONOS, ROLI, doppler labs, Razer, Narrative, soundhawk, peel, Electric Objects, meural, normal

Family
nucleus, ily, HALO, Glow, OWLET, Good Night Lamp, FiLIP, ROOP, bellabeat, monbaby, ovuline, livescribe, LULLY

Sports
STRAVA, WILSON X, Babolat, PELOTON, X2, Hamm, ZEPP, ARCCOS, INFOMOTION, recon, swingbyte, GAME GOLF, XEN, KINEKT

Toys
MATTEL, sphero, anki, Sifteo, MAKIES, WonderWorkshop, UBOOLY

Elderly
Healthsense, INDEPENDA, Lively

Home

Automation
Nest, LIFX, Honeywell, SAMSUNG, CHAMBERLAIN, iDevices, belkin, wemo, icontrol, SAVANT, ecobee, SILVAIR, LIGHT SENTRY, view, LUTRON, ORVIBO, LEVITON, somfy, bluesmart, roost, tado, KEEN

Hubs
Nest, alexa, INSTEON, iris, BOSCH, SmartThings, connect, iRule, Control4, ivee, wink, Vera, prodea, NINJABLOCKS, Fluent, NEXIA, zonoff

Security
august, SCHLAGE, Kwikset, dropcam, canary, vivint, SimpliSafe, ring, KIWI, ALARM.COM, KeyMe, BeON, Lockitron, key, cocoon, seek, scout

Kitchen
JUNE, nomiku, drop, pantry, birdi, AWAIR, BREWBOT, innit, Serenefi, CUBE SENSORS, wally HOME, sense, TRANSFORMER

Sensing
netatmo, leeo, ambient, birdi, AWAIR

Consumer Robotics
ALDEBARAN, jibo, iRobot, RobotsLAB

Pets
Whistle, Petnet, HACHIKO, Petcube, FitBark

Garden
EDYN, plantlink, BITPONICS, rachio

Trackers
tile, iotera, AtheNtek, TrackR

Vehicles

Automobiles
INRIX, waze, Automatic, STANLEY, STREETLINE, dash, Zubie, navdy, Automile, vinli, Airbiquity, consio, OpenXC, Carbin

Autonomous
Google Self-Driving Car Project, GM, Audi, TESLA, DAIMLER, UBER, cruise, Ford, QUANERGY, DELPHI, NOVARIANT, autonomo, Peloton, Valeo

UAVs
DJI, 3DR, Parrot, Airware, LILY, CyPhy, SKYCATCH, SKYDIO, YUNEEC, DRONE BASE, DroneDeploy, HEXO+, DRL, SKY FUTURES

Space
BOEING, LOCKHEED MARTIN, AIRBUS, SPACEX, BLUE ORIGIN, spire, PLANET, Orbital ATK, NANORACKS, GALACTIC, XCOR

Bicycles / Motorbikes
SOBI, HAMMERHEAD, superpedestrian, URB, gogoro, SKULLY, SKYLOCK

Enterprise

Healthcare
STANLEY Healthcare, AUGMEDIX, VERSUS, mc10, vitalconnect, NovaSom, Dmim, Senseonics, PERBRIDGE, vivify, AIRSTRIP, Rhythm, Monica, TeleTracking, PneumoCam, PRISTINE

Retail
RETAILNEXT, euclid, Theatro, PRISM SKYLABS, hiku, cloudtags, GIMBAL, PHUNWARE, NOMI, VARIABLE

Payments / Loyalty
PayPal, shopify, Square, Verifone, payleven, belly, coin, Cantaloupe, acs, SHOPKEEP, ciright, Level Up, DUALI

Smart Office
LogMeIn, CRESTRON, KISI, Robin, BUILDING ROBOTICS, CLEAR CUBE, XORA, eventboard

Agriculture
adapt-N, Ag Leader, pycno, ARGUS, DACOM, John Deere, Smartfield, afimilk, ZedX, ClimateMinds, SPENSA, i-Line

Infrastructure
WORLD SENSING, TACHYUS, mbest, ELTAV, Smart Cloud, M2M Communications, INCON, SMARTSTRUCTURES, LUMASENSE TECHNOLOGIES, SensorLogic, GroundMetrics, wavelink

Industrial Internet

Machines
CATERPILLAR, SIEMENS, BOSCH, GE, SIGHT MACHINE

Energy
Schneider, itron, enlighted, SolarCity, BAKER HUGHES, Trilliant, enevo, ENERNOC, gabelly, OSIsoft, OutSmart, enbala, e-on, lucid, SilverSpring, ENERGYSAVVY, HydroPoint, sensity, Blue Pillar, AutoGrid, Panoramic, PETRA, Retal

Supply Chain
Fleetmatics, Impinj, VILOC, SkyBitz, SMARTDRIVE, Telogis, assetpulse, WEFT, TEGO, ZEBRA, asap, PRECYSETECH, RF CONTROLS

Robotics
amazon robotics, ABB, CLEARPATH, HARVEST, rethink robotics, BostonDynamics, KUKA, ROBOTEX, EMPIRE, LIQUID ROBOTICS, tempo automation, OPENROV

Industrial Wearables
GLASS, DAQRI, parsable, BITSTEW, GUARDHAT, XOEye, APX, wavelink

Platforms & Enablement (Horizontals)

Platforms

Software
xively, GE, Axeda, Jasper, tlemetry, Ayla Networks, ThingWorx, Numerex, seeeo, M2M, davra networks, wot.io, covisint, AUTODESK, SEECONTROL, ZATAR, EVRYTHNG, PubNub, thingsquare, BSQUARE, greenwave, M2M, WiSilica, innoPath, people power, machineshop, C3 IoT, arrayent

Full Stack
samsara, EUROTECH, Predix, HELIUM, Telit

Developer
electric imp, TESSEL, resin.io, TempoIQ, Particle, theThings.iO, KONEKT, Wovyn, SensorCloud, NewAer

Analytics
splunk, sumologic, STRATOSCALE, lobeam, KAAZING, TempoIQ, UPTAKE, glassbeam

Sensor Networks
placemeter, SAFECAST, SST MotionLoft

Connectivity
SIGFOX, SIERRA WIRELESS, FILAMENT, aeris, INGENU, NEUL, VENIAM, KORE, intamac, skyroam, ARKESSA, senet, actility

Security
Symantec, gemalto, Bastille, inside secure, MOCANA, NEURA, SHODAN, escrypt, SecuriThings, CyberFlow ANALYTICS, OWASP

Open Source
KAA, ThingSpeak, iot, webinos, openHAB, nimbits

Interfaces

Virtual Reality
oculus, VIVE, PlayStation VR, Samsung Gear VR, OSVR, AVEGANT

Augmented Reality
Microsoft HoloLens, magic leap, Meta, SONY, blippar, zSpace, VUZIX, EPSON, PARACOSM

Other
amazon alexa, THALMIC, nod, EMOTIV, LEAP motion, SIXENSE, ivee, RYTHM, Omni, api.ai

3D

Printing / Scanning
3DSYSTEMS, Project Tango, intel REALSENSE, MakerBot, stratasys, occipital, DMS, VOLTERA, Matterport, formlabs, DESKTOP METAL, Carbon, BotFactory, shapeways, sculpteo, VOODOO MANUFACTURING

Content / Design
Sketchfab, Thingiverse, GRABCAD, AUTODESK, BODY LABS, FLOORED, DASSAULT SYSTEMES

Building Blocks

Hardware

Processors / Chips
intel, LG, QUALCOMM, TOSHIBA, TEXAS INSTRUMENTS, Atmel, ARM, NVIDIA, SIEMENS, NXP, MEDIA TEK, SILICON LABS, Movidius

Sensors
NXP, Atmel, TEXAS INSTRUMENTS, NATIONAL INSTRUMENTS, libelium, psikick, Qualtre, MEMSIC, VALENCELL, PetaSense, XERAFY, skyetek, mCube, MOOG, ThingMagic

Parts / Kits
ARDUINO, littleBits, Octopart, RaspberryPi, relayr, adafruit, XILINX

Charging
uBeam, WiTricity, humavox, AMPY

Software

Cloud
Google Cloud Platform, CISCO, IBM Watson IoT Platform, Microsoft Azure, amazon webservices

Mobile OS
iOS, HomeKit, android, Brillo, BlackBerry

Connectivity

Protocols
WiFi, Bluetooth, ZigBee Alliance, XMPP, LoRa Alliance, MQTT, NFC, Z-WAVE, AMQP, M-Bus, OMA, MiWi, X10, THREAD, HART, BiTX, DDS, RFID, CoAP, RuBee, 2G 3G 4G LTE 6LoWPAN LWM2M DDS LIDAR

M2M
intel, Qualcomm, MARVELL, BROADCOM, SIEMENS, FreeWave, TEXAS INSTRUMENTS, Atmel, Laird TECHNOLOGY, CISCO, MOTOROLA, FIBOCOM, goTenna, GainSpan, eleven-ocean, altair, Weaved

Telecom
verizon, at&t, China Mobile, T-Mobile, Sprint, airtel, orange, Telefonica, China Unicom, americamovil, US Cellular, vodafone

WiFi
eero, STARRY, BRCK

Partners

Retail
amazon, Walmart, BEST BUY, Apple, THE HOME DEPOT, TARGET, Lowe's

Consultants / Services
IDEO, Dragon Innovation, MESH SYSTEMS, PTC, pch, R/GA, 3D HUBS, makexyz, altiux, 8

Alliances
ALLSEEN ALLIANCE, OMA, INDUSTRIAL INTERNET CONSORTIUM, AIOTI, OPEN CONNECTIVITY FOUNDATION

Incubators
techstars, Highway1, HAX, LEMNOS Labs, BOLT

Manufacturing
foxconn, flex, SANMINA, JABIL, PEGATRON, Benchmark, Celestica

Funding
KICKSTARTER, INDIEGOGO, AngelList

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FIRSTMARK

Buildings have become IP driven

Buildings in the past
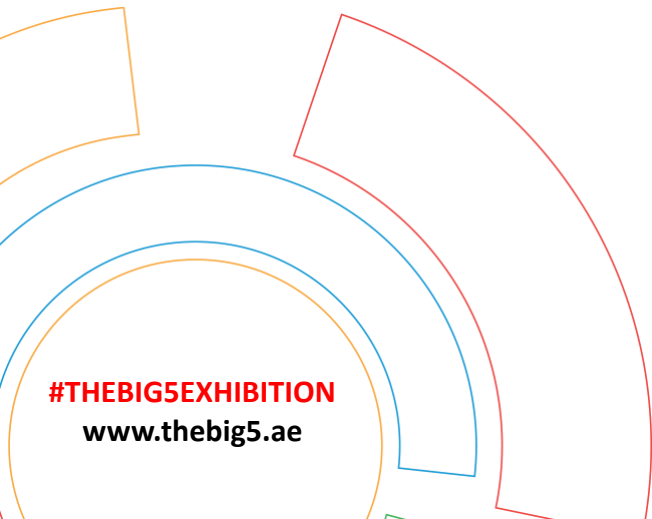
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Buildings have become IP driven

Buildings today and tomorrow

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Buildings have become IP driven

Collaborative Building

2020 Smart Building

2010 Automated Building

< 2010 Traditional Building
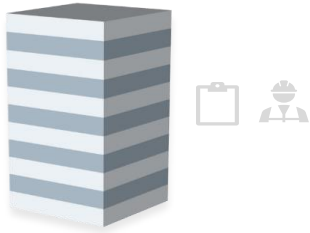
Local switches and on-site services managed by paper and clipboards

Automated Operation

Automated systems with on-prem building management stations

Preventive Maintenance

Software-supported inspection and maintenance planning

Connected Operation

Remote building controls with centralized management stations

Predictive Maintenance

IoT-enabled remote diagnostics and failure prediction

Self-adaptive Operation

Intelligent building automation with the ability to self-adapt and optimize

Prescriptive Maintenance

Automatic service scheduling and step-by-step maintenance instructions

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Buildings have become IP driven

The cloud

connected sensors

connected edge devices
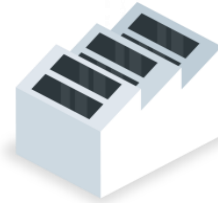
connected controllers

connected fire panels

Buildings have become IP driven

As-Is: Variety of non-IP field busses

- Different standards do not only provide individual data model & services but also different application, transport, network, link and physical layers

BACnet	KNX	ZigBee	FDnet
BACnet	KNX (S-mode, LTE, PL-Link)	ZigBee	FDnet
BACnet/ MSTP · BACnet/IP	KNX · KNX/IP	ZigBee Pro	FDnet
RS-485 · WLAN · Ethernet	KNX RF · KNX TP1 · Ethernet	WPAN	FDnet · Swing
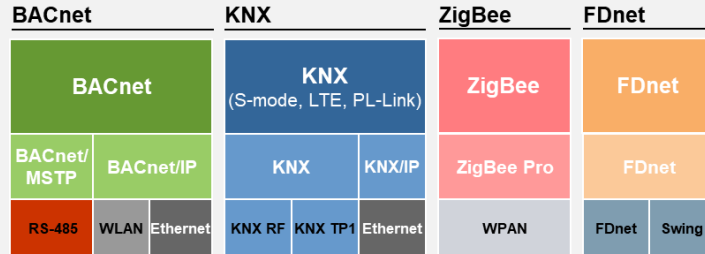
As Desired: Converged Stack

Aligned Information Models & Services
Standard Security
- Open standards, IT friendly, Multi-vendor- & cloud agnostic

IP for Network Communication
- Well-known protocols, open standards
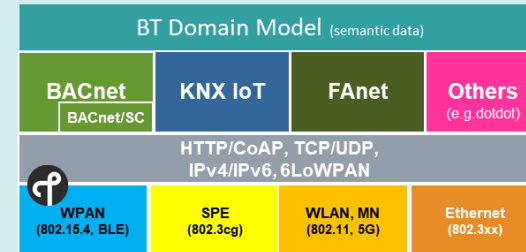
BT Domain Model (semantic data)			
BACnet / BACnet/SC	KNX IoT	FAnet	Others (e.g.dotdot)
HTTP/CoAP, TCP/UDP, IPv4/IPv6, 6LoWPAN			
WPAN (802.15.4, BLE)	SPE (802.3cg)	WLAN, MN (802.11, 5G)	Ethernet (802.3xx)

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Today: Many Building Technologies...

Not a new organization

Existing organizations
working together
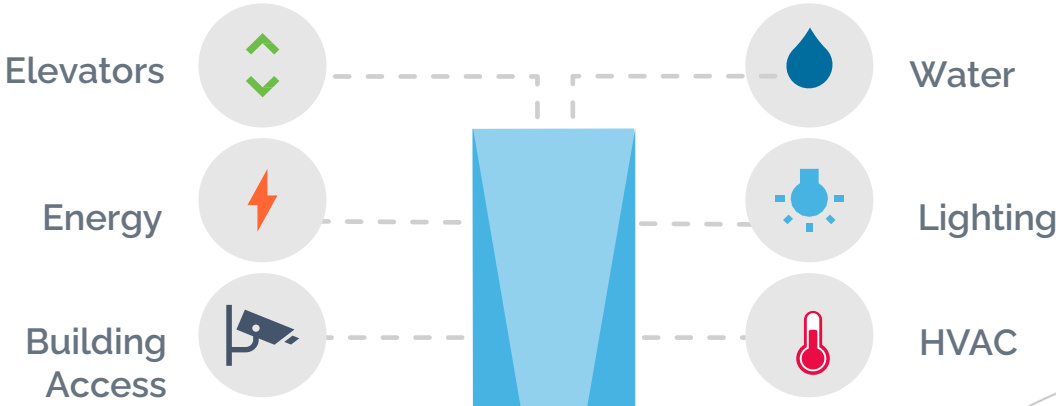
Today: Building Technologies in Silos
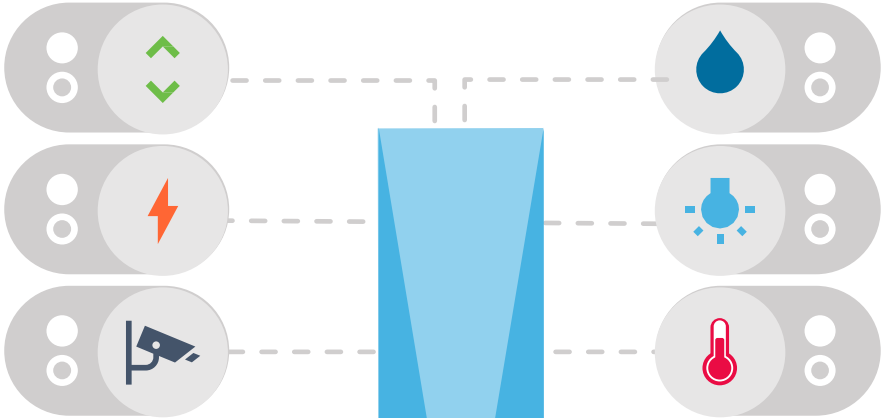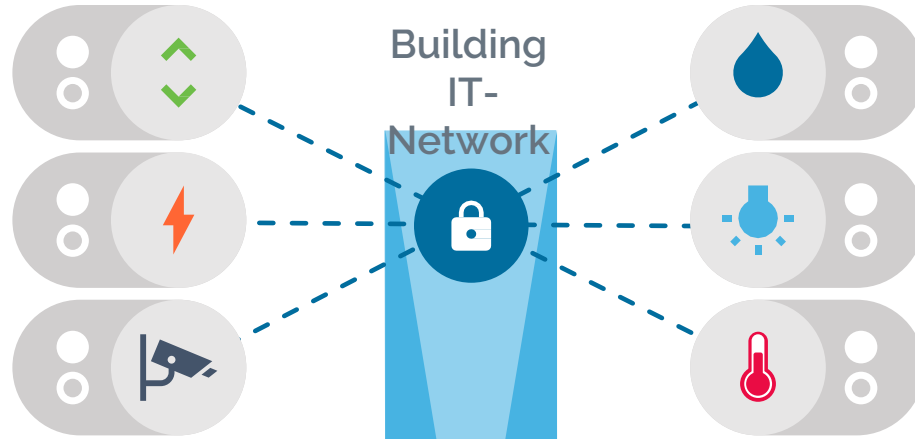
Each system evolved independently with their own proprietary solution

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Trend: Convergence of Building Systems with IT...

This will result in a common secure IP-based infrastructure

Building IT-Network

Talks
Urban Design & Landscape | THE BIG 5

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Trend: Facilitates IoT for Commercial Buildings...

No silos. No proprietary applications.

Allows multiple systems to communicate together using cloud services & cloud computing

Cloud Services

Building IT-Network

Building Control

Talks
Urban Design & Landscape
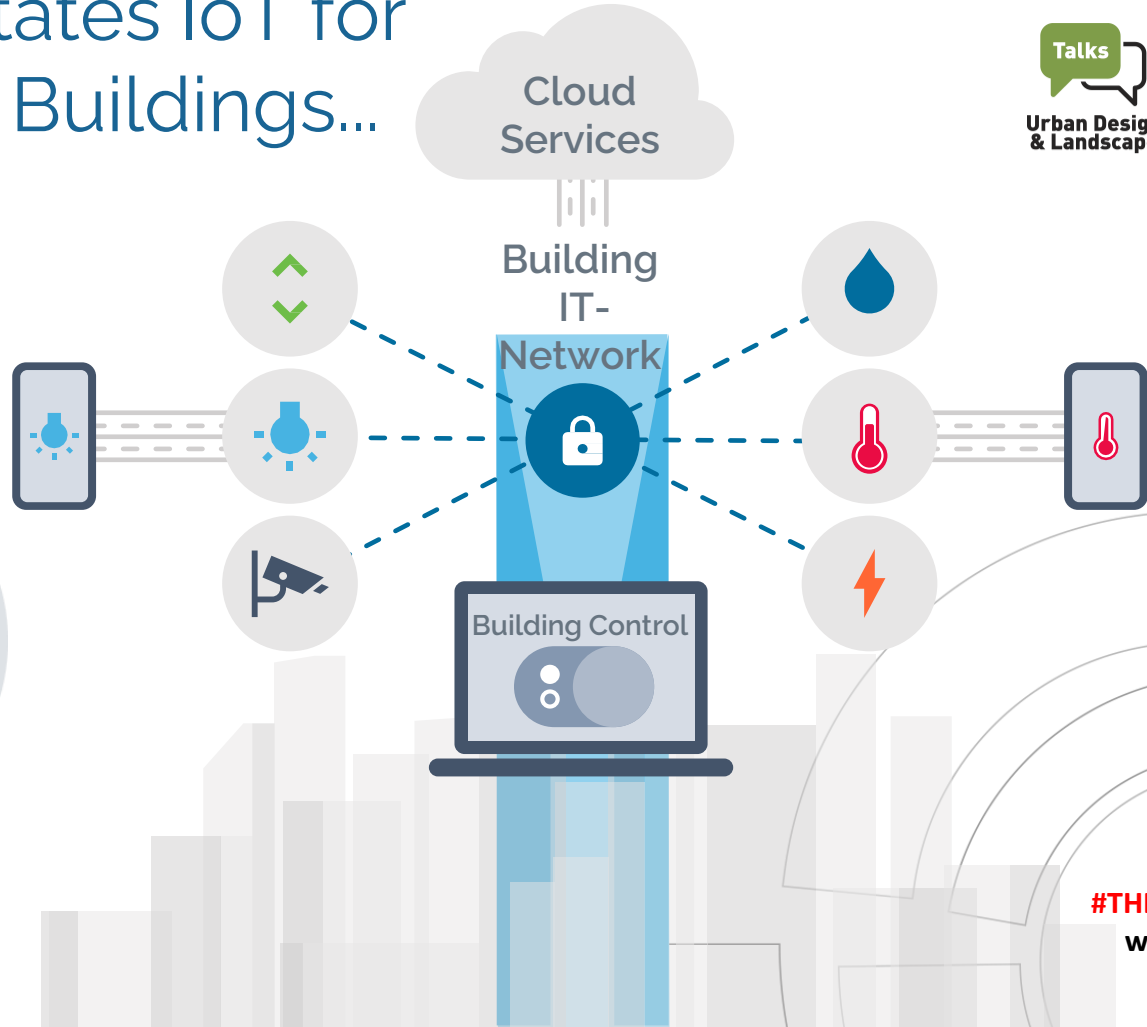
THE BIG 5

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IP-BLiS Vision & Goal

Our VISION
To make commercial buildings more responsive to the needs of users by promoting a secure, multi-standard, IP-based harmonized IoT solution

OUR GOAL
Harmonization of access to an IP network with connected building automation products allowing for better integration

Talks
Urban Design & Landscape

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Benefits of IP-BLiS

Single IP Backbone
For all building automation products: IP (IPV6)

Common Security
Allows common security in building networks

Simplified Support & Administration
Eases IT department's ability to support, eliminates need to know application protocol for building automation products

Seamless Connectivity Options
Seamlessly integrates wired and wireless connectivity options to reduce installation costs

Device Groups & Policies Possible
Uses Common IP networks to allow for monitoring groups of devices instead of single devices

Scalability
Offers limitless scalability & simple cloud integration

Application
Potentially enables common semantic interpretation of data independent from the used application protocol

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PROBLEM: Isolated building-automation domains and networks

Each dmin requires a gateway (GW) to translate proprietary protocols into IP. The building administrator has limited control over individual device in each domain, and provisioning is complex.

Building Automation Domains
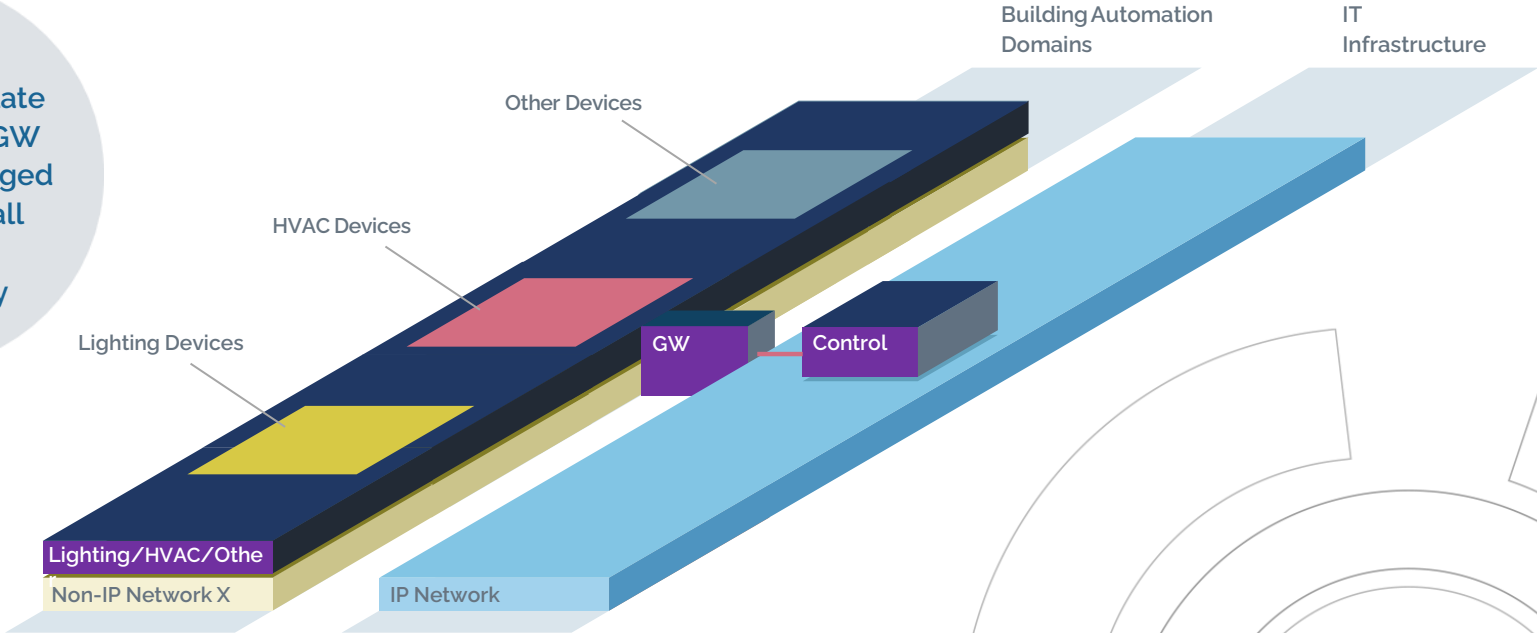
IT Infrastructure

Control

Isolated Network Z

Control

GW

Control

HVAC

Non-IP Network Y

Control

GW

Control

Lighting

Non-IP Network X

IP Network
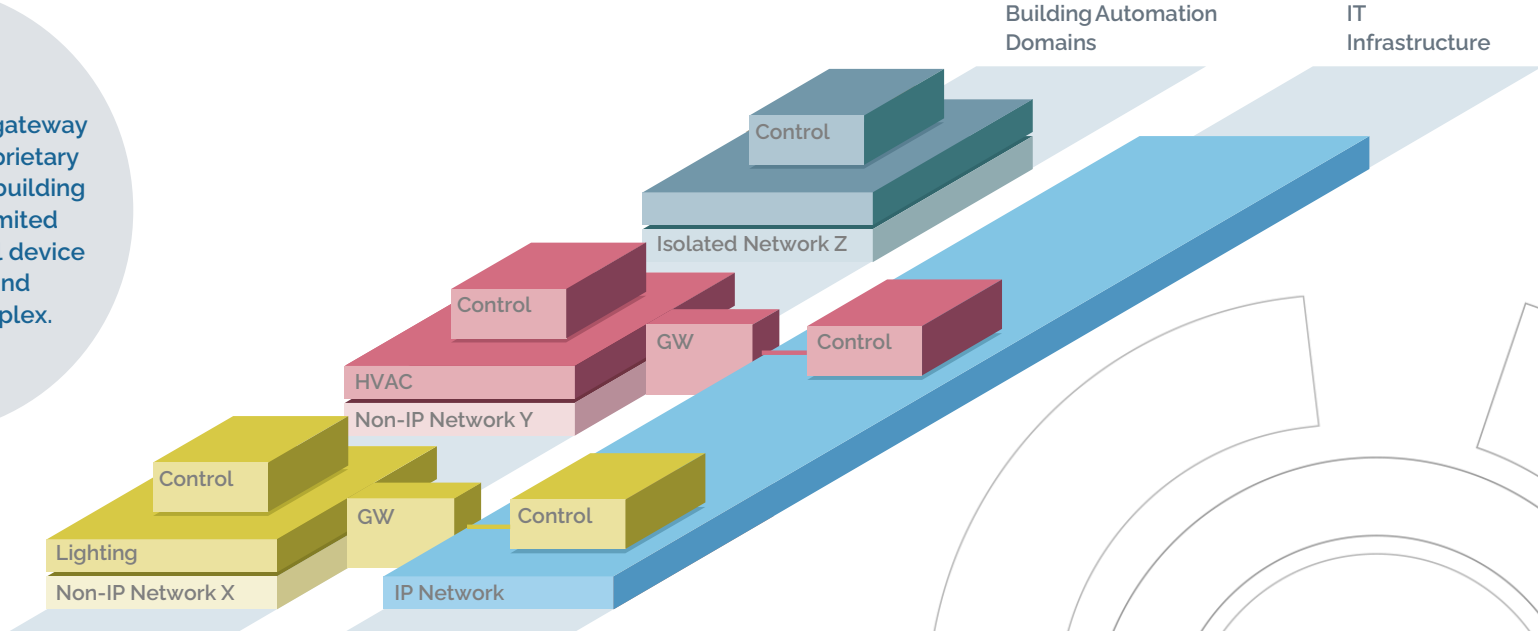
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PROBLEM: Why convergence on the application layer doesn't (always) work

One shared gateway to translate protocol into IP. GW needs to be managed and trusted by all verticals simultaneously

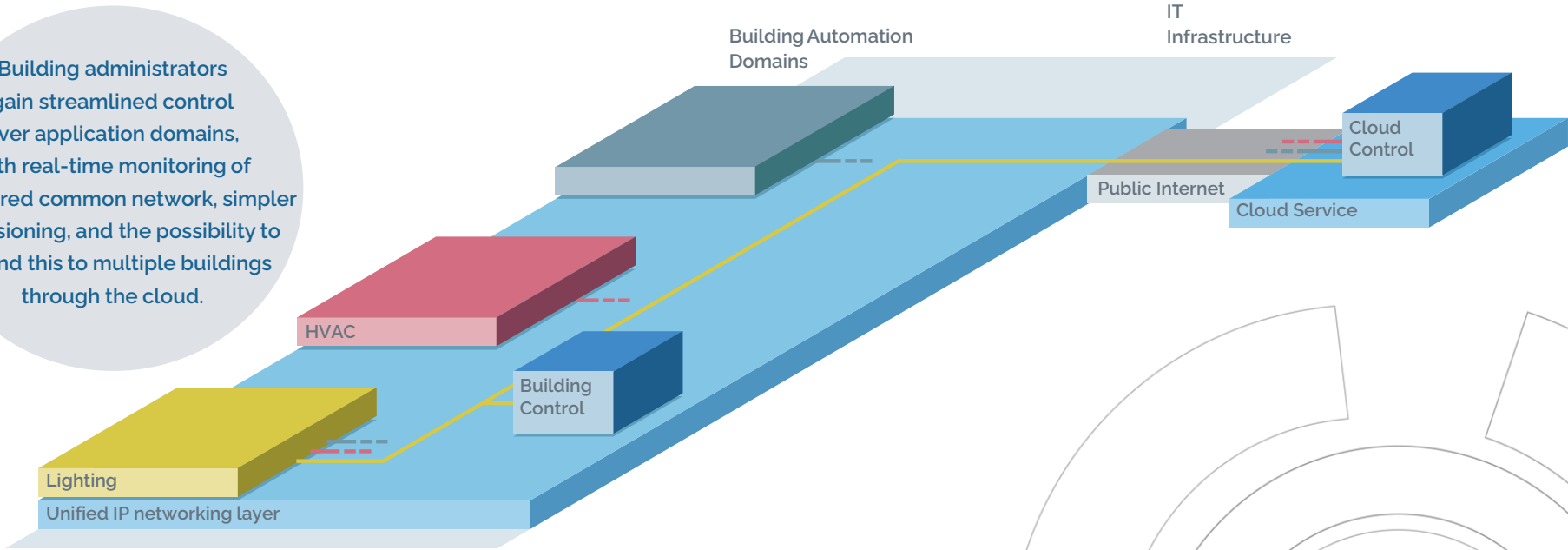Building Automation Domains

IT Infrastructure

Other Devices

HVAC Devices

GW

Control

Lighting Devices

Lighting/HVAC/Othe

Non-IP Network X

IP Network

SOLUTION: Common IP-based infrastructure

Building administrators gain streamlined control over application domains, with real-time monitoring of the shared common network, simpler provisioning, and the possibility to extend this to multiple buildings through the cloud.
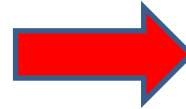
Building Automation Domains

IT Infrastructure

Cloud Control

Public Internet

Cloud Service

HVAC

Building Control

Lighting

Unified IP networking layer

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Buildings have become IP driven
Vision

Environmental Transition

Digital Transition

"The development of new digitally enhanced services in buildings and cities will become possible when traditional silo approaches are overcome"

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Talks
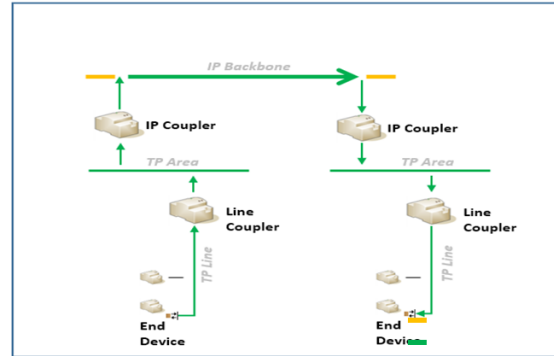Urban Design & Landscape | THE BIG 5
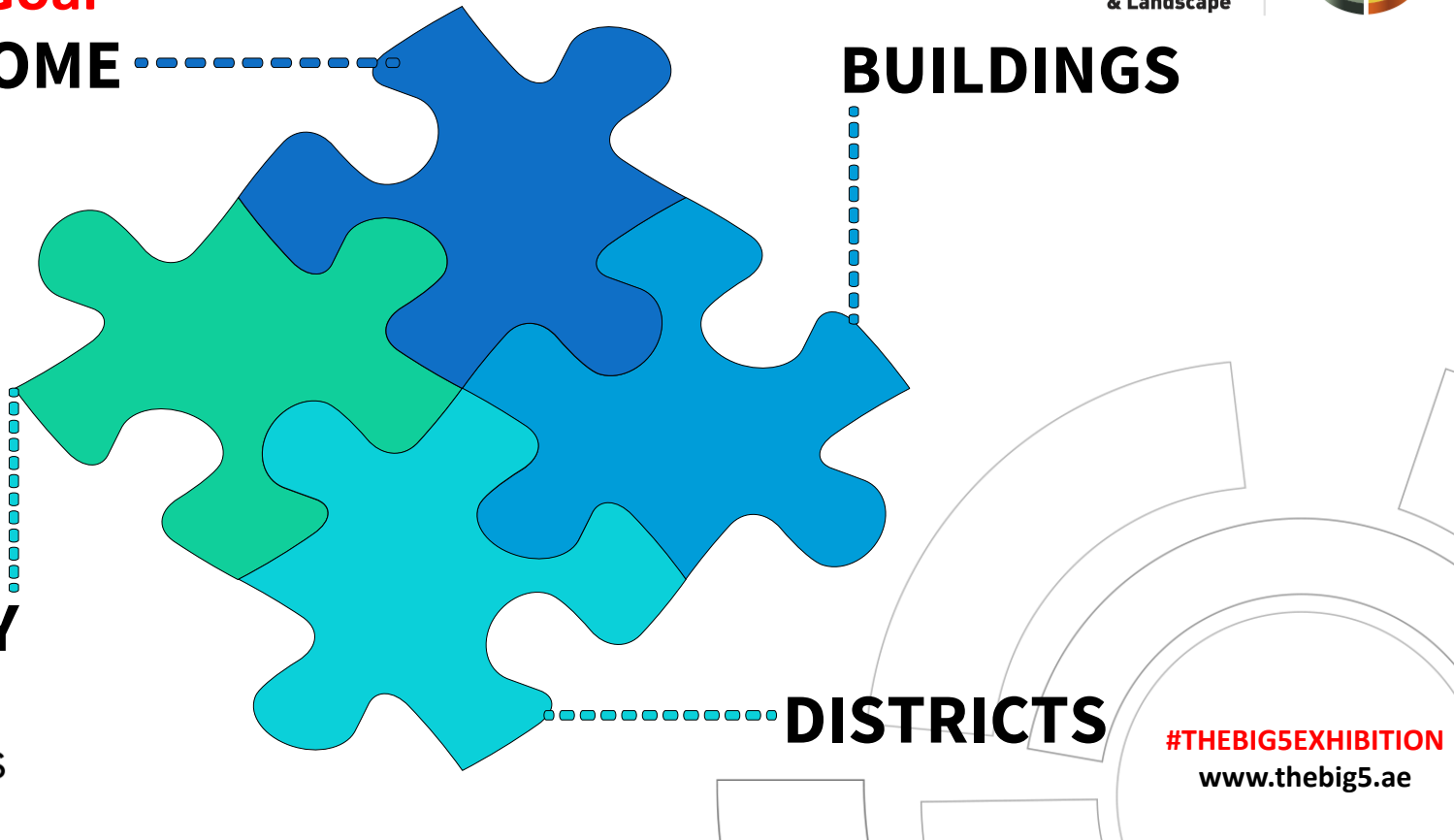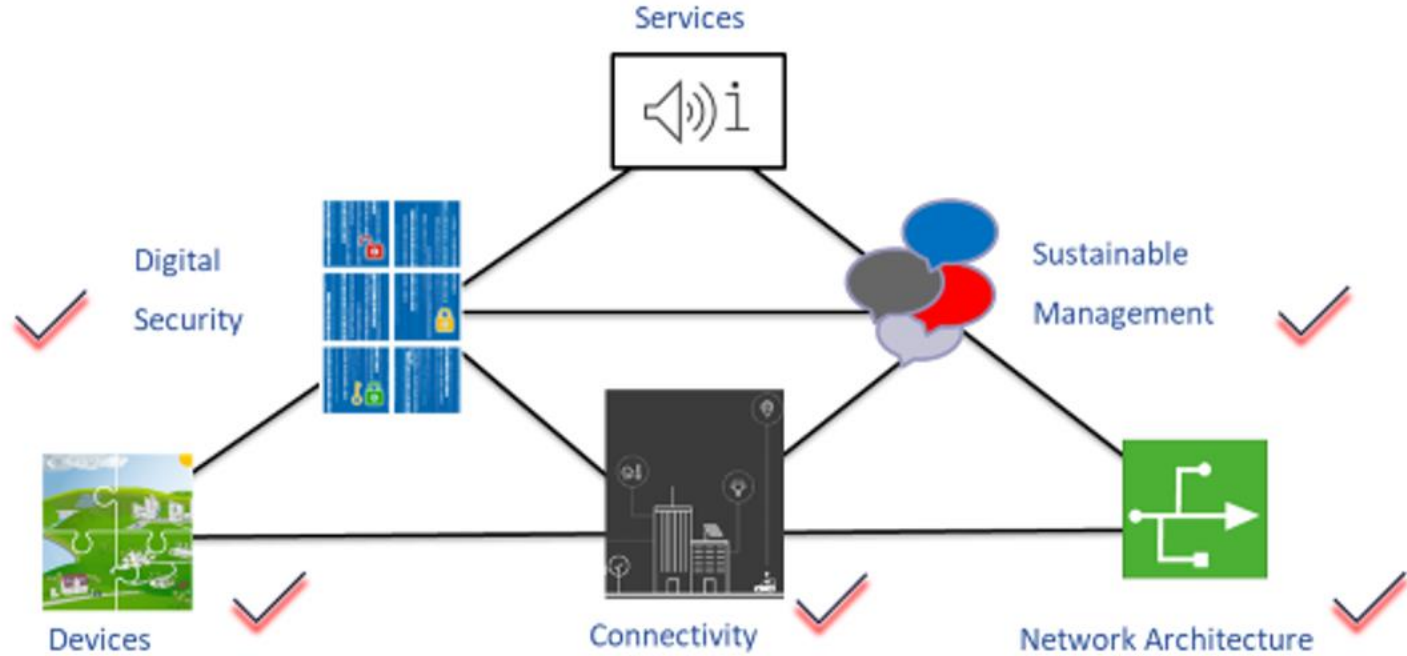
Buildings have become IP driven

Buildings have become IP driven

KNX IP Secure
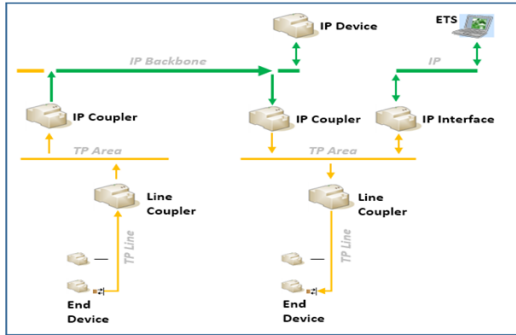
All KNX telegrams between the two (or more) IP Couplers are encrypted

KNX Data Secure

Unsecured communication

Secured communication

The group communication of a particular sender (one or more group objects) to another group object(s) is encrypted

- **KNX IP Secure** and **KNX Data Secure** can be combined in an ETS project/ installation.
- ETS handles key management/ distribution, establishes 'secure links' and downloads these links in KNX Secure devices independent of the KNX Secure types.

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Buildings have become IP driven

- KNX Secure uses AES128 CCM for encryption/ authentication and elliptic curve Diffie-Hellman for a secure key exchange

- Advanced Encryption Standard (AES) is a standard encryption algorithm ISO/IEC 18033-3
  Several animations on the Internet (https://www.youtube.com/watch?v=mlzxpkdX), usage in KNX (KNX IP Secure)

- Elliptic curve Diffie- Hellman key exchange is a worldwide standardized and widely used algorithm to share a common secret key on an unsecure communication channel

- KNX Secure is an own international standard:
  - EN 50090-3-4 : Data Secure
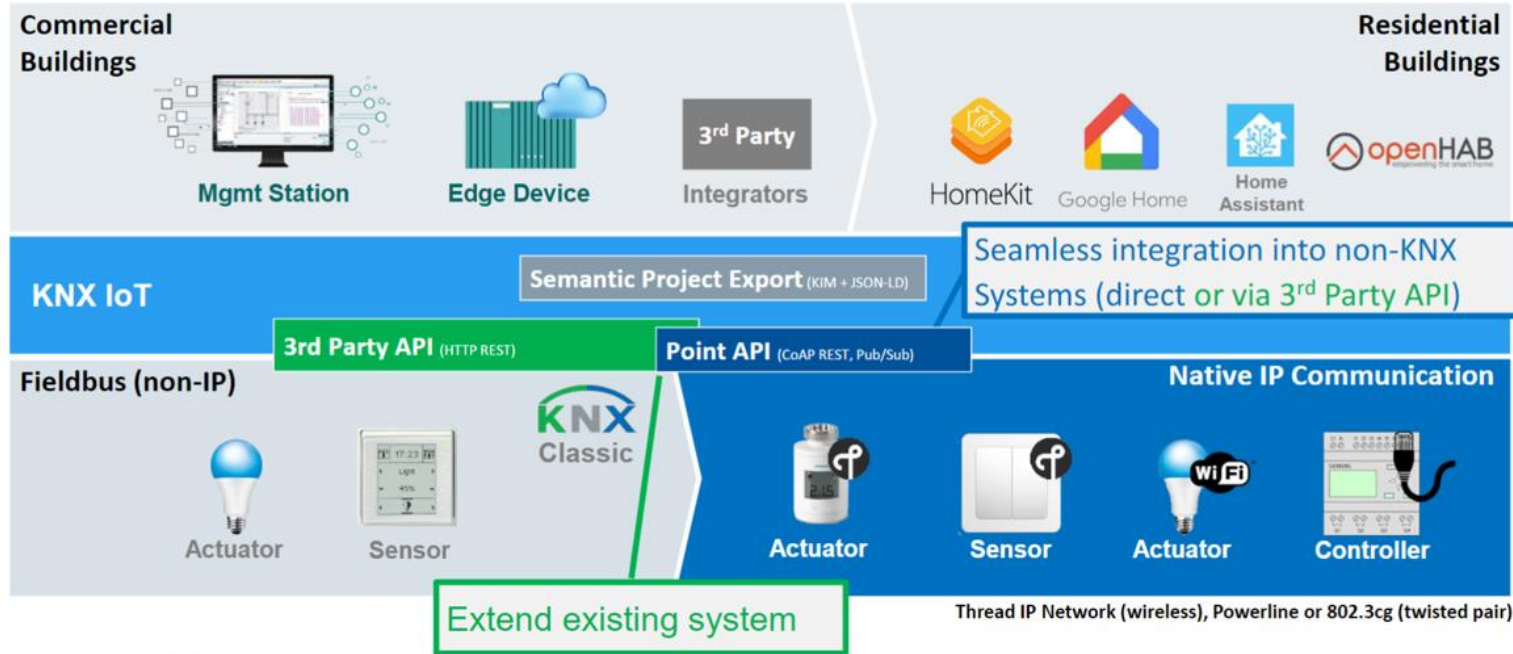 - prEN ISO 22510 : IP Secure

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KNX IoT- Horizontal and vertical integration

Commercial Buildings

Mgmt Station   Edge Device   3rd Party Integrators

Residential Buildings

HomeKit   Google Home   Home Assistant   openHAB

KNX IoT

Semantic Project Export (KIM + JSON-LD)

Seamless integration into non-KNX Systems (direct or via 3rd Party API)

3rd Party API (HTTP REST)   Point API (CoAP REST, Pub/Sub)

Fieldbus (non-IP)

Native IP Communication

KNX Classic

Actuator   Sensor

Actuator   Sensor   Actuator   Controller

Extend existing system

Thread IP Network (wireless), Powerline or 802.3cg (twisted pair)

Buildings have become IP driven
The Future of IoT in Home and Building Automation

► Smart Homes & Buildings become intelligent

► The perspective changes from „inside" to „outside", i.e. there will be much more external applications, which will use the data and functions of a building in a simple way

► Also „Smart Home & Building non-specialists" will/must use this infrastructure

► The semantic description of data will improve the provision of data and the interoperability
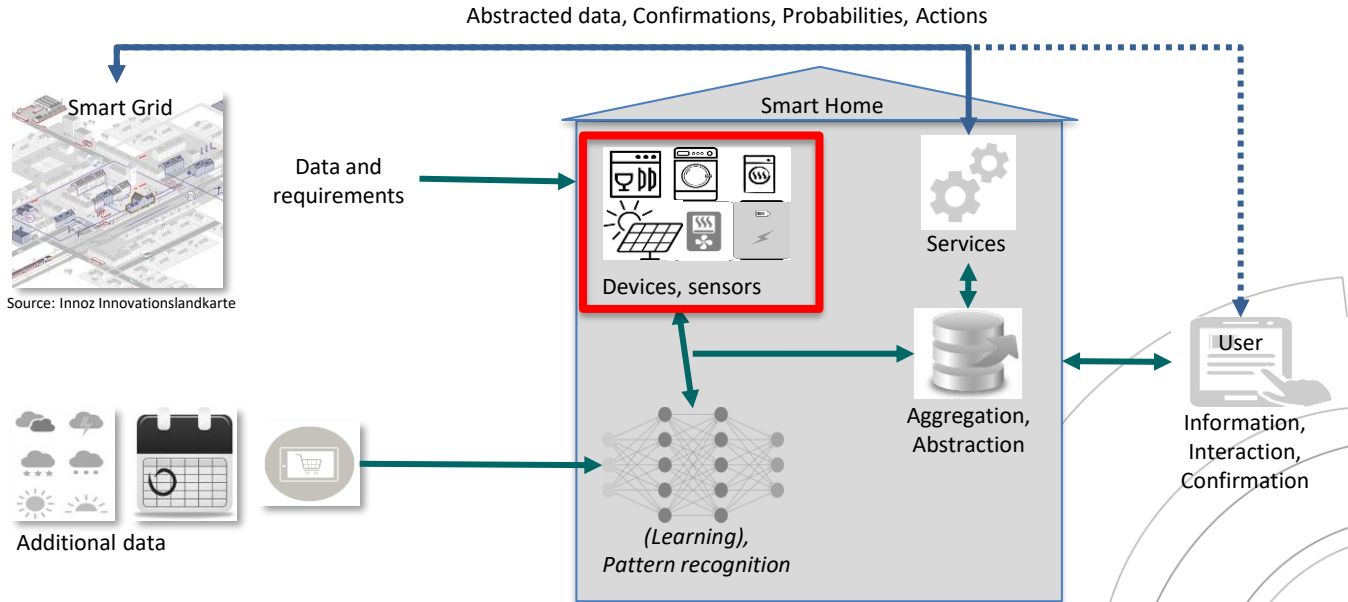
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Buildings have become IP driven
The Future of IoT in Home and Building Automation

Building as Service

Abstracted data, Confirmations, Probabilities, Actions

Smart Grid

Smart Home

Data and requirements

Source: Innoz Innovationslandkarte

Devices, sensors

Services

Additional data

(Learning), Pattern recognition

Aggregation, Abstraction

User

Information, Interaction, Confirmation

Source: DFKI

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Buildings have become IP driven
Services with KNX

"As KNX enters its fourth decade, everything is different. KNX is forging ahead again, taking new paths into a new age, into a new era. On the threshold of a new decade and with all our experience, we know: if we are to remain reliable, sustainable and fit for the future, we must take part in shaping the future. If data is the oil of the future, then services are the smart applications of the future."

"…Services are increasingly becoming a business model of the future. Data is the new oil."

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THANK YOU