Technische Hochschule Brandenburg
University of Applied Sciences

Beyond Connectivity: A Sustainable Approach to Municipal LoRaWAN Infrastructure and Services

Prof. Dr.-Ing. André Nitze, DASAIT 2024, Barcelona, Spain

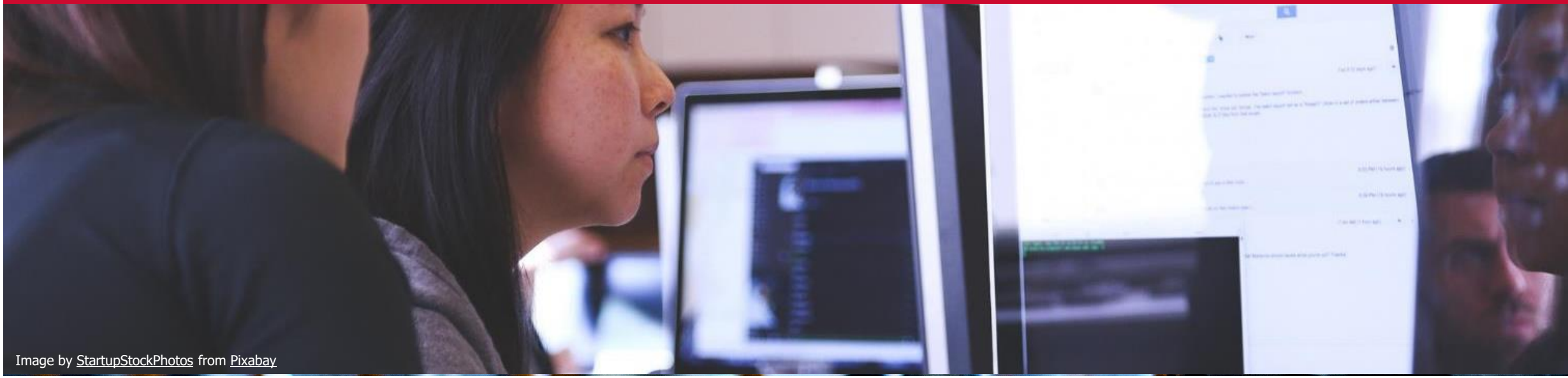

Image by StartupStockPhotos from Pixabay

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Smart Cities

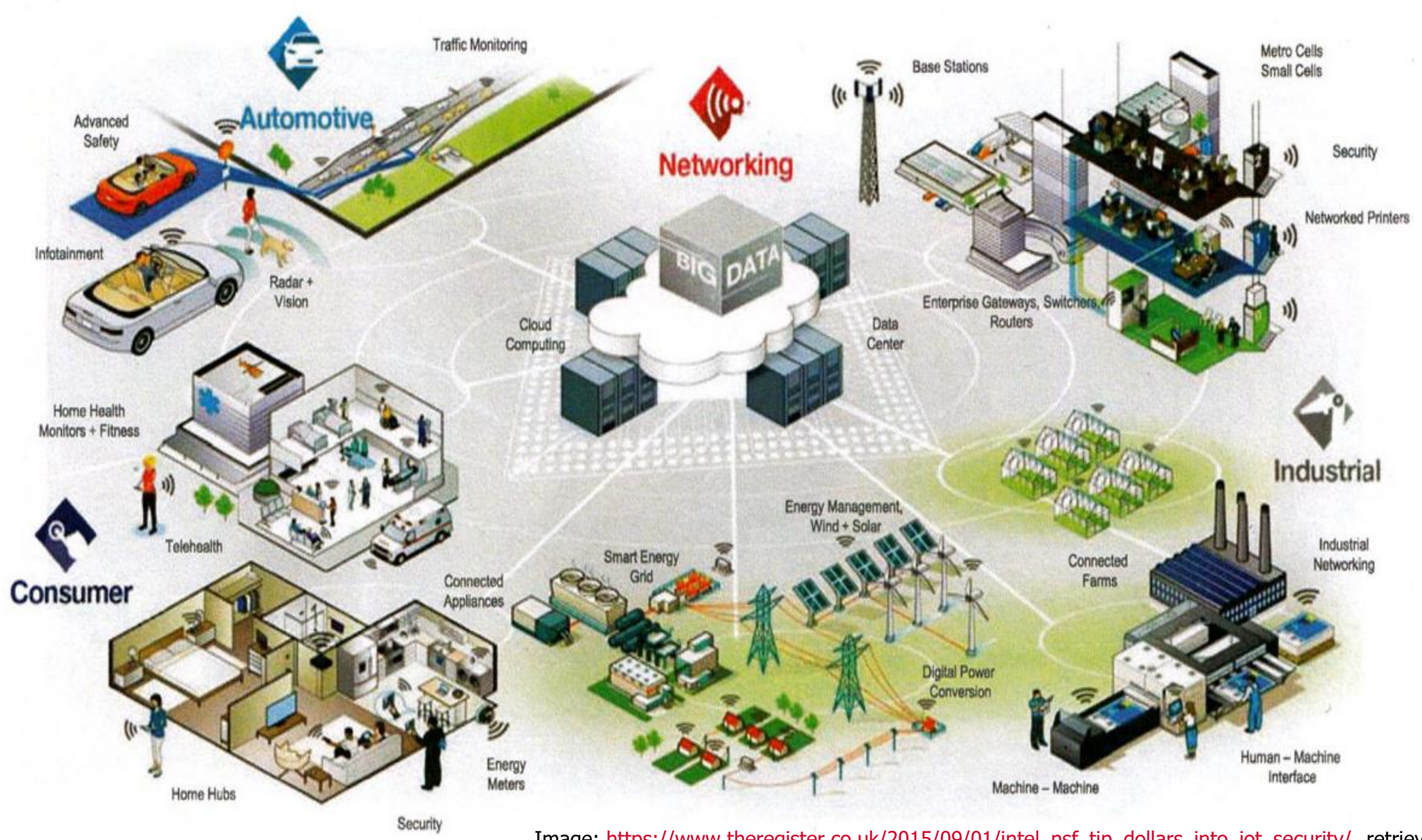
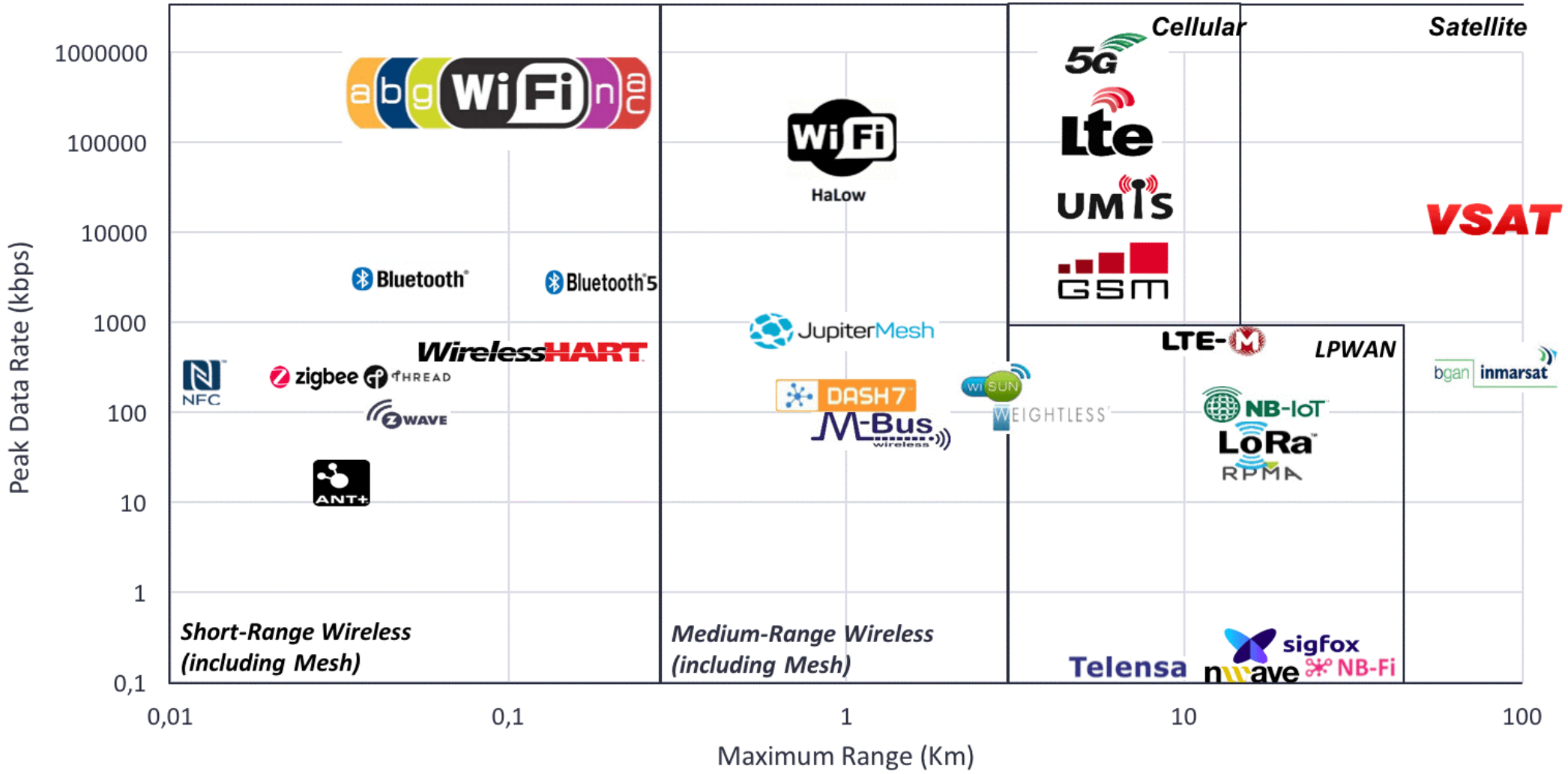


Image: https://www.theregister.co.uk/2015/09/01/intel_nsf_tip_dollars_into_iot_security/, retrieved Dec 08, 2019

Connectivity options for smart cities



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Connectivity options for smart cities

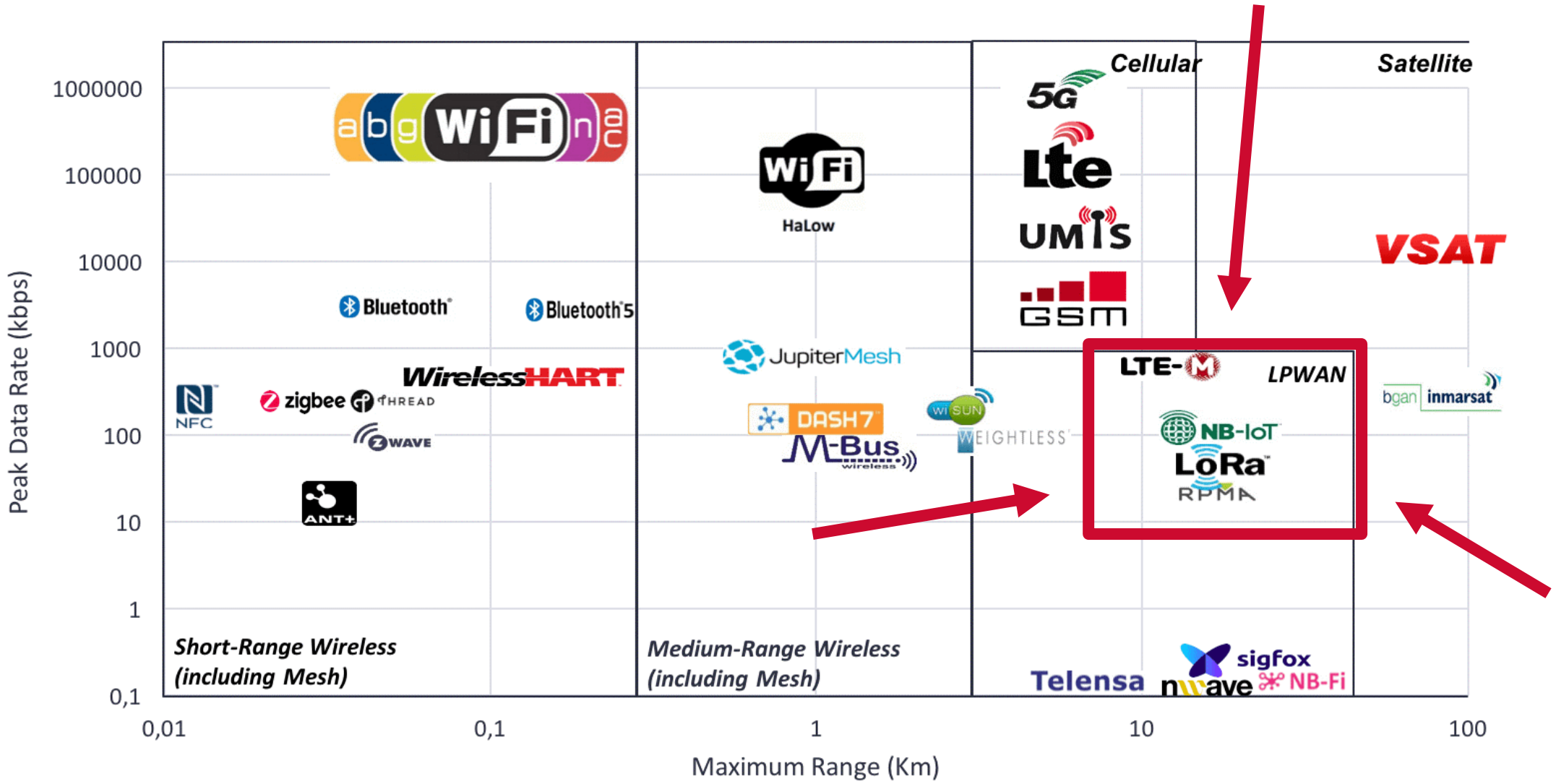

Image: https://iot-analytics.com/iot-segments/iot-connectivity/, retrieved Dec 08, 2019.

Long-Range Wide-Area-Network (LoRaWAN)

LoRaWAN™

RESOURCE-EFFICIENT

LONG TRANSMISSION RANGE

END-TO-END-ENCRYPTION

Long-Range Wide-Area-Network (LoRaWAN)


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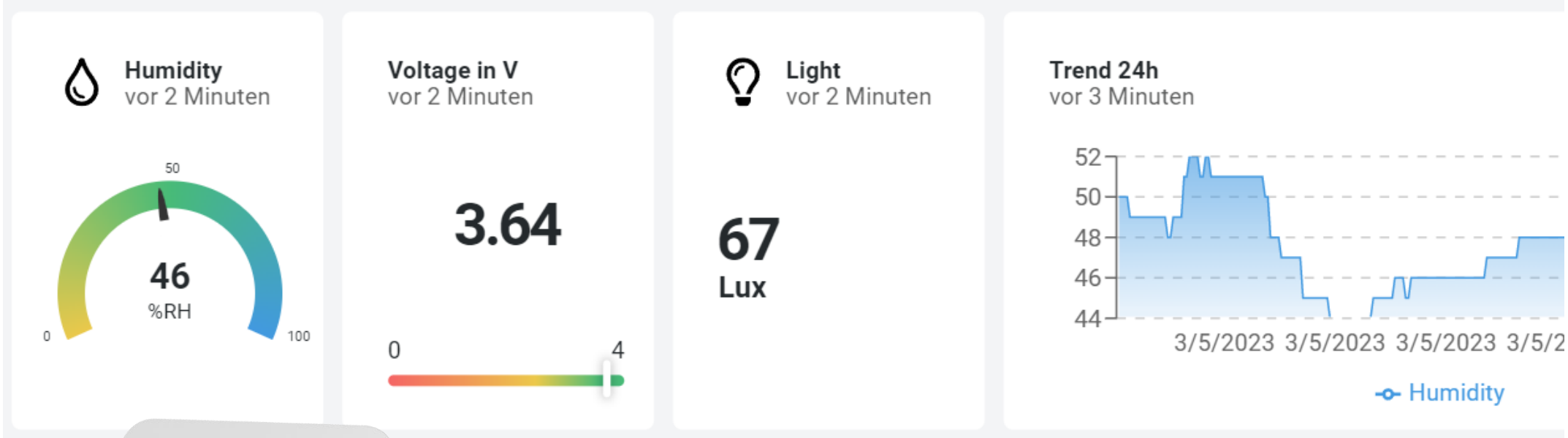
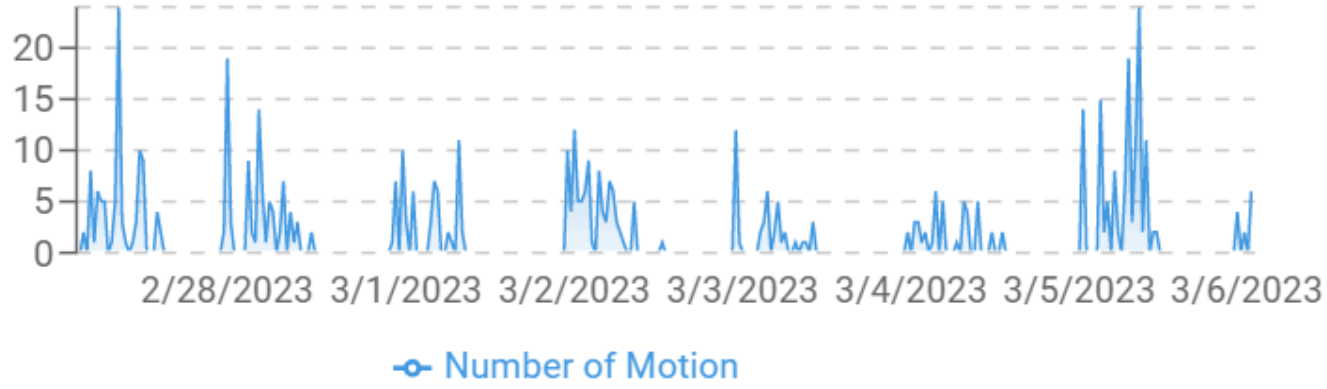
"decoded_payload": {
  "humidity": 47,
  "light": 60,
  "motion": 0,
  "temperature": 21,
  "vdd": 3638
},
```


Image: www.reichelt.de/raumsensor-klima-lora-wan-elsys-ers-p273016.html, retrieved: 2023-03-06.

Long-Range Wide-Area-Network (LoRaWAN)





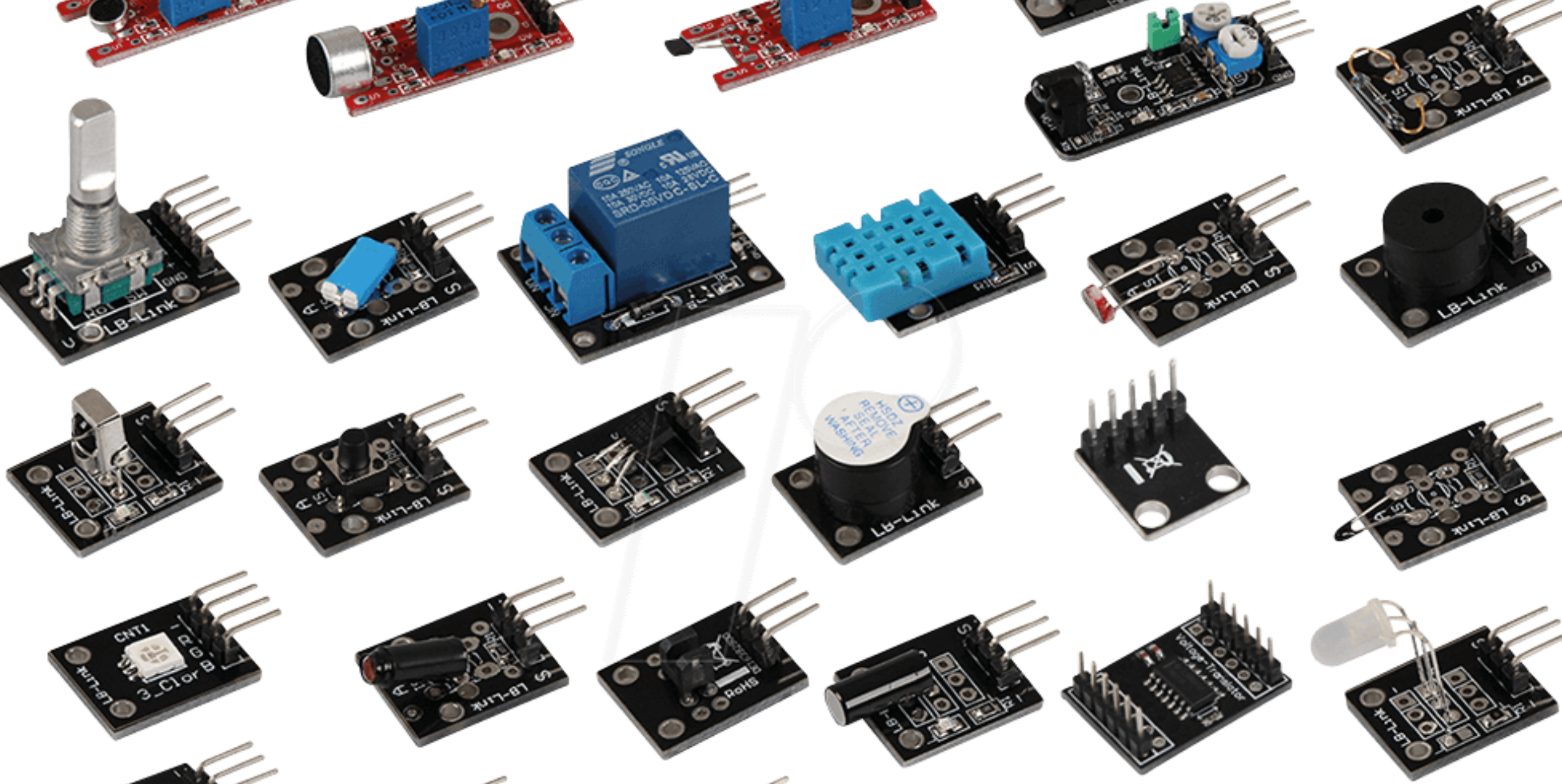


Image: https://www.reichelt.de/entwicklerboards-sensor-kit-40-in-1-debo-sensorkit40-p192149.html

Image: JCG / Fotolia.com

Smart City = Data-driven decisions in all areas

CO2 pollution

"Dieses Foto",, CC BY-SA

Soil moisture

Image: Bayrischer Rundfunk

Waste volumes

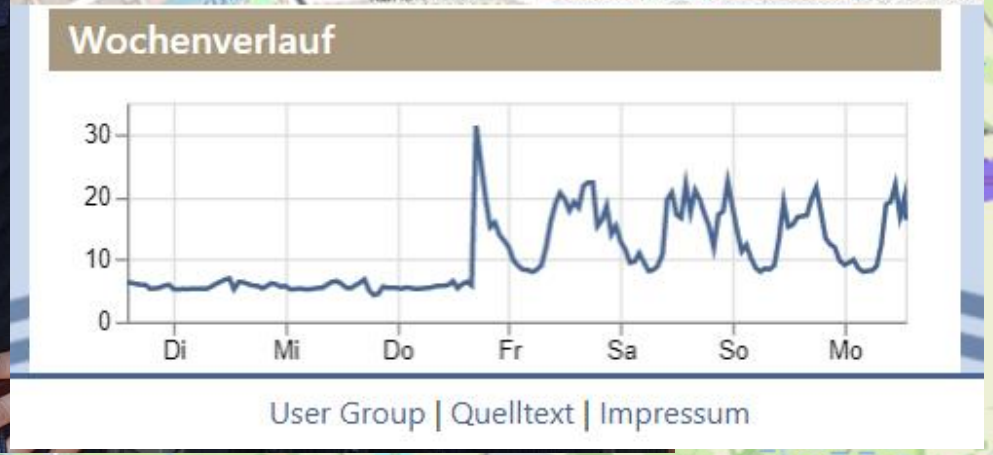
"Dieses Foto", CC BY-SA

Image: JCG / Fotolia.com


HAPPY HOUR:
montags - freitags bis 10.00 Uhr
Milchkaffee zum 1/2 Preis!
Zum Naschen:
Muffins & Cookies
nach Angebot

PAX-Counter


Altstadt
Packhof
Am Marienberg
Wallstraße
Klosterstraße
Packhofstraße
Lindenstraße
Hauptstraße
Brandenburg
an der Havel
Heinrich-Heine-Ufer
Havelstraße
Kurstraße
Kanalstraße
Leaflet | © OpenStreetMap contribute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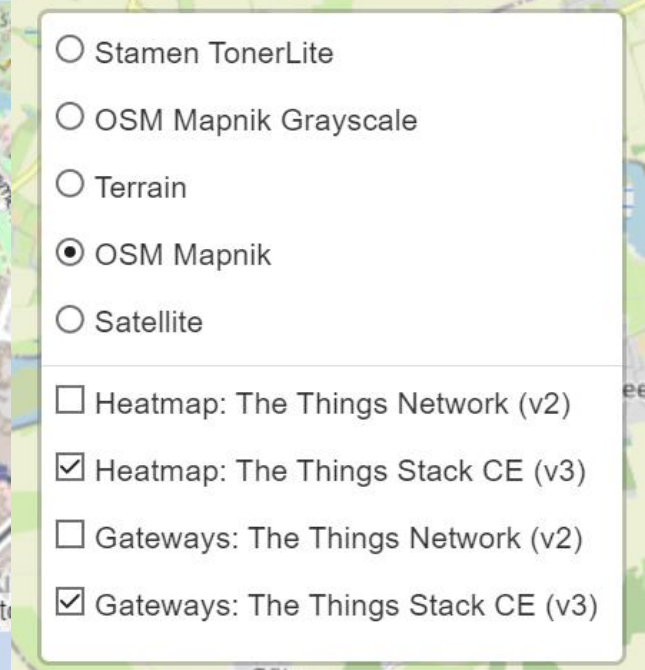
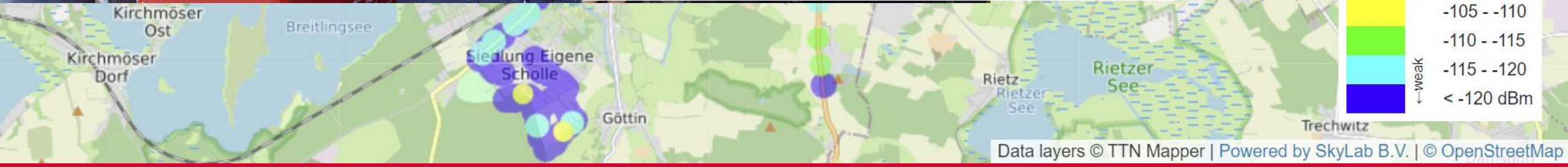

Stamen TonerLite
OSM Mapnik Grayscale
Terrain
OSM Mapnik
Satellite
Heatmap: The Things Network (v2)
Heatmap: The Things Stack CE (v3)
Gateways: The Things Network (v2)
Gateways: The Things Stack CE (v3)


Kirchmöser
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Jeserig
Schenkenbe
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Colour
Signal
strong→
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> -100 dBm
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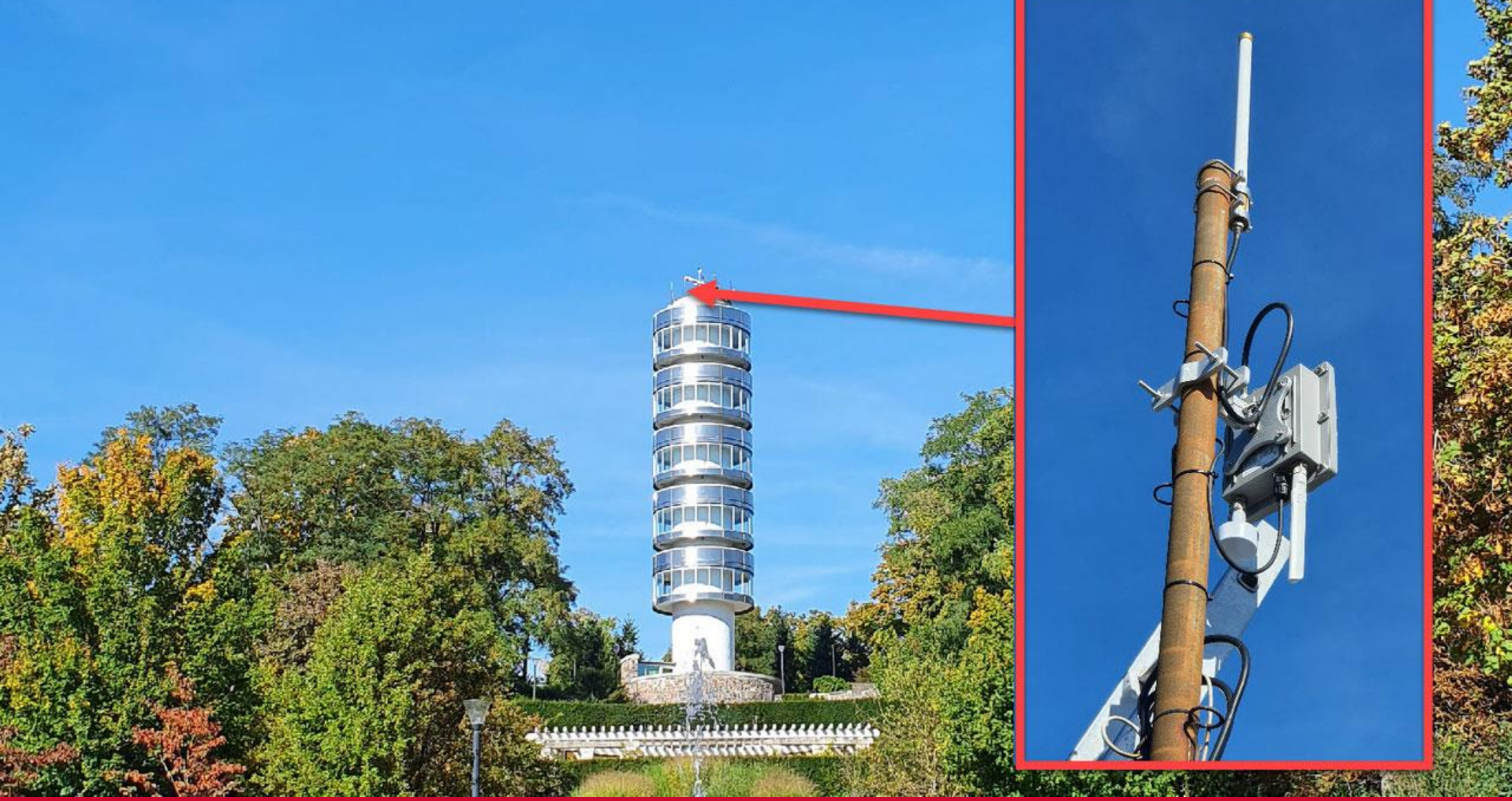
-105 - -110
-110 - -115
-115 - -120
< -120 dBm
Data layers © TTN Mapper | Powered by SkyLab B.V. | © OpenStreetMap



Challenges within LoRaWAN projects

Technical requirements
- Power
- Internet connection (ethernet/cellular)
- Gateways (s. image)
- Sensors / actuators
- LoRaWAN Network Server (LNS)
- Visualization software / data integrations

Organizational requirements
- General technology know-how
- Project management
- Internal responsibilities and processes
- (Lots of) Interdisciplinary alignment

Method

- Practical experience from several real-world LoRaWAN „technology transfer" projects
- Project partners in rural Germany (around Berlin, s. table)
- Projects closely tied to Sustainable Development Goals (SDGs), e.g., modal split, soil moisture, moors
- Publicly funded projects (2/4 projects had grants)
- Our role: End-to-end technical project management

Site	Population	Pop. density (people per sq. km)	Time frame	Deployment
Brandenburg an der Havel	72,100	320	2022-2024	12 gateways, 25 sensors
Rüdersdorf	15,500	228	2024	2 gateways, ~10 sensors
Michendorf	11,600	202	2023	2 gateways, 38 sensors
Wiesenburg	4,900	19	2022-2024	4 gateways, 30 sensors

Result: LoRaWAN Collaboration Framework (LCF)

Definition of roles in LoRaWAN projects

Wants & needs

What stakeholders want and need (independent of skill and financial resources)

Capabilities

What stakeholders are able to contrbute to the LoRaWAN value chain

Result: LoRaWAN Collaboration Framework (LCF)

	Infrastructure		Application		
	Network operators and utility companies	Hosting and IT service providers	Start-ups, universities, and specialized IT companies	Administrations	End-users
Wants & Needs what stakeholders want and need	• Market expansion • New revenue streams and business models	• Stable contracts and partnerships • Maintainenance-friendly software components • Opportunities to showcase and deploy new technologies • Support by hardware and software vendors	• Evaluating cutting-edge technology • Funding for R&D or transfer projects • Partnerships • Visibility and recognition	• Education on technology options • Fast and efficient delivery of services to citizens • Enhanced citizen engagement and satisfaction • Limited Total Cost of Ownership (TCO) • User feedback on provided services	• Convenient access to municipal services • Intuitive interfaces and good user experience • Integration with other IT systems • Security features to protect user data and privacy • Regular updates and improvements
Capabilities what stakeholders are able to contribute to the LoRaWAN value chain	• Provide sites and connectivity for gateways • Operate the LoRaWAN Network Server (LNS) • On-site servicing of sensors (batteries, cleansing, replacement)	• Provide computing resources (hardware, software, virtual machines, and networks) • Install and configure standard software packages • Configure sensors • Backups & security • Customer support and training for municipal staff and end-users	• Build innovative prototypes • Find or build the right sensors for use cases • Develop custom software • Integrate custom data sources and platforms • Create machine learning models • Support and train end-users	• Problems / use cases • Provide sites for gateways • Deploy sensors • Budget or funding for public IT projects • Collaboration with private entities and other government agencies	• Problems / use cases • Give feedback on services

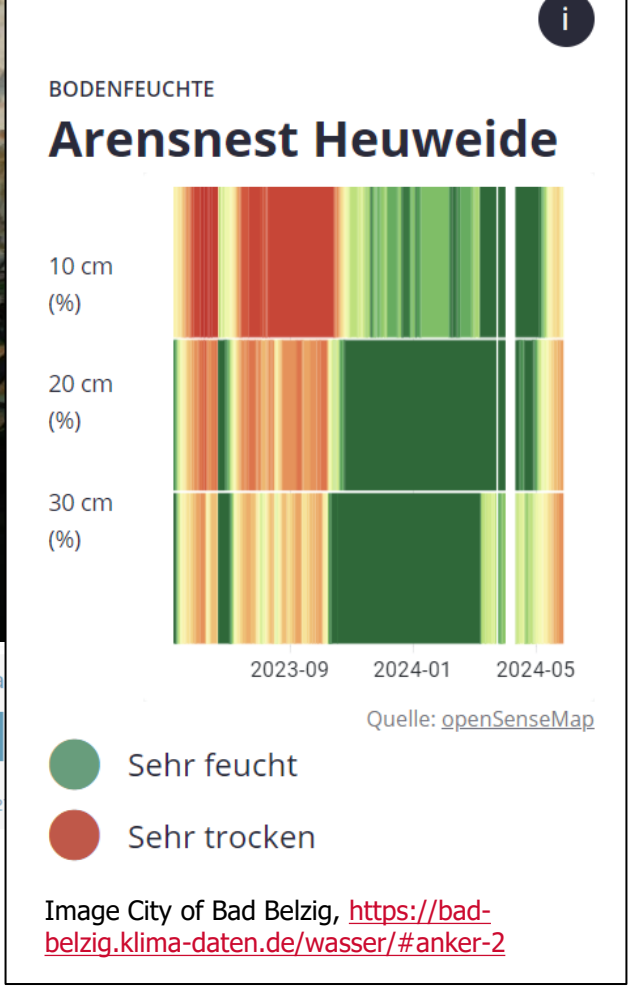
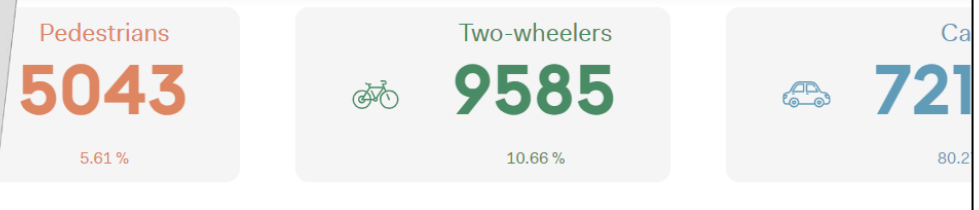
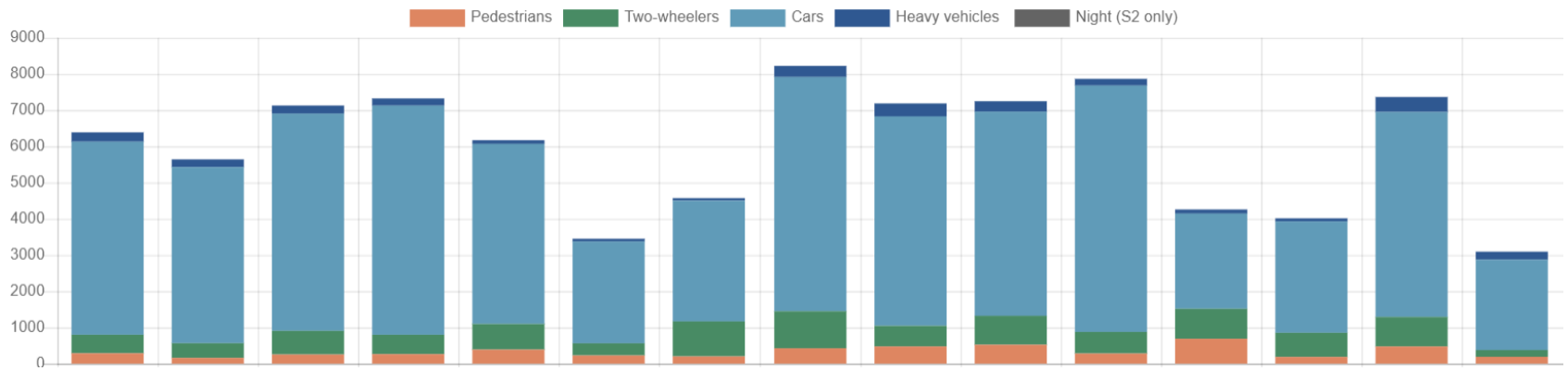


Image City of Bad Belzig, https://bad-belzig.klima-daten.de/wasser/#anker-2





Summary

- **Research goal:** Identify effective operating model for municipalities to implement LoRaWAN projects
- **Proposed solution:** LoRaWAN Collaboration Framework clarifies roles and responsibilities
- **Main insight:** Interdisciplinary collaboration is crucial for successful LoRaWAN deployments in rural and smaller municipalities → exchange best practices and pool financial resources
- **Further research** required on economic viability and (holistically) sustainable solutions

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Thank you for your attention!
Questions?

Prof. Dr.-Ing. André Nitze