ASPires

Advanced Systems for Prevention & Early Detection of Forest Fires

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ASPires Platform Design. LoRa Sensors. Fixed and Mobile Gateways. Drones

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Agenda

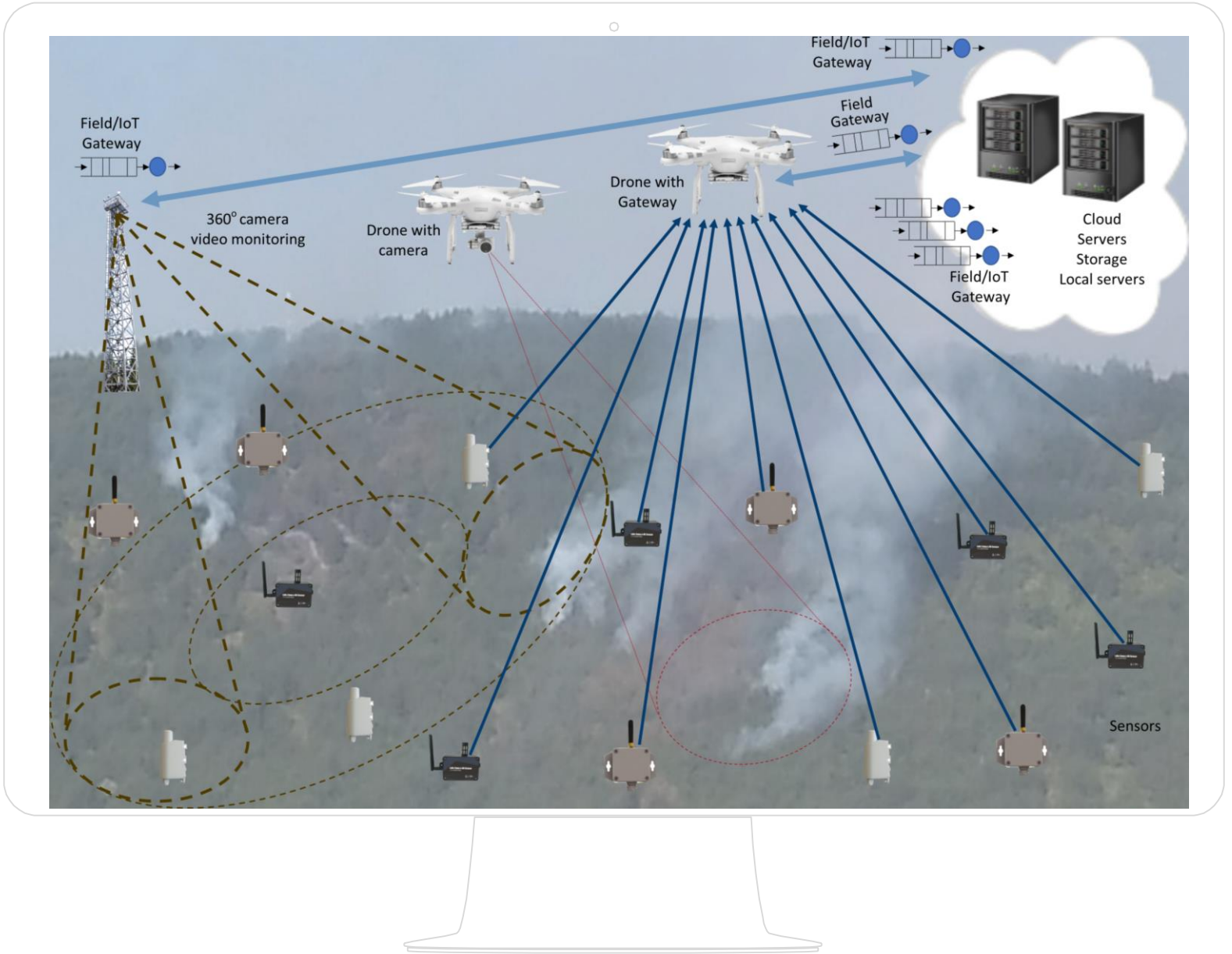
1. Objectives
2. Platform Design
3. LoRa Sensors
4. Field Gateways
5. Drones
6. Conclusions

Objectives

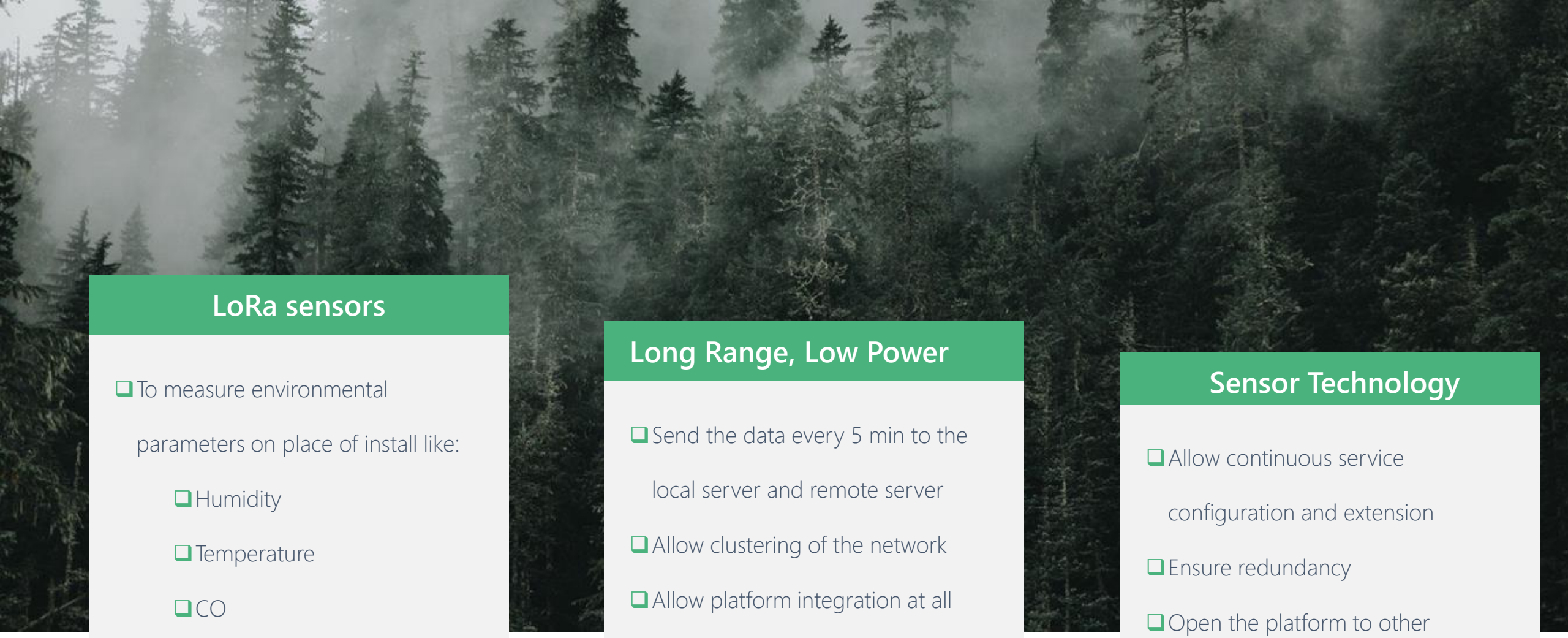
- Integrated platform
- Fully interoperable
- Working in different scale – regional, national, international, European
- Open for new technologies, applications, development

Possible integration to the platforms for:

- Smart cities and environment
- Smart water and villages
- Smart home appliances
- Smart wearables and living environments
- Smart transport and other IoT platforms



ASPires Platform Overview



LoRa sensors

- To measure environmental parameters on place of install like:
  - Humidity
  - Temperature
  - CO
  - CO2
  - Atmospheric aerosol particles

Long Range, Low Power

- Send the data every 5 min to the local server and remote server
- Allow clustering of the network
- Allow platform integration at all hierarchical levels
- Allow platform scaling and customization

Sensor Technology

- Allow continuous service configuration and extension
- Ensure redundancy
- Open the platform to other platforms

LoRa. Measurements

Panel with mounted transmitter for:

- CO, T, RH
- CO2
- Fine dust particles
- Modbus RTU I/O module
- MQTT I/O module
- Power supply

- Response times
- Deviation of measured parameters

T, RH

CO

CO2

CO2, T, RH

FDP

Sensors

- LoRa sensors for temperature measurement: range at least from -20ºC to +50ºC, accuracy ±1.0ºC or better.
- LoRa sensors for humidity measurement: range from 0% to 100%, accuracy ±5% or better.
- LoRa sensors for CO measurement: range at least 0 – 300 ppm, accuracy ±10 ppm or better.
- LoRa sensors for CO2 measurement: range at least 0 – 2000 ppm, accuracy ±40 ppm or better.
- LoRa sensors for fine particles measurement: particle size PM1, PM2.5 or PM10; range at least 0 – 500 ppm, accuracy ±10 ppm or better.
- LoRa sensors for soil moisture: range of Volumetric Water Content (VWC) 0 – 100%, accuracy ±5% or better.

ppm - Parts Per Million atmospheric aerosol particles or fine particles
PM2.5 - particles with diameter less than 2.5 μm

Installations

- SCADA HMI
- Modbus RTU/Modbus TCP gateway
- Local data management

Payload of RHF1S001 EU868 for temperature and humidity

Bytes	1	2	1	2	1	1	1
Item	Header	Temperature	Humidity	Period	RSSI	SNR	Battery

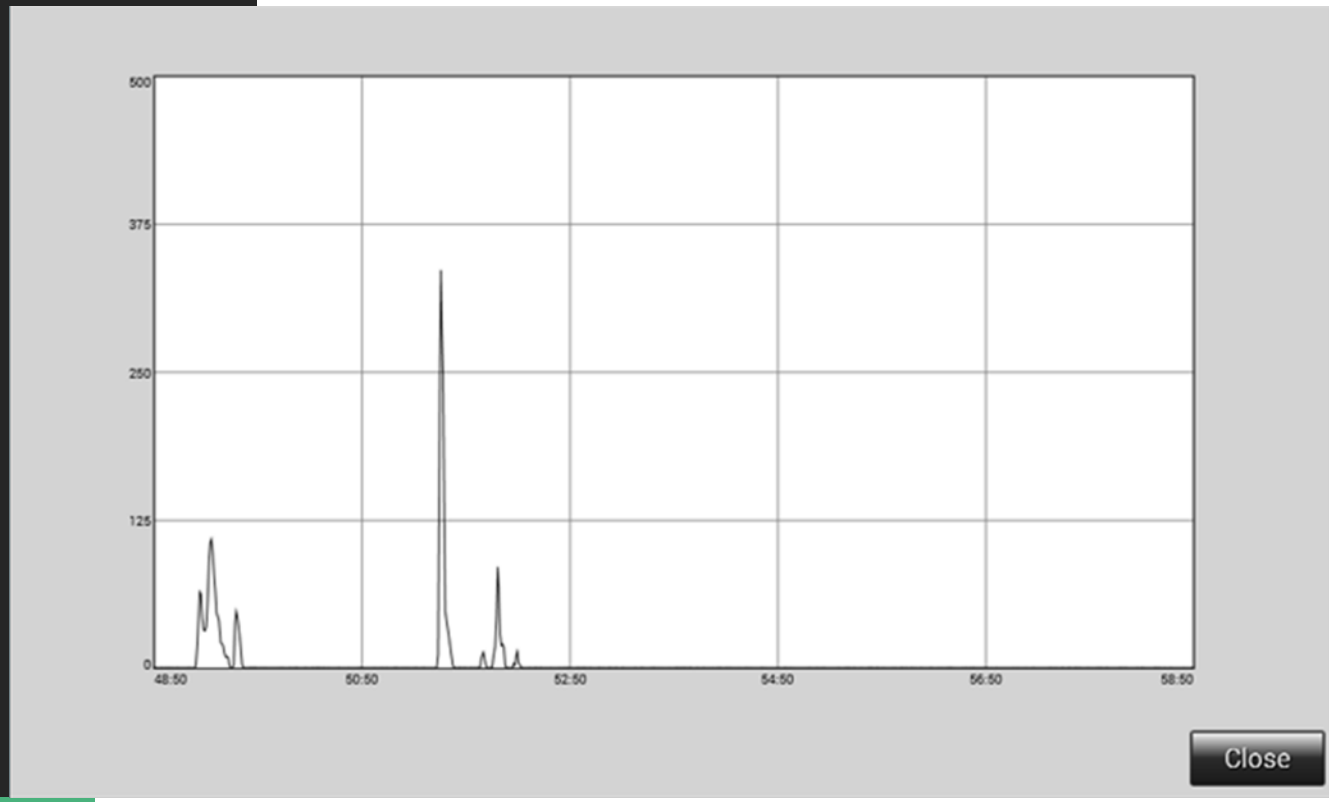
Example of the data from sensor OY1100 868 for temperature and humidity and humidity

Size (Nibble)	2	2	1	1
FHDR	Temp[0xAB]	Humidity[0xDE]	Temp[0xC]	Humidity[0xF]

Experiments

30 meters

- Fine particles transmitter - deviation up to 350ug/m3 - 70% of the measurement scale.
- CO transmitter - without deviation.
- CO2 transmitter - without deviation.
- The CO2 sensor is very slow and sensor readings do not show big differences- up to 1% of the scale. Practically not applicable for fire detection.
- The CO sensor catches deviations at distance up to 5 m from the fire and is more sensitive - 10-20% of the scale by memory.
- The fine particle sensor is extremely good - a very fast response, at small distances reacts very often and up to 100% of the scale. Captures smoke even at 30 m.



Results

Date and time	Frame Number	Gateway ID	Sensor ID	TagID	Float Value	Integer Value	Param. Type	Param. Description
4/17/2018 11:20:02	19967	b827ebFFFE6df81f	57AD6362	236	23		401	Temperature
4/17/2018 11:20:02	19967	b827ebFFFE6df81f	57AD6362	235	7,5		305	LSNR (Lora Signal to Noise Ratio)
4/17/2018 11:20:02	19967	b827ebFFFE6df81f	57AD6362	234		12	304	SF (Spreading factor)
4/17/2018 11:20:02	19967	b827ebFFFE6df81f	57AD6362	233		-105	303	RSSI
4/17/2018 11:20:02	19967	b827ebFFFE6df81f	57AD6362	232	868,3		302	Radio Frequency
4/17/2018 11:20:02	19967	b827ebFFFE6df81f	57AD6362	231		1	301	Frame counter for this sensor
4/17/2018 11:18:36	19965	b827ebFFFE6df81f	57059248	243		710	408	CO2
4/17/2018 11:18:36	19965	b827ebFFFE6df81f	57059248	242		36	404	RH
4/17/2018 11:18:36	19965	b827ebFFFE6df81f	57059248	241	-2,2		305	LSNR (Lora Signal to Noise Ratio)
4/17/2018 11:18:36	19965	b827ebFFFE6df81f	57059248	240		12	304	SF (Spreading factor)
4/17/2018 11:18:36	19965	b827ebFFFE6df81f	57059248	239		-121	303	RSSI
4/17/2018 11:18:36	19965	b827ebFFFE6df81f	57059248	238	868,1		302	Radio Frequency
4/17/2018 11:18:36	19965	b827ebFFFE6df81f	57059248	237		17665	301	Frame counter for this sensor

Results

Date and time	Frame Number	Gateway ID	Sensor ID	TagID	Float Value	Integer Value	Param Type	Parameter Description
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	230		44	404	RH
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	229	20,1		401	Temperature
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	228	3,5		307	Battery [V]
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	227	6,5		305	LSNR (Lora Signal to Noise Ratio)
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	226		12	304	SF (Spreading factor)
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	225		-101	303	RSSI
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	224	868,3		302	Radio Frequency
4/17/2018 11:14:54	19961	b827ebFFFE6df81f	0064BF88	223		17555	301	Frame counter for this sensor
4/17/2018 11:12:32	19957	b827ebFFFE6df81f	565EAA85	250		1	410	Dust
4/17/2018 11:12:32	19957	b827ebFFFE6df81f	565EAA85	249		1	407	CO
4/17/2018 11:12:32	19957	b827ebFFFE6df81f	565EAA85	248	3		305	LSNR (Lora Signal to Noise Ratio)
4/17/2018 11:12:32	19957	b827ebFFFE6df81f	565EAA85	247		12	304	SF (Spreading factor)
4/17/2018 11:12:32	19957	b827ebFFFE6df81f	565EAA85	246		-114	303	RSSI
4/17/2018 11:12:32	19957	b827ebFFFE6df81f	565EAA85	245	868,1		302	Radio Frequency
4/17/2018 11:12:32	19957	b827ebFFFE6df81f	565EAA85	244		17664	301	Frame counter for this sensor

Next steps

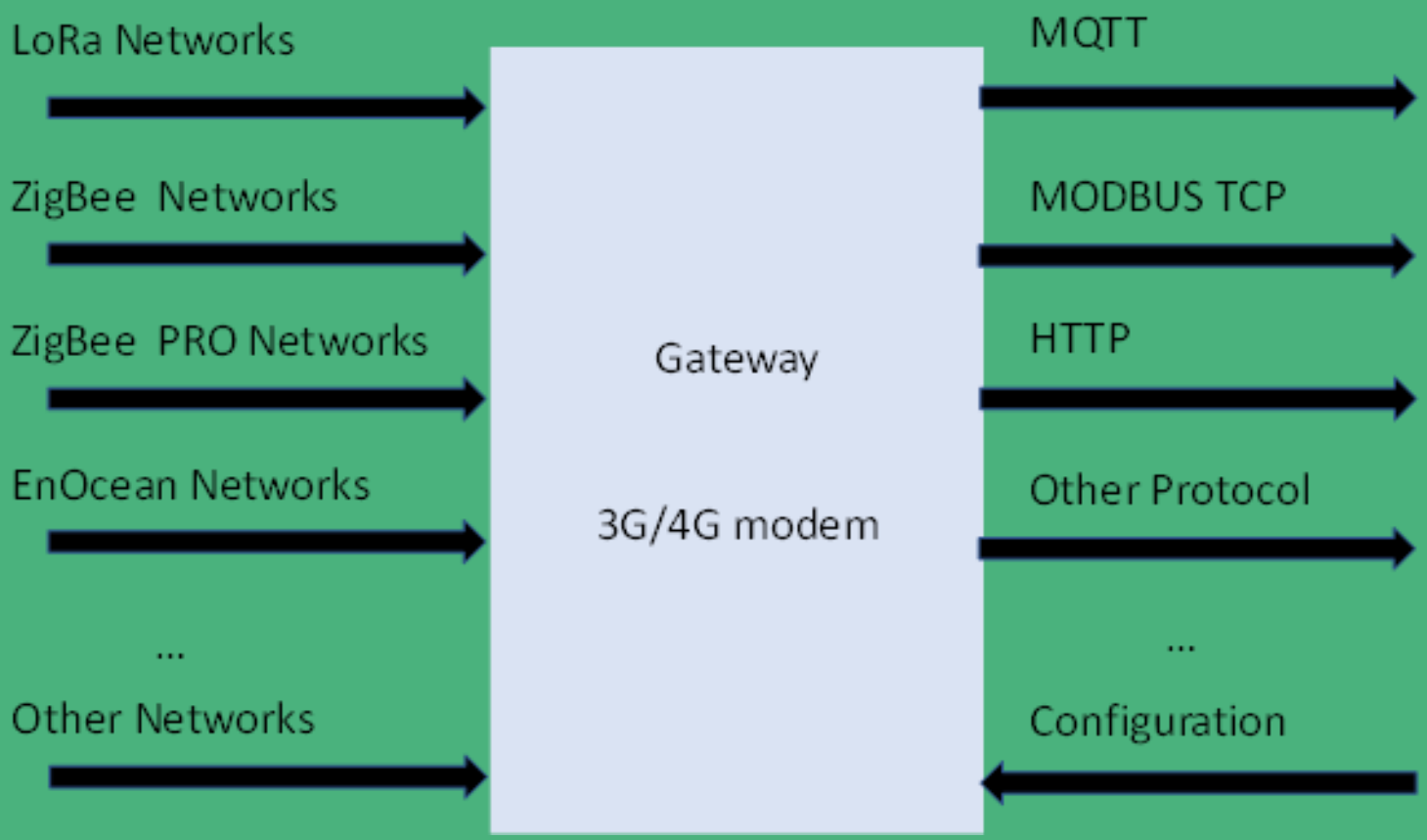
- The purpose of the experiments with LoRa sensors is to examine the influence of the distance and the topography of the area on the quality of data transmission. LoRa sensors from different manufacturers will be used.

- Communication parameters to be registered and analysed, such as:
- - RSSI - Received Signal Strength Indicator
- - SNR - Signal to Noise Ratio
- - SF- Spread Factor
- - PER - Packet Error Rate

Scenarios

- The first scenario is to start remote access to the live cam and to get visual confirmation.
- The second scenario is to send Drone equipped with HD camera to the location of already predefined position of the sensor.
- The drone could carry a gateway for collecting data from sensors locally in areas with limited coverage and limited tower infrastructure.
- According to visual confirmation they set fire alarm or release warning level.

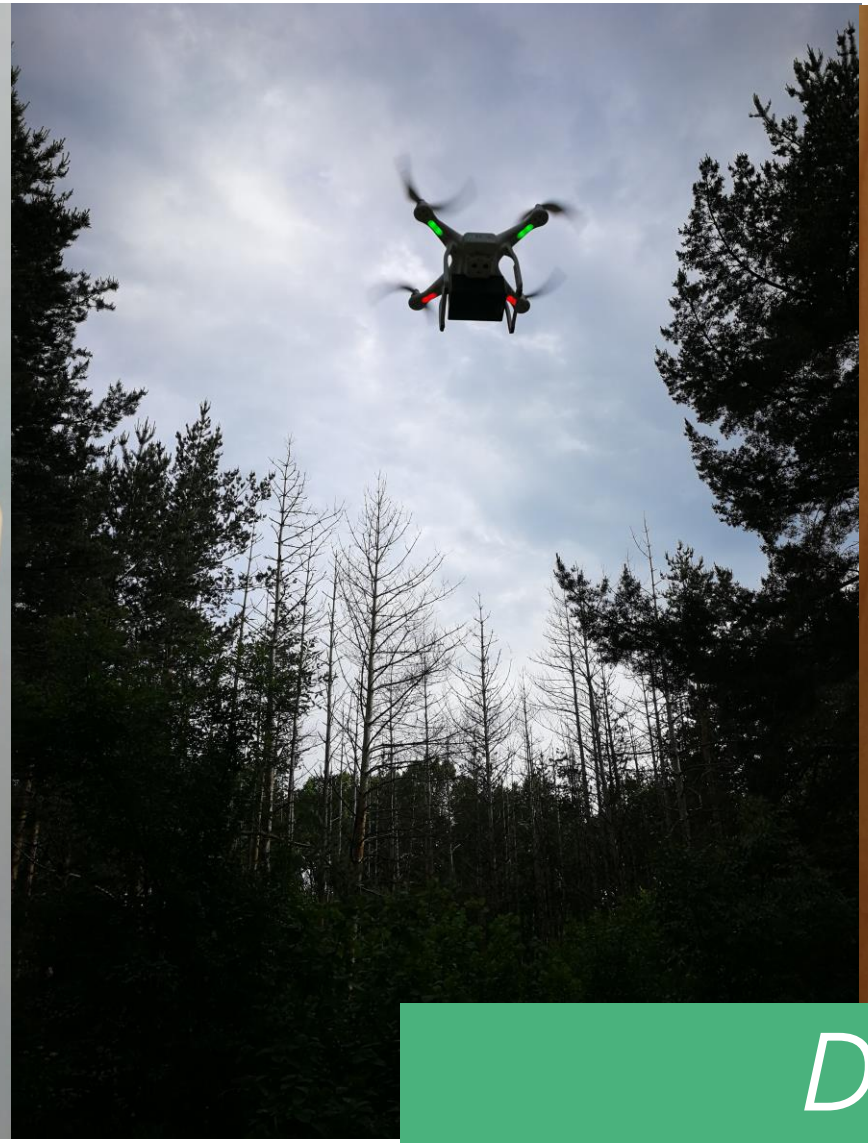
Gateway to different sensor technologies. LoRa Technology. Field Gateway



Drone

The role of the drone for forest fire prevention and detection could be significant in all places where:

- There is no sensor network gateway or it is damaged
- There is no line of sight for the camera
- The area is in high risk
- There is a need of alarm confirmation
- The combination of wireless sensor network with drone having a gateway on board allows fast data collection from the area of importance and could decrease the delay in forest fire detection.



Drone

Conclusion

- LoRa technology looks promising
- First experiments demonstrate it
- Possibility to use field and IoT gateways
- Possibility to use gateways to connect also proprietary solutions
- Easy scaling

- Clustered
- Easy configuration
- Big enough range
- Telecoms build LoRa infrastructure
- Good combination with drones, cameras

Thank you very much!
Questions&Answers?