AARC Meeting Minutes
November 8, 2022

Meeting started at 7:20 PM by Ed Berkowitz, acting president. Meeting at PVCC and on Zoom. The start was delayed due to room access problems.

Treasurer's report from Larry Eicher:

Balance end of October is $33,847.

New members voted in:

Brian Williams, Charlottesville, not licensed, yet Associate member
Richard Hunter, Charlottesville, KQ4DZB, Technician, Full member

Bob Pattison presented motion for creating a scholarship for the 2023-24 school year of $2000 in honor of Harry J. Dannals, W2HD, for his service to amateur radio and to AARC. It will be administered by the ARRL. Requirements are that the recipient be a licensed amateur radio operator from the VA section or, if no qualifying applicants, then from the Roanoke division. The successful applicant should be attending an accredited 2 or 4- year college or university.
Motion was approved with one opposing vote by Dave Damon.

Ian described items for the raffle.

Presentation by John Porter, KK4JP on LoRaWAN and Internet of Things.
John mentioned that this presentation builds upon the presentation by talk by Mike McPherson in 2019 on Internet of Things.

See attached for details on John Porters Presentation.

Other business:

Ian ran the raffle and raised $42.

Meeting adjourned at 8:21 pm by Ed.

Respectfully submitted,

Stephen Kramer, Secretary

Attendees:

In-person:

Ed Berkowitz	N3US
Steve Kramer	KN4CJI
Bob Pattison	K4DU
Len Soika	KQ4BBR
Bob Romanko	AK4BR
Ian Callahan	KN4TBG
Joe Thompson	KN4WJK
John Porter	KK4JP
Ben Kidd	KG4EIF

On Zoom:

Rich Freeman	KI4QKV
Dave Damon	K4DND
Lawrence Eicher	K4JZQ
Michael Ellington	KN4BFB
Frank Haynes	W4NUA
James Owen	K4CGY
Dave Beebe	K4UEK
Tim Freeze	KO4ELL
Bill Oleksy	KF4IE
Michael Ellington	KN4BFB
Ron Richey	K4RKA
Jim Wilson	K4BAV
Warren Yursik	KN4LYF

LORAWAN RADIO AND THE INTERNET OF THINGS

John Porter, KK4JP

INTERNET OF THINGS - IOT

- In 2019, Mike McPherson gave a talk to the club about the "Internet of Things" (https://youtu.be/wT42hxPkc7g) - this talk will build on that, but focus more on how LoRaWAN operates with commodity IOT devices
- What is "the Internet of Things?"
  - A way of interconnecting DEVICES
    - Sensors – room temperature and humidity, room occupancy, stress on bridges, presence of people, alarms
    - Controls – Thermostats, Power, Lighting, Switches
    - Appliances – warnings, start/stop

- I do research on the Eastern Shore
- Some of our sites (stars) are in the middle of shallow lagoons
- We'd like to put sensors in the lagoons (water temperature, light, etc.)
- But providing POWER in the lagoons is very difficult - no place to put solar panels!

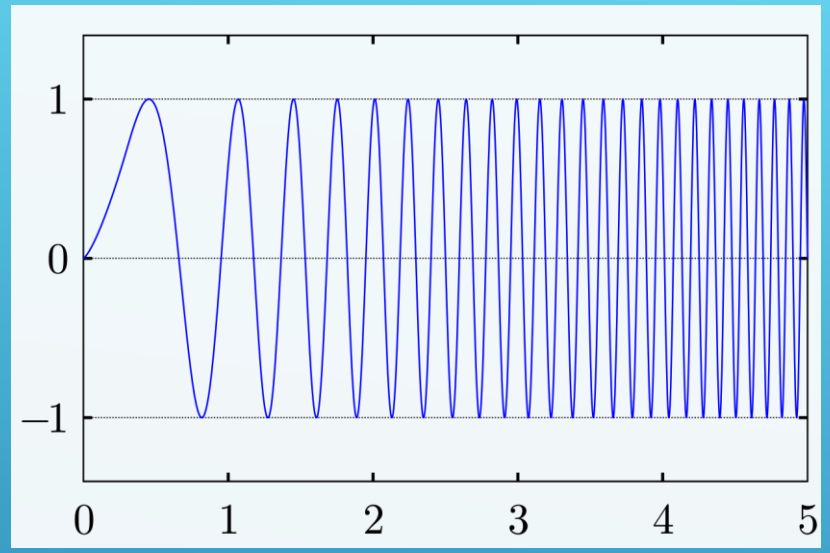
WHY MY INTEREST?

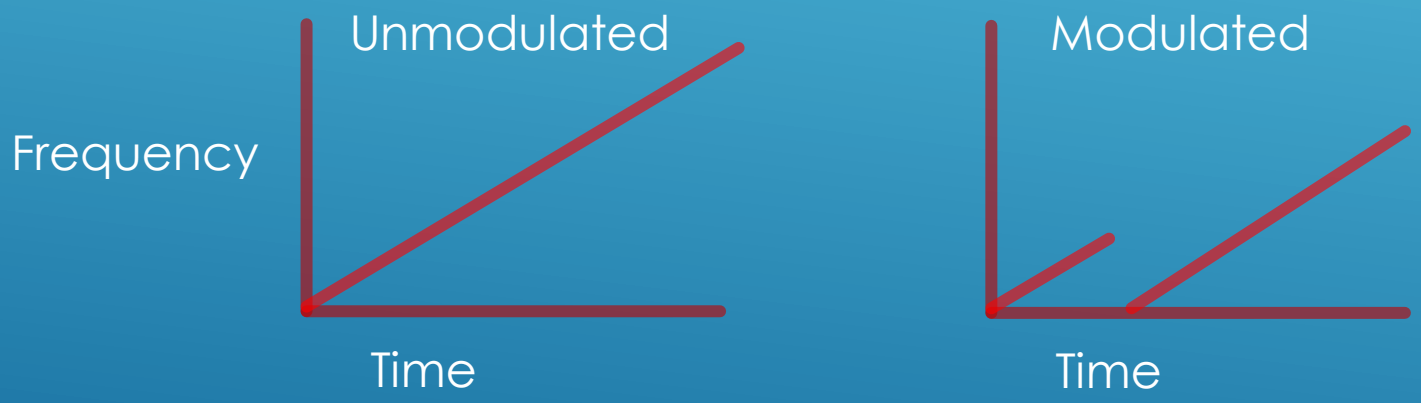
- Our lagoon research sites fall within 10-12 km of existing, network-equipped towers
- 10-16 km is the maximum range for LoRa under very good conditions, so it might be able to let us put sensors in the lagoons

POTENTIAL IOT SOLUTION

LORA – "LONG RANGE"

- LoRa Radio Technology
  - Digital
  - "Long Range" – means 16 km or less – often much less (100m to 3 km) in cities
  - Very low signal power

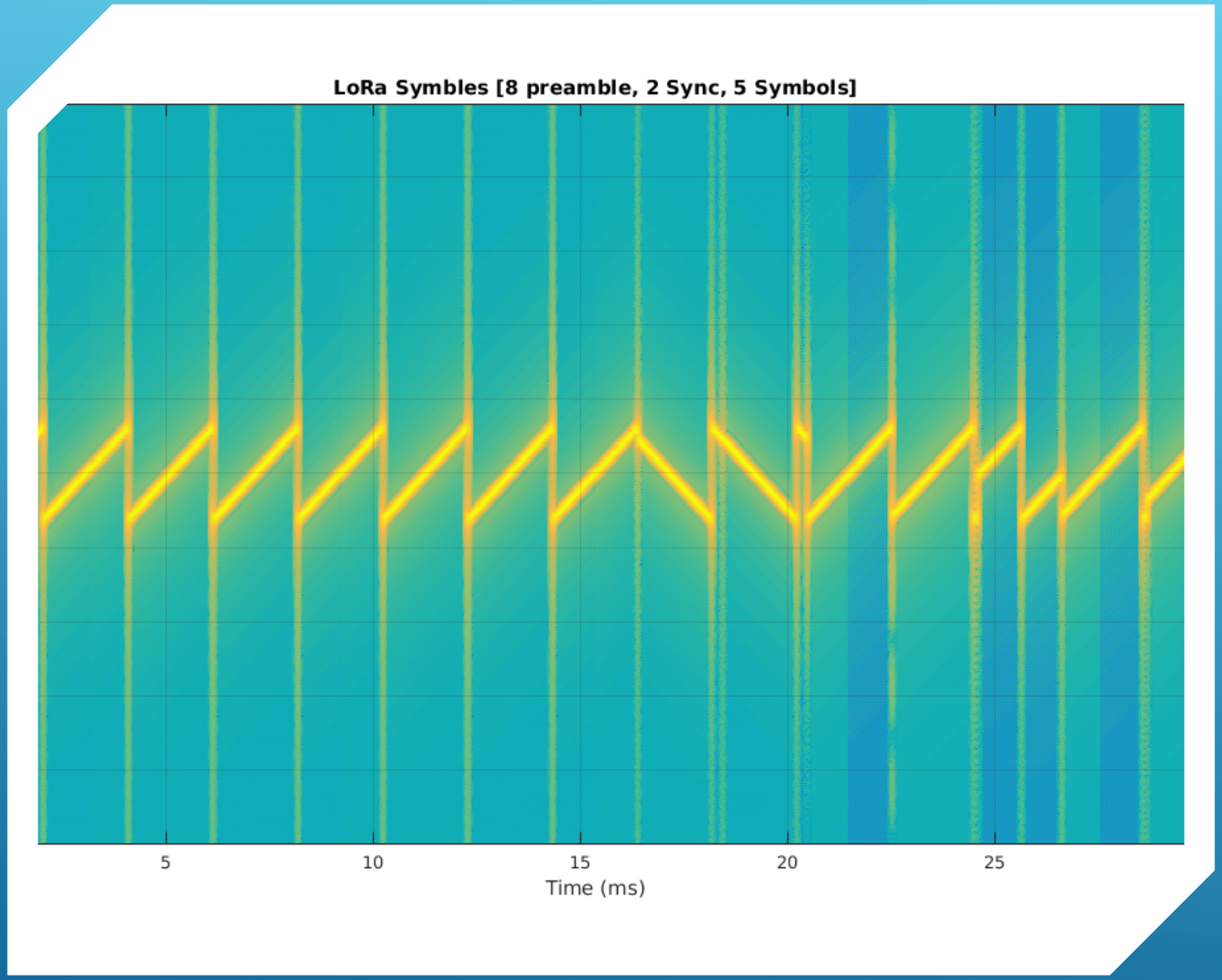




- Spread Spectrum "Chirp" –based
  - Low Speed (max "modem" not broadband Internet speeds)
  - Very low power - < 25mW
  - High Interference Rejection
  - Resistant to multi-path fading
  - Unaffected by speed (Doppler-effect resistant)
  - In US, around 915MHz (902-928 MHz) under FCC Part 15
    - Canada ~ 783 MHz,
    - Europe ~865 MHz, and
    - Asia - ~433 MHz (UHF)
  - 64x125 KHz & 8x500 KHz channels

LORA RADIO CHARACTERISTICS

https://lora-developers.semtech.com/documentation/tech-papers-and-guides/lora-and-lorawan/



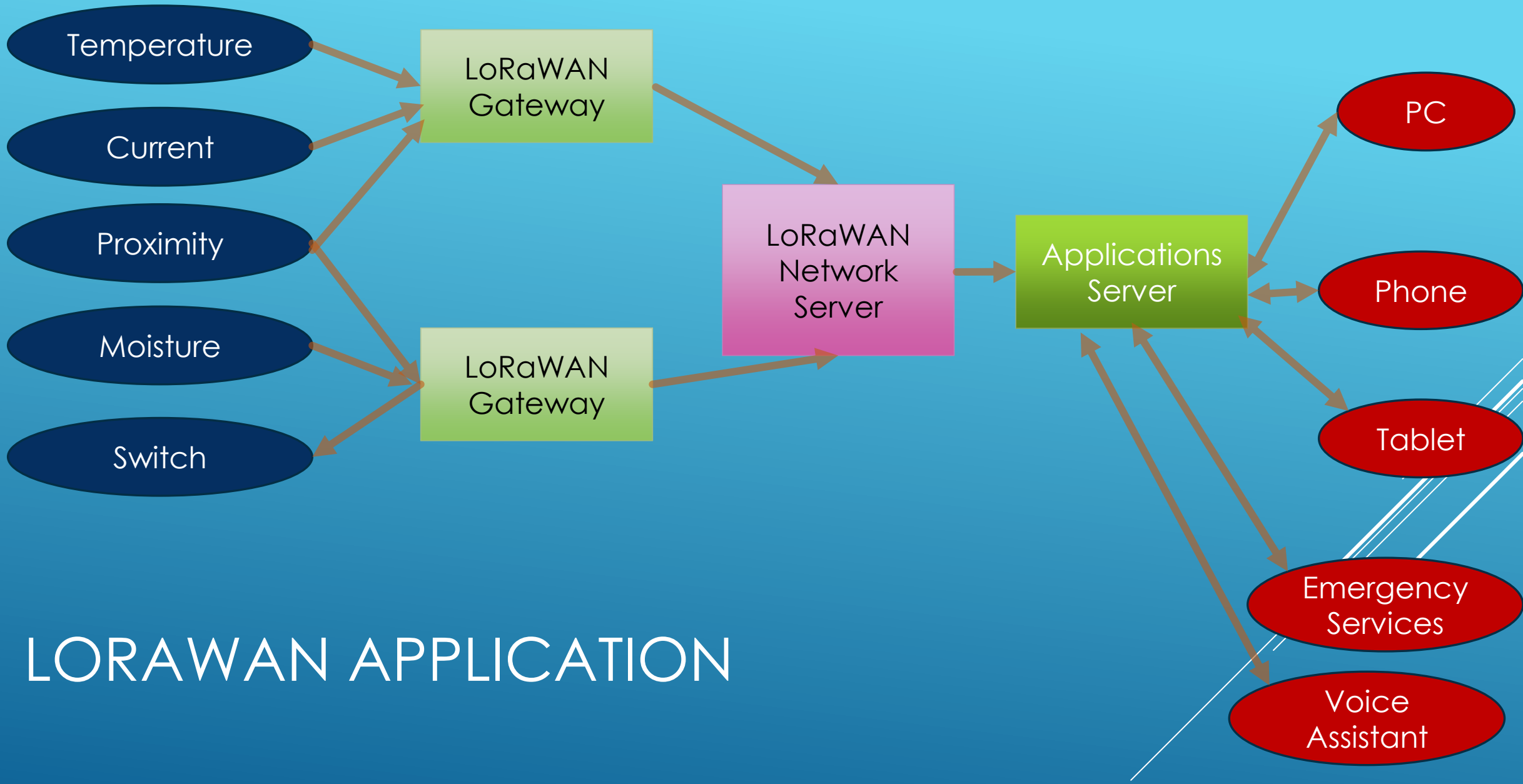
SAMPLE SIGNAL

- 8 up-chirp preamble
- 2 down-chirp synchronization
- 5 modulated symbols (payload)

http://www.sghoslya.com/p/lora-is-chirp-spread-spectrum.html

SENSORS

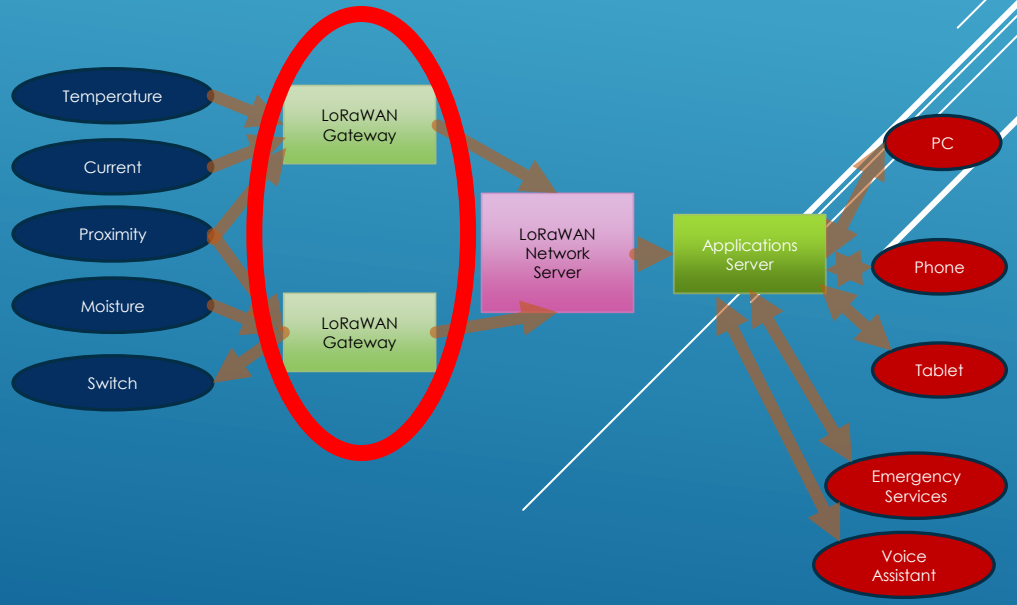
- LoRa sensors are characterized by:
  - Low Cost ($20-80 typical)
  - Low power requirements
  - Low data rates (no images or sound)
  - Easy to add to a LoRaWAN network (just need the device ID and the encryption key)



LORAWAN APPLICATION

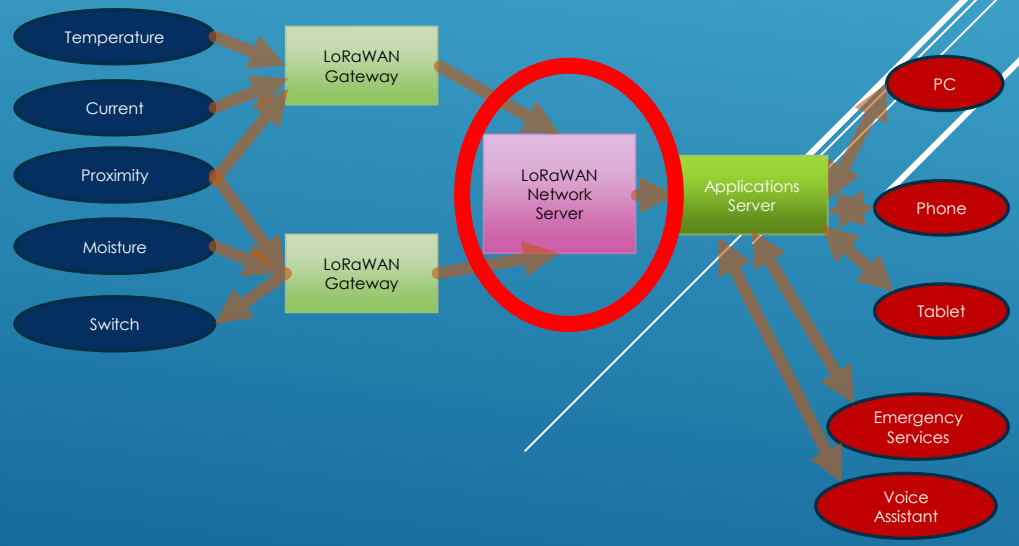
LORA GATEWAYS

But you may NOT need your own Gateway if you live near existing gateways



NETWORK SERVERS

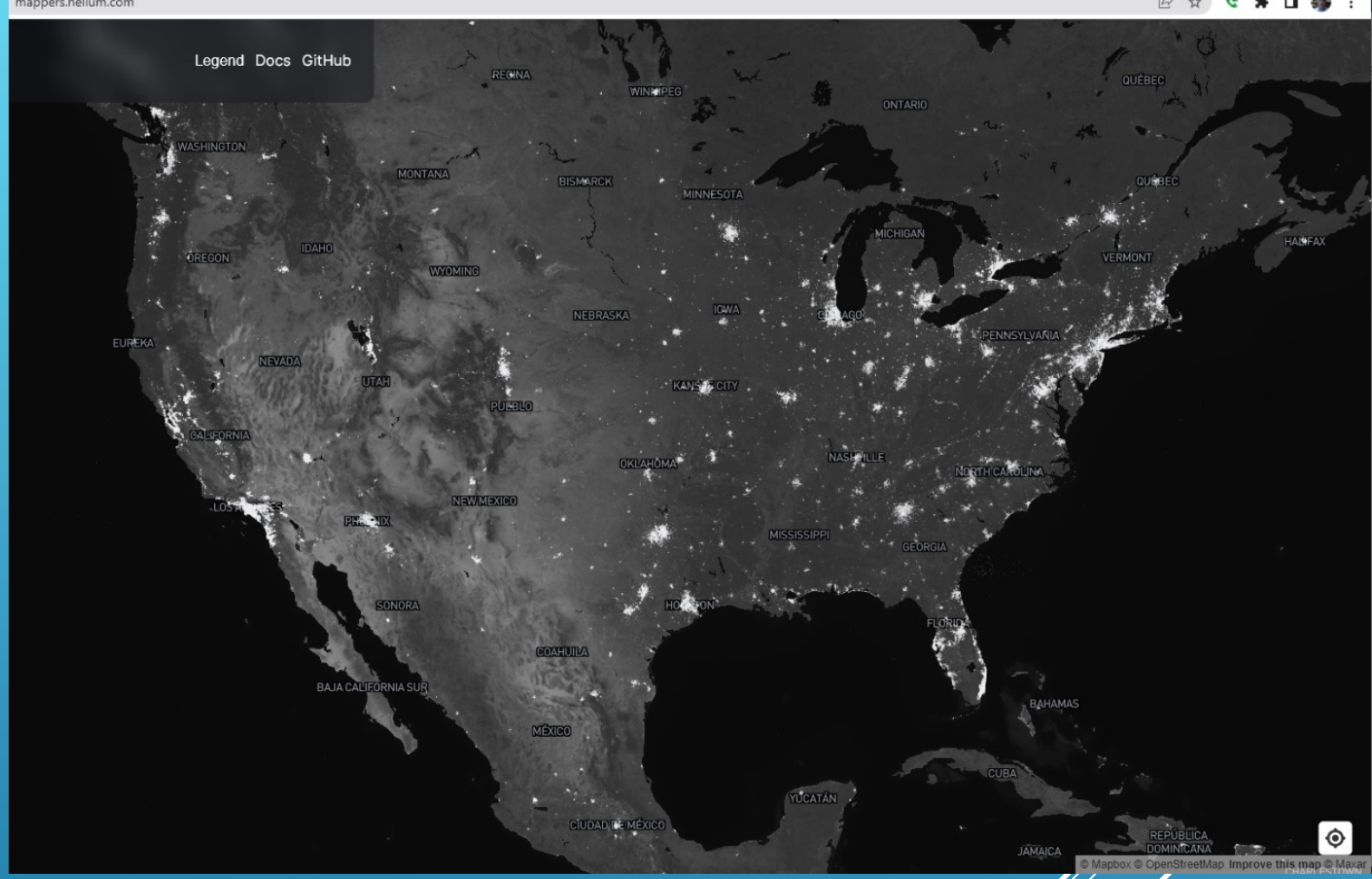
- AWS IoT Core for LoRaWAN
- ChirpStack
  - Runs locally
- Helium
  - “mines” cryptocurrency
- KPN
- LORIOT
- Objenious
- Senra
- Senet
- The Things Network
  - Developer-focused
- TTN Stack v3
- AllThingsTalk
- Tencent Cloud



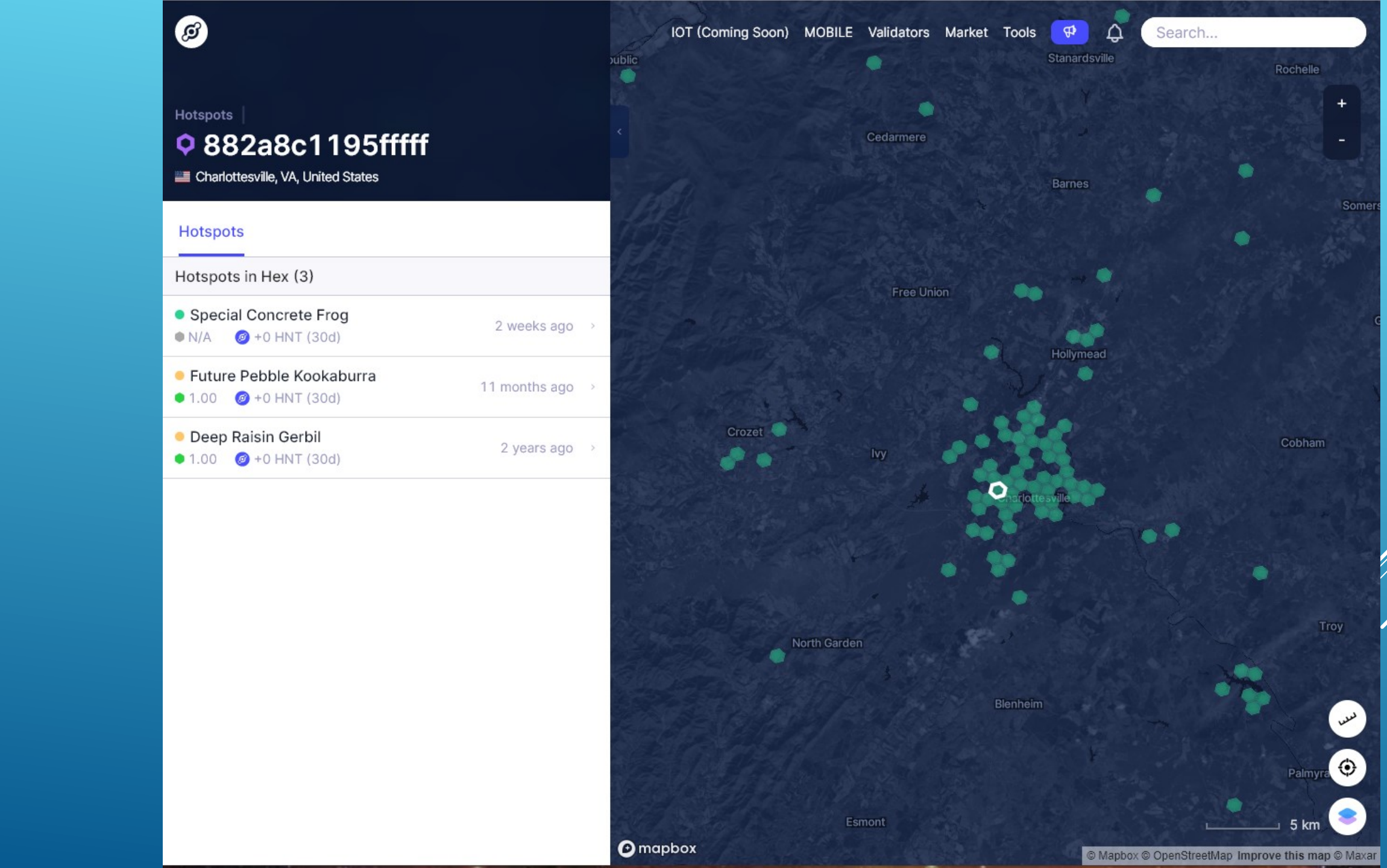
TTN GATEWAYS

- The Things Network (TTN)
  - Includes Open Source (FREE)
  - Optional fee-based services
  - ~20 K gateways

- 192K Gateways



"HELIUM" LORAWAN NETWORK MAP


IOT (Coming Soon)
MOBILE
Validators
Market
Tools
Search...
Hotspots
882a8c1195fffff
Charlottesville, VA, United States
Hotspots
Hotspots in Hex (3)
Special Concrete Frog
N/A
+0 HNT (30d)
2 weeks ago
Future Pebble Kookaburra
1.00
+0 HNT (30d)
11 months ago
Deep Raisin Gerbil
1.00
+0 HNT (30d)
2 years ago
Stanardsville
Rochelle
Cedarmere
Barnes
Free Union
Hollymead
Crozet
Ivy
Cobham
Charlottesville
North Garden
Troy
Blenheim
Palmyra
Esmont
5 km
mapbox
© Mapbox © OpenStreetMap Improve this map © Maxar

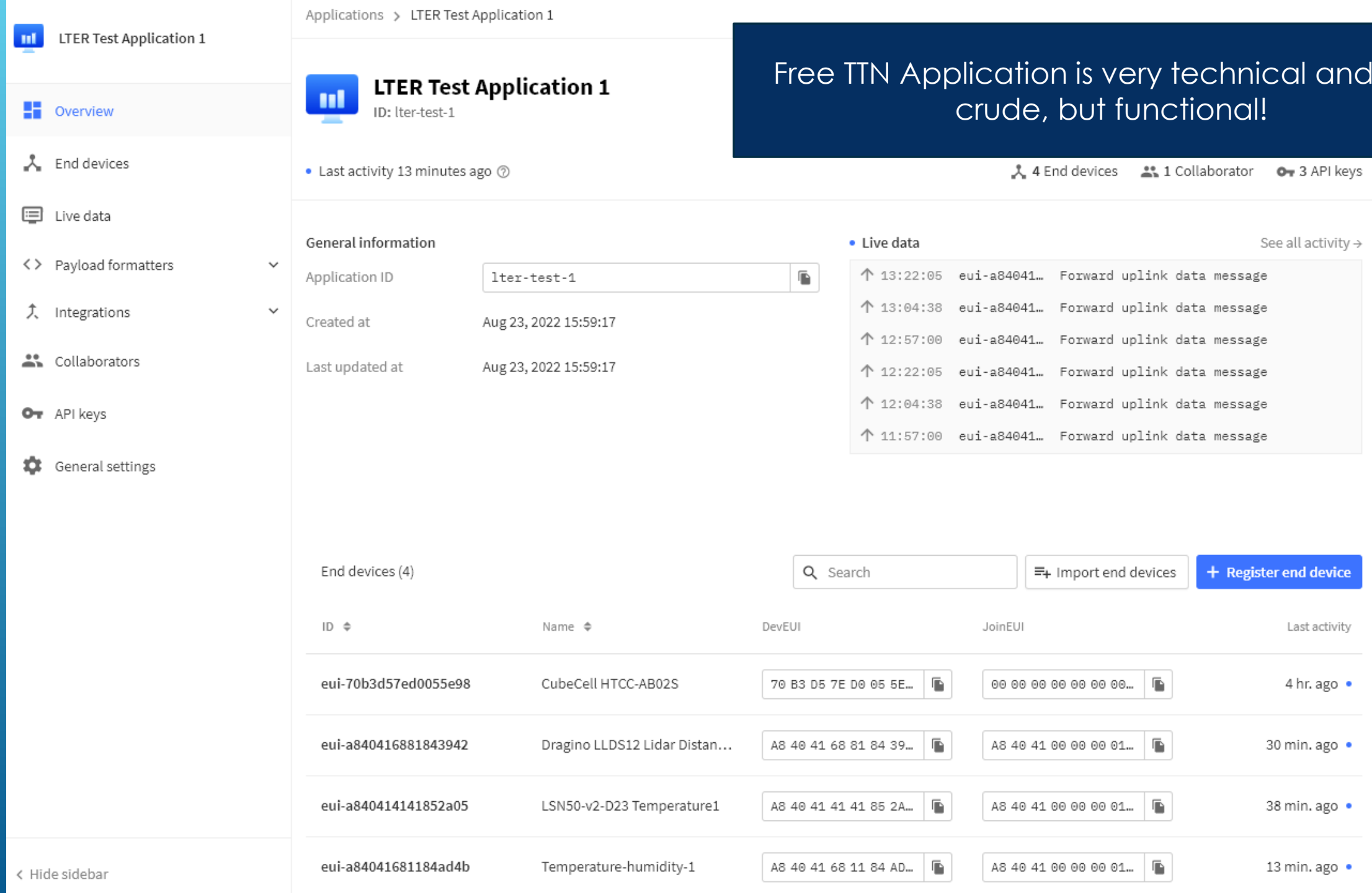
WHY SO MANY HELIUM ACCESS POINTS?

- LoRaWAN is not free - the ultimate receiver of the sent data (e.g., the organization that gets to USE the data) pays a small per-message cost (fraction of a penny) per message received by purchasing "Data Credits"
- Helium uses a block-chain-based cryptocurrency to pay the operators of gateways that transfer those messages a small fee per message
- Setting up a gateway on the Helium Network is used for "Helium Mining" - getting paid for purchasing and operating a gateway that passes data to Helium Network data users
  - Can be lucrative - if you are in the right spot!
  - Payment is in "Helium Units" (HNT) - a cryptocurrency

LORAWAN COSTS

- AWS IOT charges $2.30 for each 1 million LoRaWAN messages 5 kb or less in length (or 0.0023 cents per message)
- Helium - $0.00001 per 24-byte packet (= 1 "Data Credit")
- The Things Network Community Edition
  - $0 for free tier (only 24-hour data retention)
  - Limited devices, data volume

Free TTN Application is very technical and fairly crude, but functional!



Snippet from output


```
"received_at": "2022-11-08T20:22:05.765378443Z",
"uplink_message": {
  "session_key_id": "AYL5BSOfP15sAJPukTVa+A==",
  "f_port": 2,
  "f_cnt": 3640,
  "frm_payload": "y/EGeAIJAQYnf/8=",
  "decoded_payload": {
    "BatV": 3.057,
    "Hum_SHT": "52.1",
    "TempC_DS": "15.75",
    "TempC_SHT": "16.56"
  },
  "rx_metadata": [
    {
      "gateway_ids": {
        "gateway_id": "lter-a84041ffff21f4d4",
        "eui": "A84041FFFF21F4D4"
      },
      "time": "2022-11-08T20:22:05.464406013Z",
      "timestamp": 1279257767,
      "rssi": -85,
      "channel_rssi": -85,
      "snr": 13.25,
      "uplink_token": "CiMKIQoVbHRlci1hODQwNDFmZmZmMjFmNGQ0EgioQEH//yH01BCn2f/hBBoMCO30qpsGEPzJvosCINjY0c2dlgU=",
      "received_at": "2022-11-08T20:22:05.522344665Z"
    }
  ],
  "settings": {
    "data_rate": {
      "lora": {
        "bandwidth": 125000,
        "spreading_factor": 7,
        "coding_rate": "4/5"
      }
    },
    "frequency": "904900000",
    "timestamp": 1279257767,
    "time": "2022-11-08T20:22:05.464406013Z"
  },
```


Decoded Data

Gateway Info

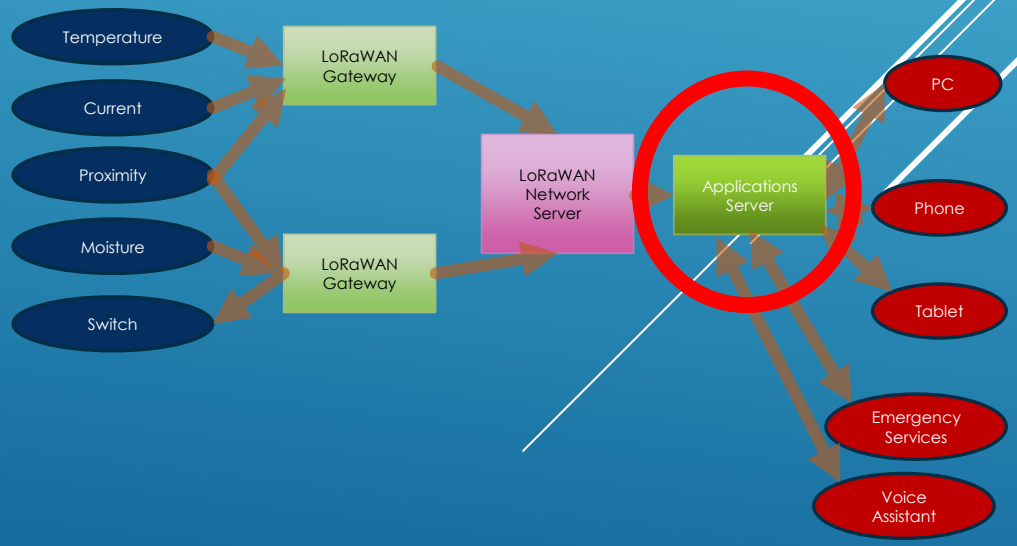
Signal Strength

LoRa parameters and frequency

The JSON-formatted message includes lots of "bookkeeping" as well as the data itself

APPLICATION SERVERS

- Data Cake
- Tago.IO
- Mapwize
- MyDevices/Cayenne
- Node-Red
- Losant
- OpenRemote



SAMPLE CAYENNE INTEGRATION USING TTN DATA

LORA AND HAM RADIO

NO's

- By default, devices AUTOMATICALLY encrypt data - so you can't use them on Ham Radio frequencies
  - Many devices may not allow you to not encrypt
- LoRaWAN, to work well, needs to be open to non-hams
- Commodity devices don't send ham call signs (only a device ID)

YES's

- Development devices (Arduino, Raspberry Pi) can be programmed
  - LoRaHam project (LoRa on 70 cm) https://github.com/travisgoodspeed/loraham
- Specialized Hardware: HamShield LoRa Edition - 1 W, 70cm band
- LoRaWAN for controlling radios or detecting problems in the shack
- LoRaWAN position reporting for APRS

GETTING STARTED

- Identify an application where small amounts of data would be useful to you, where providing sensor power has been an issue in the past
- Identify a pre-built sensor, or LoRa-equipped microprocessor capable of doing the job and purchase it
- Set up a free "starter" account on a network where you THINK you'd be able to reach an existing gateway
  - Or purchase and install your own gateway
- Add your device to your application/account on the network provider
- Configure a network application to work with the ingested data