

FedeLoRa

Une fédération de réseaux LoRa pour la recherche et l'enseignement

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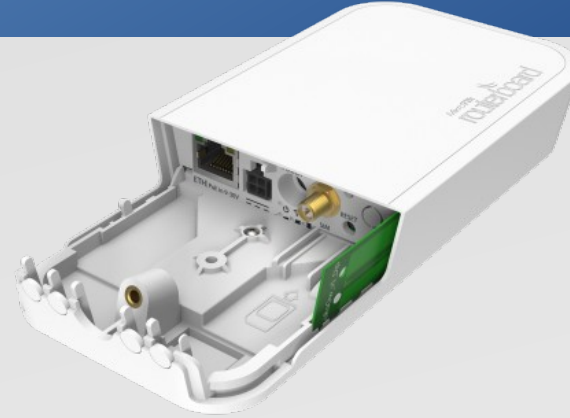
- 1) Éléments de contexte
- 2) Objectifs et proposition
- 3) Architecture
- 4) Résultats

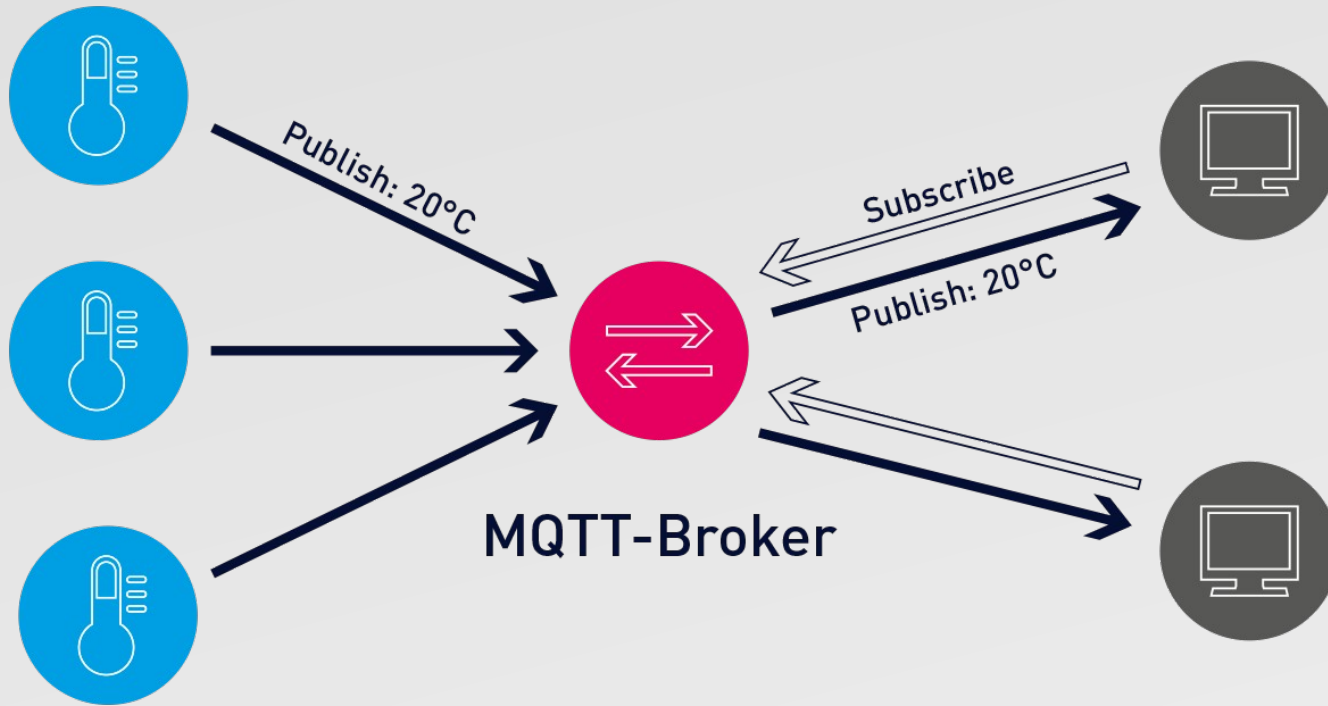
- Constats
 - Multiples réseaux LoRaWAN sur une même zone
 - Architecture identique
 - Partenaires « semblables »
 - parfois un réseau LPWAN privé par application !!
 - Le déploiement et la maintenance coûte cher
 - Ne pas être dépendant de LoRaWAN

- Proposition (perspective thèse Nicolas Gonzalez)
 - Profiter infra LoRaWAN MQTT
 - Fusionner les réseaux dans une fédération basée sur un bus MQTT commun
 - Avoir un accès « bas niveau »
 - LoRaWAN comme RawLoRa
 - Tester des protocoles MAC en rupture
 - Multiplier les serveurs de réseaux, simuler des roamings...
 - ...

- Enseignement et recherche
 - Académiques : universités, IUT, laboratoires et lycées
 - IUT de Blagnac, IRIT-UPS, LAAS
 - Lycée Déodat de Séverac, ISIS, N7, École des Mines d'Albi
 - Entreprises impliquées dans la R&D et la formation
 - OperaMetrix
 - Milieu associatif impliqué dans les télécoms
 - Tetaneutral.net

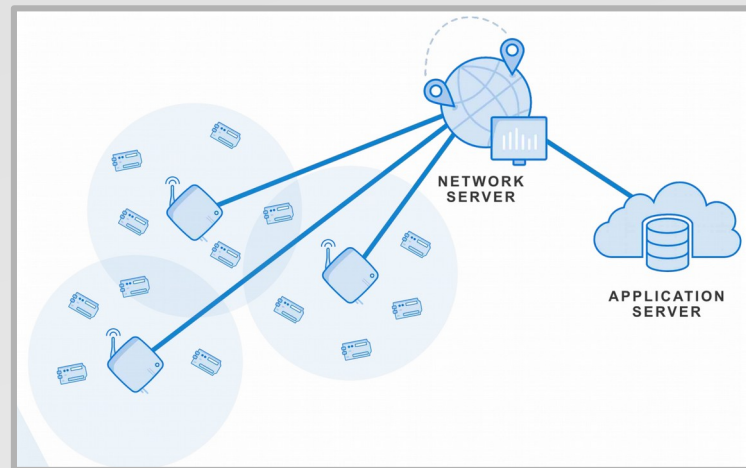
- Matériels
 - Gateways, antennes
- Infrastructure
 - Serveur de réseau, broker et proxy MQTT
- Logiciels
 - MQTT explorer, CartoLoRa





Chirpstack, MQTT et GuardMQ

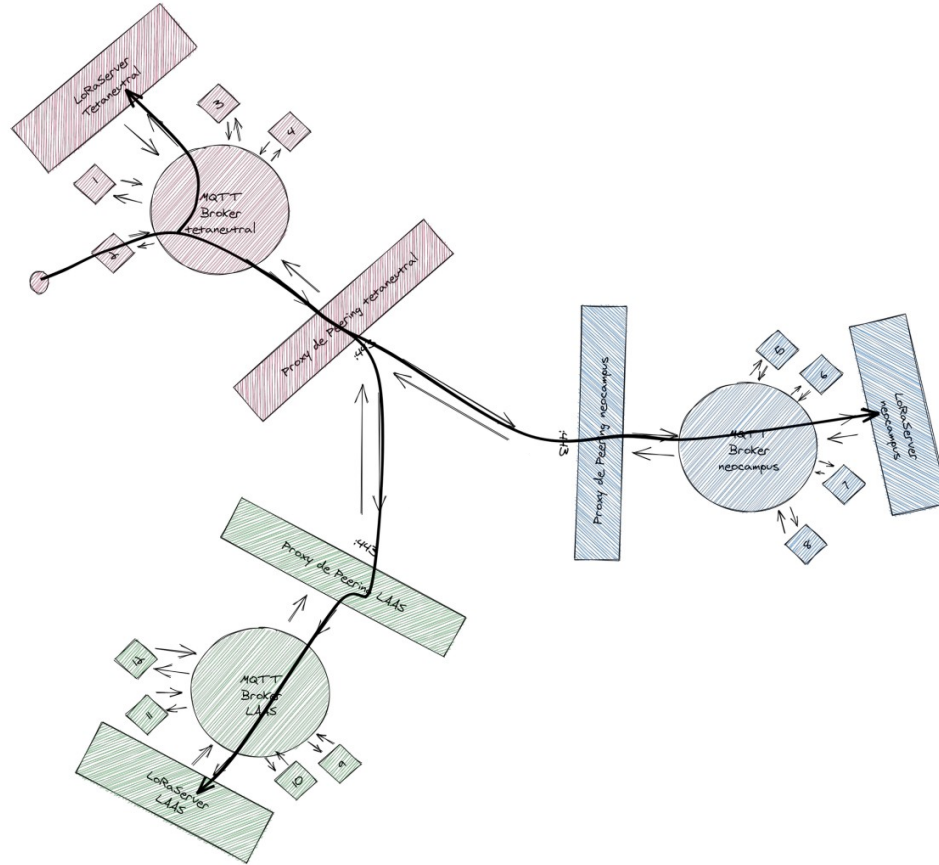
- Broker MQTT + Chirpstack + packet forwarder
 - Chaque gateway a son topic MQTT
 - event/up, event/stats, event/ack, command/down
- Proxy MQTT : GuardMQ
 - Bridge MQTT via TLS
 - Peering sécurisé par échange de certificats
 - Passage de pare-feux → :443
 - Importation et exportation de gateways, aka de topics MQTT
 - Possibilité d'insérer des middlewares



```
▼ gateway
  ► 647fdafffe007f8c (1 topic, 1 message)
    ▼ 31500000000000003
      ▼ event
        up = {"phyPayload": "QCkhqA6Ac"}
        stats = {"gatewayID": "MVAAAAA"}
        ack = {"gatewayID": "MVAAAAA"}
      ▼ command
        down = {"phyPayload": "4LFaI5c-
```

<https://github.com/operametrix/guardmq>

Infrastructure



Infrastructure (fin)

peers:

```
- hostname: "peering.loraserver.tetaneutral.net"
port: 443
tls: true
cafile: "/etc/guardmq/certs/peers/peering.lora.tetaneutral.net/ca.crt"
mtls: true
certfile: "/etc/guardmq/certs/peers/peering.lora.tetaneutral.net/iut-blagnac.crt"
keyfile: "/etc/guardmq/certs/peers/peering.lora.tetaneutral.net/iut-blagnac.key"
import:
```

```
- "gateway/3170000000000001/command/#"
- "gateway/3170000000000004/command/#"
- "gateway/3170000000000005/command/#"
- "gateway/3170000000000007/command/#"
- "gateway/3170000000000008/command/#"
- "gateway/3170000000000009/command/#"
- "gateway/3170000000000010/command/#"
- "gateway/8100000000000002/event/#"
- "gateway/3170000000000006/event/#"
- "gateway/8217000000000001/event/#"
- "gateway/3114000000000001/event/#"
```

export:

```
- "gateway/3170000000000001/event/#"
- "gateway/3170000000000004/event/#"
- "gateway/3170000000000005/event/#"
- "gateway/3170000000000007/event/#"
- "gateway/3170000000000008/event/#"
- "gateway/3170000000000009/event/#"
- "gateway/3170000000000010/event/#"
- "gateway/8100000000000002/command/#"
- "gateway/3170000000000006/command/#"
- "gateway/8217000000000001/command/#"
- "gateway/3114000000000001/command/#"
```

Je permets aux autres
NS d'émettre sur mes
GW

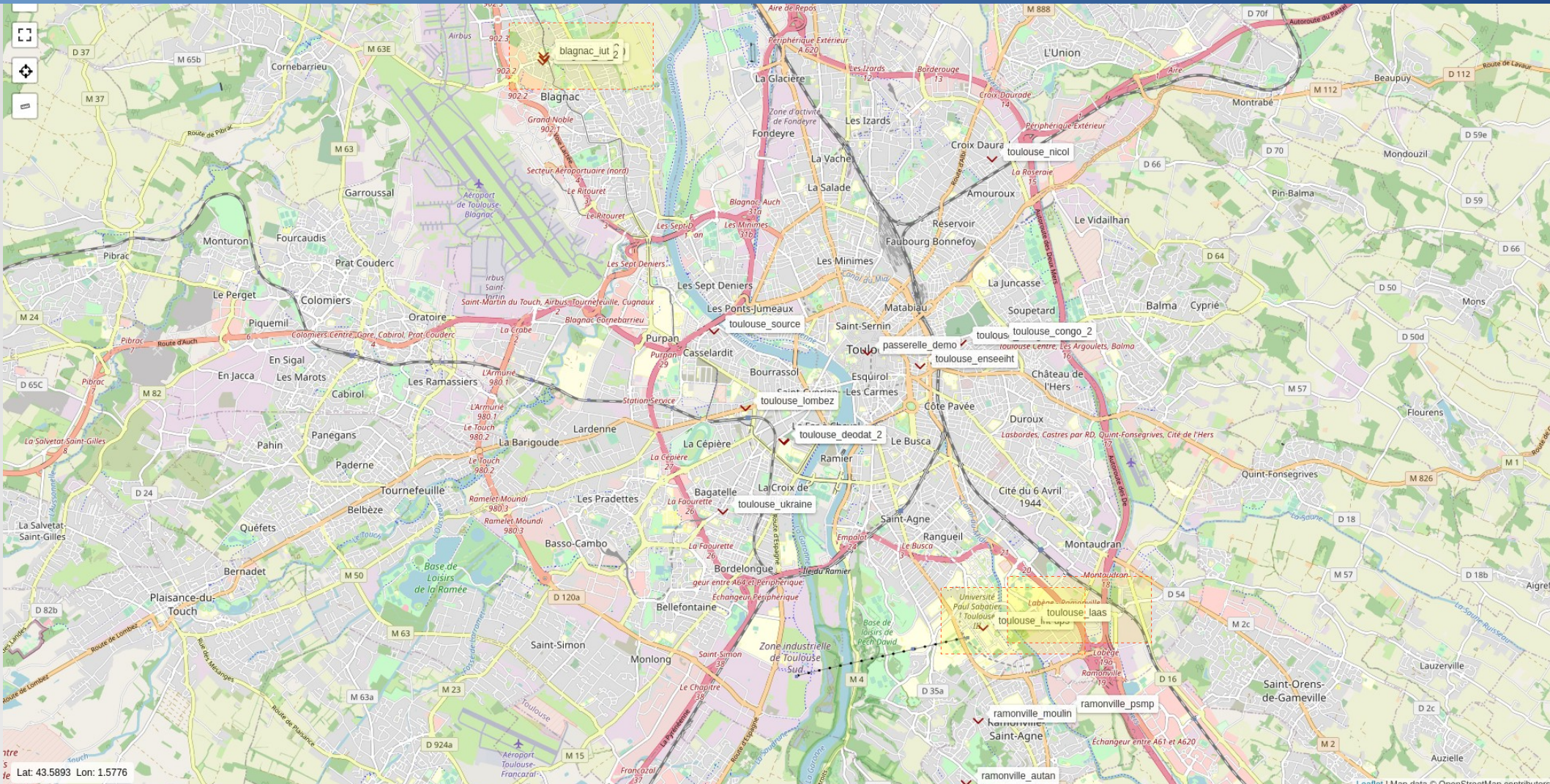
Je permets à mon NS de
recevoir via les GW des
autres

Je permets aux autres
NS de recevoir mes GW

Je permets à mon NS
d'envoyer sur les GW
des autres

- 4 peers déployés
 - Tetaneutral.net
 - IRIT-UT2J (site IUT de Blagnac)
 - LAAS
 - IRIT-UPS

Résultats



- Network-servers
- Gateway-profiles
- Organizations
- All users
- API keys

tetaneutral

- Org. settings
- Org. users
- Service-profiles
- Device-profiles
- Gateways
- Applications
- Multicast-groups

Gateways

LIST

MAP

Last seen	Name	Gateway ID	Gateway activity (30d)
a few seconds ago	albi_mines		
5 days ago	albi_mistral		
a few seconds ago	beauzelle_ecureuils		
7 months ago	blagnac_iut		
a few seconds ago	blagnac_iut_10		
a few seconds ago	blagnac_iut_12		
16 days ago	blagnac_iut_2		
16 days ago	blagnac_iut_3		
a few seconds ago	castelneadelevis_chateau		
8 months ago	dieupentale_drien		
19 days ago	dieupentale_jeandesbois		
16 days ago	goyrans_crete		

+ CREATE

gateway

- ▶ 647fdaffe007f8c (1 topic, 1 message)
- ▶ 3150000000000003 (2 topics, 162 messages)
- ▶ 3114000000000001 (2 topics, 140 messages)
- ▶ 3170000000000010 (2 topics, 100 messages)
- ▶ 77aaaa5500000002 (3 topics, 7 messages)
- ▶ 3152000000000001 (2 topics, 34 messages)
- ▶ 8100000000000003 (2 topics, 14 messages)
- ▶ 3130000000000333 (2 topics, 29 messages)
- ▶ 3120000000000001 (3 topics, 7 messages)
- ▶ 3110000000000001 (2 topics, 12 messages)
- ▶ 8211000000000001 (2 topics, 84 messages)
- ▶ 3152000000000003 (2 topics, 19 messages)
- ▶ 3170000000000012 (2 topics, 8 messages)
- ▶ 3150000000000001 (2 topics, 15 messages)
- ▶ 8115000000000001 (2 topics, 43 messages)
- ▶ 3152000000000002 (3 topics, 65 messages)
- ▶ 77aaaa5500000001 (1 topic, 22 messages)
- ▶ 3170000000000006 (3 topics, 24 messages)
- ▶ 3130000000000002 (3 topics, 28 messages)
- ▶ 8170000000000001 (2 topics, 11 messages)

b827ebfffe589404

event

```
up = {"phyPayload":"QLKjDwEAQAYCwk2ks/FX/ojQMkC/FA9Ij4ablH04vPP4wi+IN+p7UR2pZkc51dg/DuW04GhU7b8iQK7",
stats = {"gatewayID":"uCfr//5YIAQ=", "ip":"140.93", "time":"2021-07-08T09:46:46Z", "location":null, "configVersion":"","n
ack = {"gatewayID":"uCfr//5YIAQ=", "token":"56624", "error":"","downlinkID":"3TCHPD6RQmOD1sV/FuB3cA==", "items":[{"statu
```

command

```
down = {"phyPayload":"4CBg+Rk=", "txInfo":{"gatewayID":"uCfr//5YIAQ=", "frequency":"868100000", "power":"14", "modulation":"L
```

▶ 8110000000000001 (1 topic, 3 messages)

▶ application (1 topic, 1 message)



Lat: 43.5918 Lon: 1.3922

Conclusion & perspectives

- Conclusion
 - PoC validée
 - Déplacement d'un objet validé → augmentation de la couverture
 - Observation de la stabilité sur la durée
- Perspectives
 - Étude de la scalabilité → en nombre de messages
 - Problème de la boucle
 - Officialisation dans nos tutelles (convention ?)
... puis ouverture ?