



BUILDING A GLOBAL INTERNET OF THINGS NETWORK TOGETHER

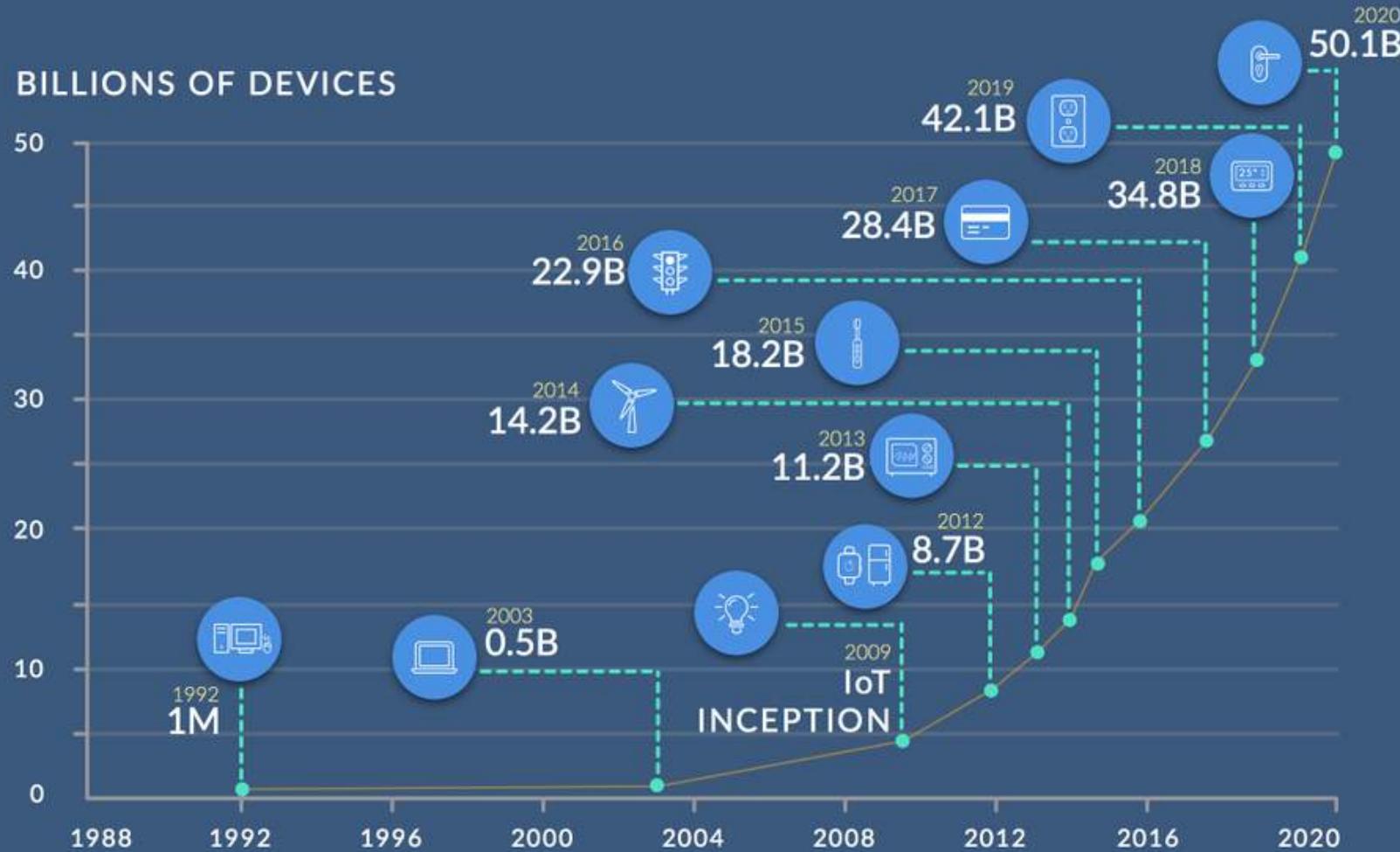
Laurens Slats

THE INTERNET OF THINGS



GROWTH IN THE INTERNET OF THINGS

THE NUMBER OF CONNECTED DEVICES WILL EXCEED **50 BILLION** BY 2020



THE THINGS
NETWORK



KEVIN ASHTON
1999



[News in Audio](#)[News in Video](#)[Newyddion](#) [Новости](#)[Noticias](#)[جیار](#) [国际新闻](#) [粵語廣播](#)

SMART FRIDGE 2000

Screenfridge, as it is called, allows you to send and receive e-mail, watch television, pay bills and handle personal banking. You can also keep food in it.

Wednesday, February 10, 1999 Published at 15:30 GMT

Sci/Tech

Making your kitchen cool



What can I have for supper?



[The computer is moving off the desktop into every home appliance](#)

This has got to be the coolest gadget yet for the kitchen: a fridge freezer that is hooked up to the Internet.

Screenfridge, as it is called, allows you to send and receive e-mail, watch television, pay bills and handle personal banking. You can also keep food in it.

[Sci/Tech Contents](#)

Relevant Stories

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[24 Nov 98 | Sci/Tech 'E-commerce set to explode'](#)

[08 Sep 98 | Sci/Tech The future is Internet shopping, says BT](#)

Internet Links

[ICL](#)[Electrolux](#)

The BBC is the content sites.

SMART FRIDGE 2000

Screenfridge, as it is called, allows you to send and receive e-mail, watch television, pay bills and handle personal banking. You can also keep food in it.

Fuck Yeah Internet Fridge

Why doesn't my fridge have the internet yet?
Curated by @rooreynolds

Archive

Submit your Internet Fridge

Search

September 2nd, 2016 at 4:37PM



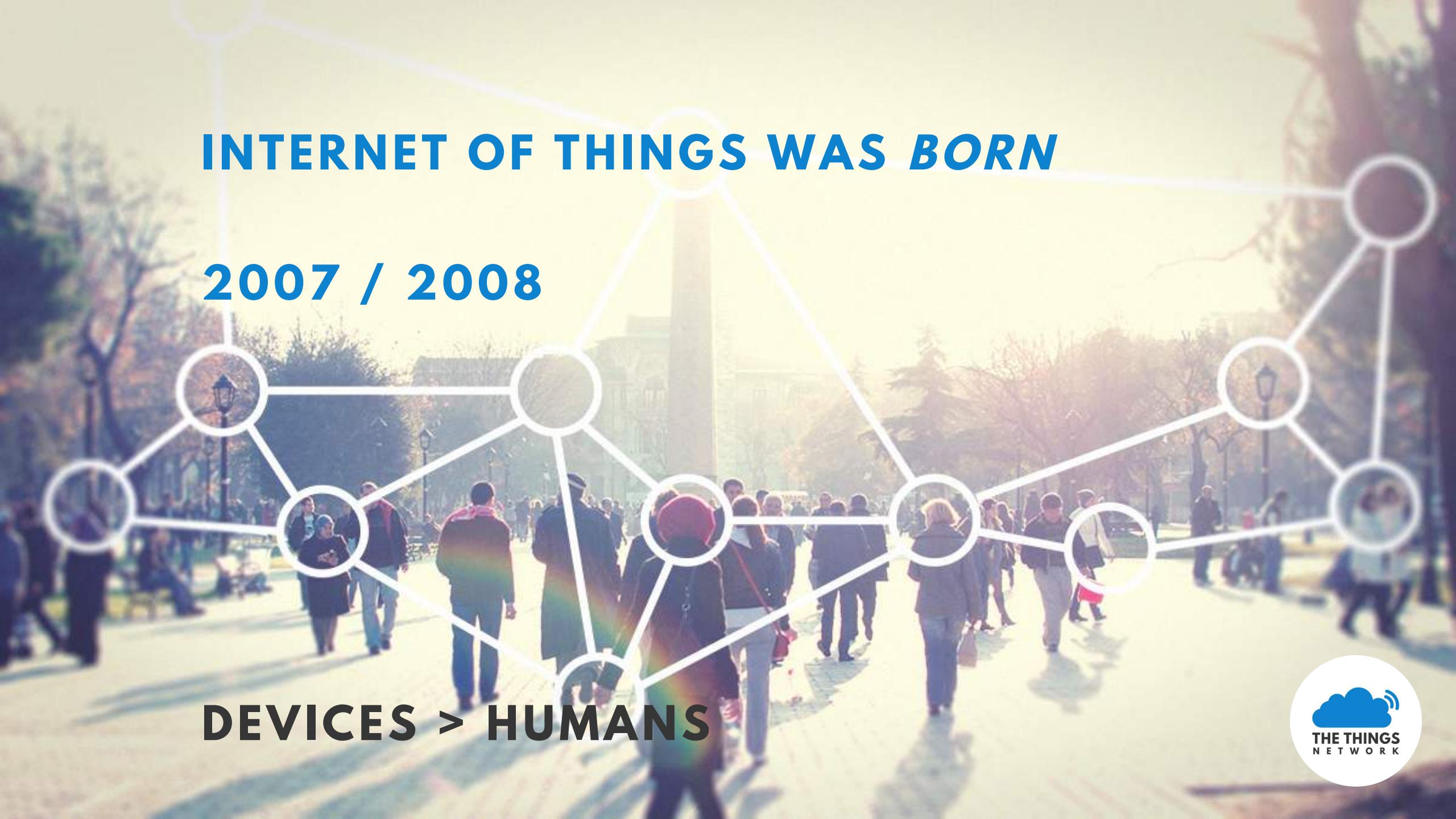
Thanks, [@hardillb](#)

2 notes

Source: [theverge.com](#)

August 25th, 2016 at 8:23PM





INTERNET OF THINGS WAS BORN

2007 / 2008

DEVICES > HUMANS



IPV6

2011

340 UNDECILLION

340,282,366,920,938,

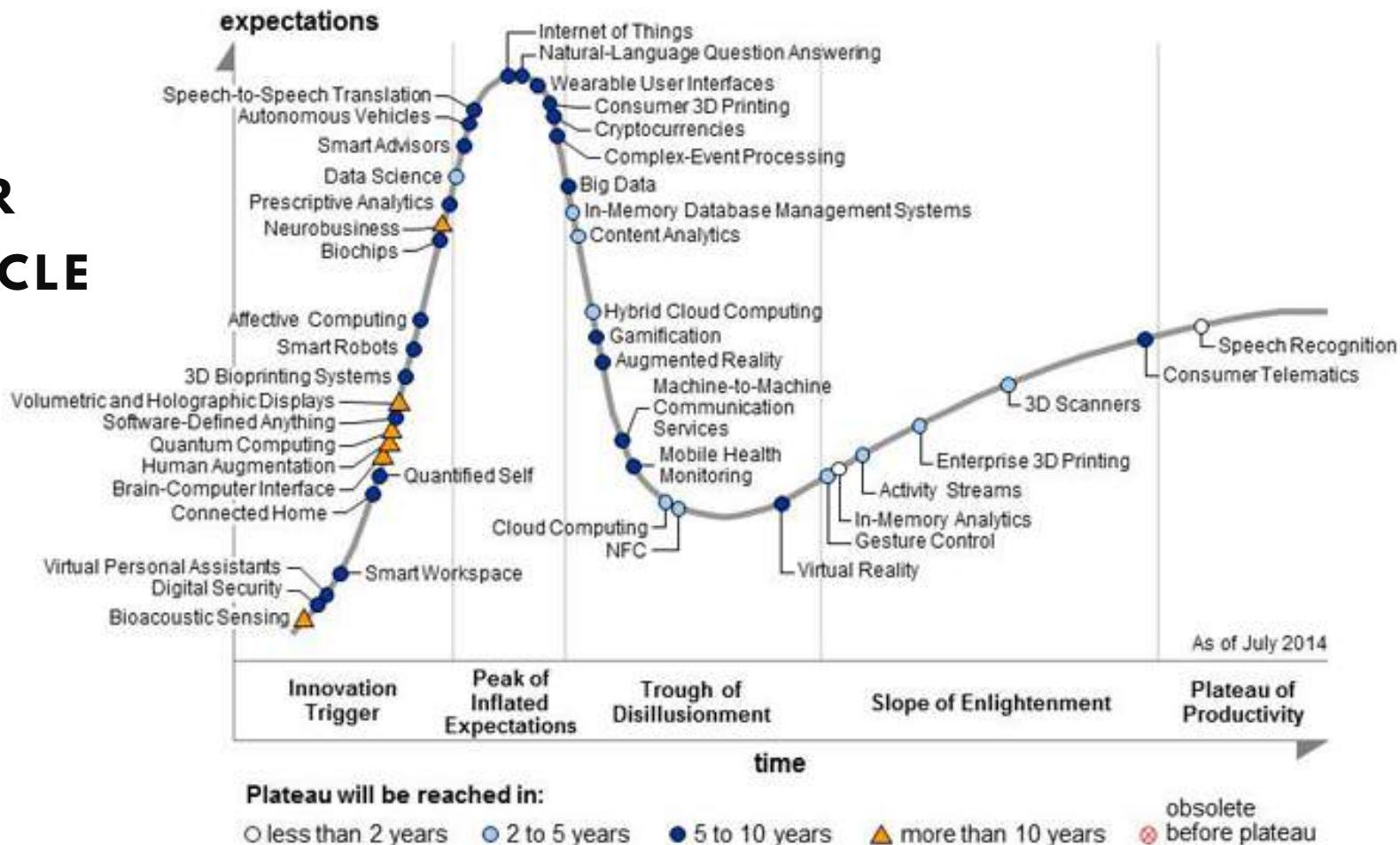
463,463,374,607,431,

768,211,456

PEAK OF INFLATED EXPECTATIONS

2014

GARTNER HYPE CYCLE





WIRELESS COMMUNICATION



Suitable for Spotify, Netflix,
large file exchange

Suitable for battery powered,
connected sensors

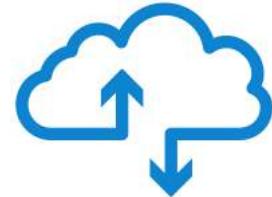
WIRELESS TECHNOLOGIES



Yes No



Yes No



Yes No

WIRELESS TECHNOLOGIES



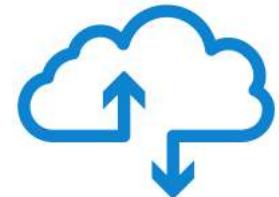
Yes No

Up to 10km



Yes No

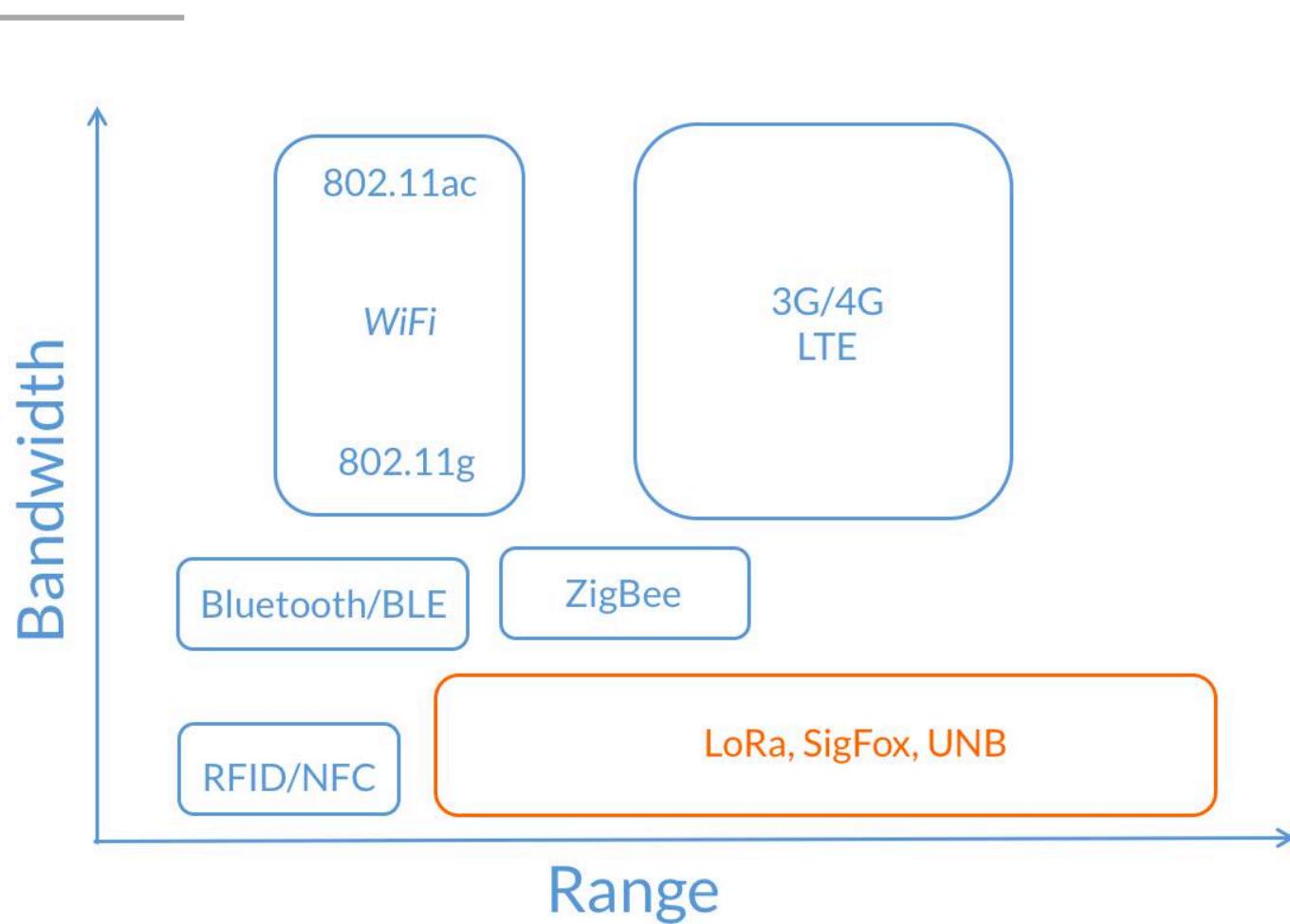
Years on a
battery



Yes No

Max 50kb/s

BANDWIDTH vs. RANGE



3 variables, you can only pick 2

- Long Distance
- High Speed
- Low Power

HELIUM BALLOON

Helium balloon flew from **Utrecht (NL)** to
Düsseldorf (DE)

Went up to **22.6 km**, reaching the TTN
Hamburg gateway: **333 km** away with **SF7**

By @telkamp (mapping @jpmeijers)



HOW IT ALL STARTED

July 2015, Amsterdam

AMSTERDAM



**Our mission is to build a
DECENTRALIZED,**

OPEN and CROWDSOURCED

INTERNET OF THINGS data network

OWNED and OPERATED by its USERS





HOOSJE BOOTJE



••••• vodafone

28%

23:41

donderdag 20 augustus



TTN nu

Uw boot staat onder water!

schuif om te antwoorden



HOOSJE BOOTJE



BUILDING A GLOBAL NETWORK



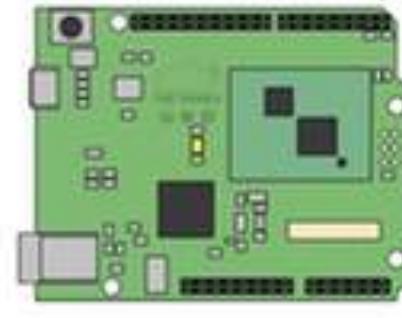


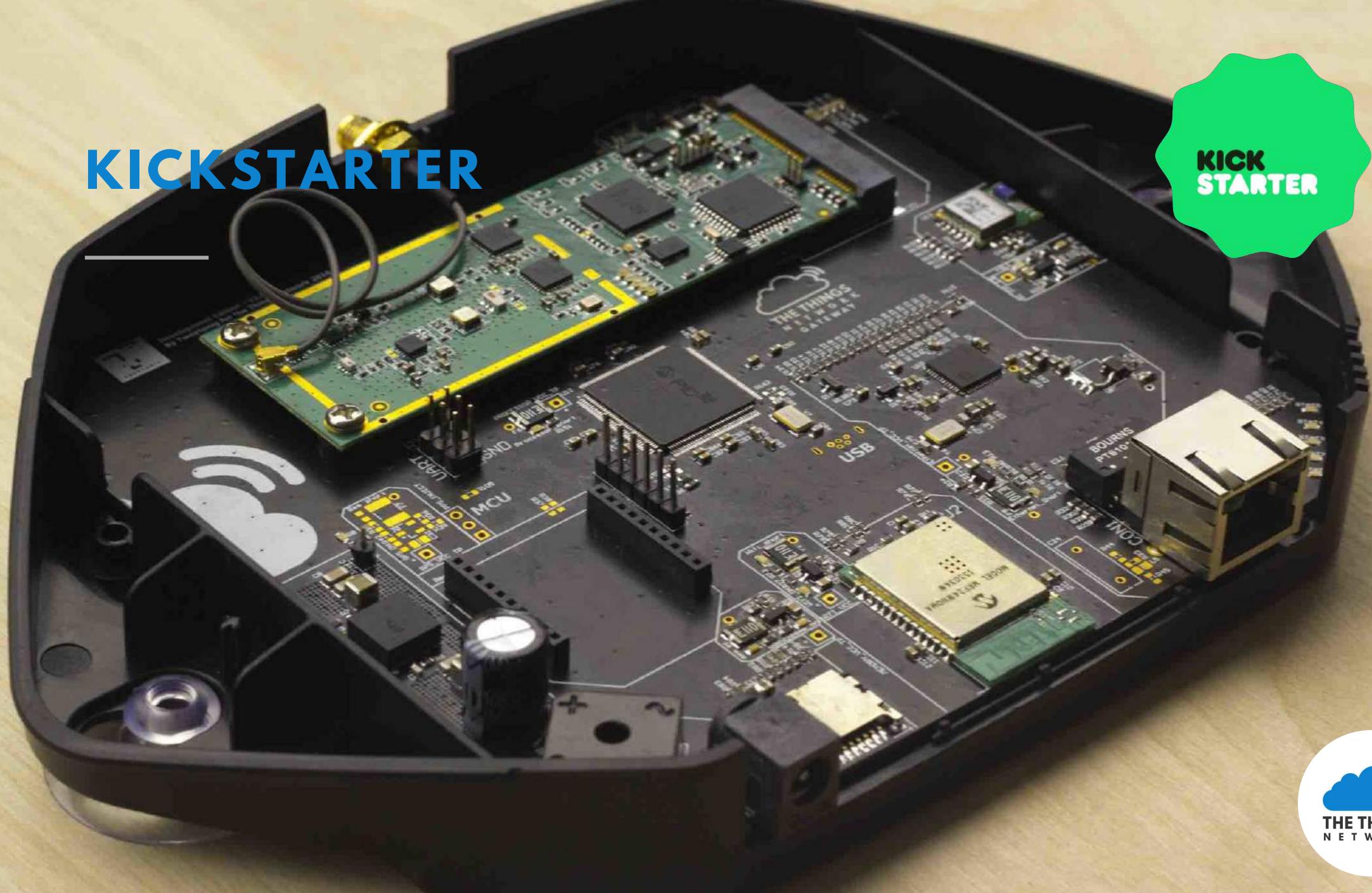
A screenshot of the 'The Things Network Brasil' Facebook page. The cover photo shows a night view of a bridge over water with illuminated buildings. The page header includes the 'THE THINGS NETWORK' logo and the text 'The Things Network Brasil Non-profitorganisatie'. There are sections for 'Tijdslijn', 'Info', 'Foto's', 'Vind-ik-leuks', and 'Meer'. A post from 'The Things Network Brasil' is visible, dated 7 oktober om 2:29, with a video thumbnail and the caption 'Video explicativo da The Things Network'.

A screenshot of a Meetup group page titled 'Internet das Coisas na Prática, Disrupting the Physical World'. The header features the 'THE THINGS NETWORK' logo. The main content discusses the digital revolution and the Internet of Things. It includes a post by 'São Paulo, Brazil' from 'Founded Nov 1, 2012' with statistics like 1,659 members and 12 upcoming meetups. The text emphasizes the mission to spread IoT knowledge across various fields such as Education, Health, Sustainability, Logistics, Agriculture, Manufacturing, and Intelligent Cities.

A screenshot of the 'The Things Network Buenos Aires' Facebook page. The cover photo shows a night view of a city skyline. The page header includes the 'THE THINGS NETWORK' logo and the text 'The Things Network Buenos Aires Openbare groep'. The page appears to be inactive with no recent posts.

KICKSTARTER





BUILDING A GLOBAL NETWORK

With help of communities

350+ COMMUNITIES 80+ COUNTRIES

(February 2017)



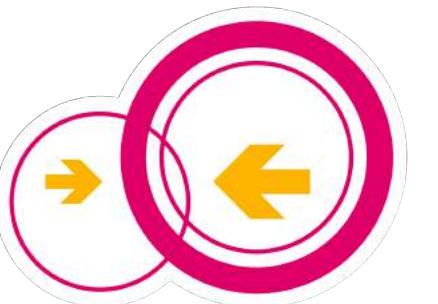
THE THINGS
NETWORK

TOGETHER CONNECTING 1100+ GATEWAYS

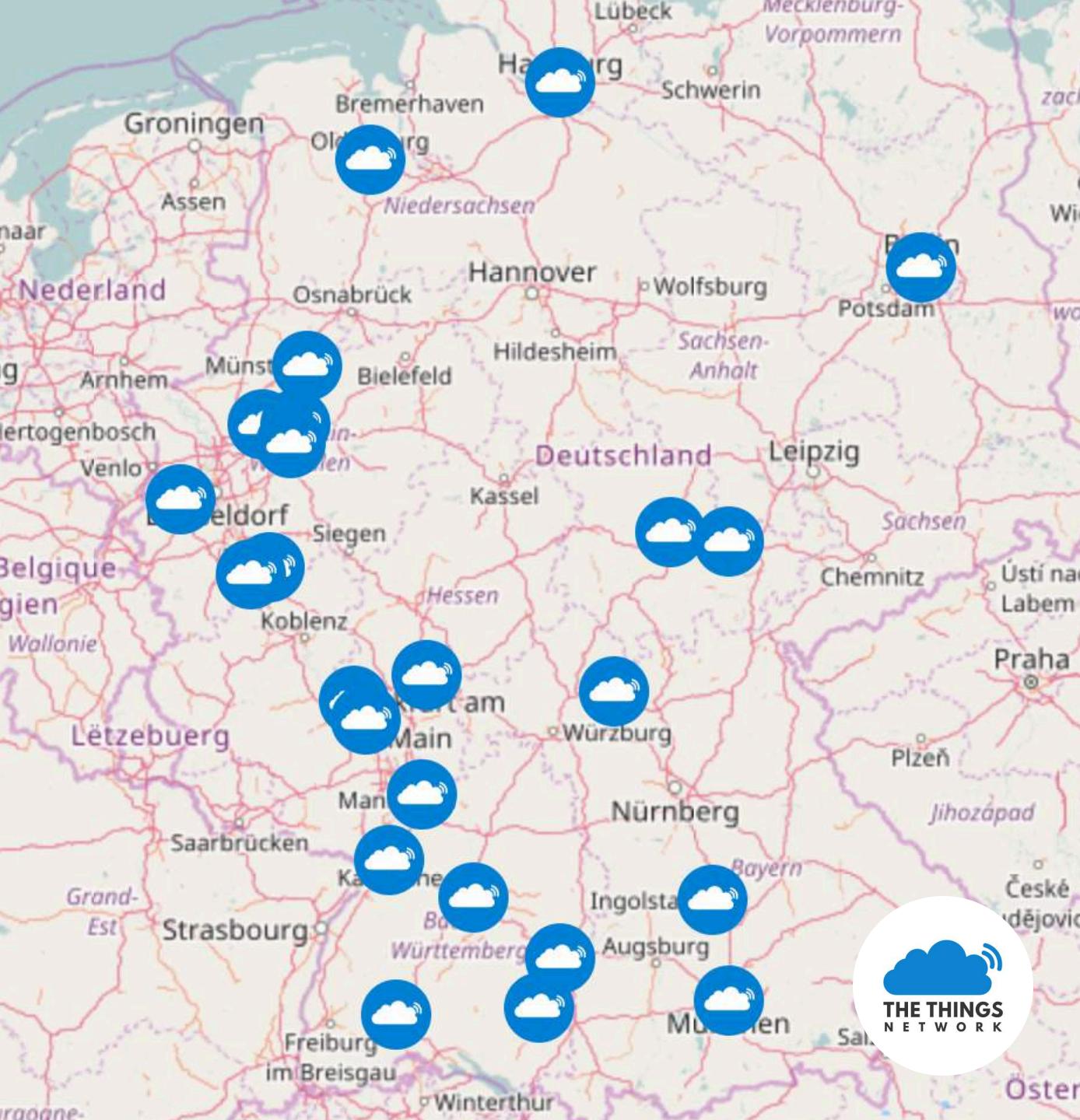
(February 2017)



GERMANY



freifunk.net



USE CASES

So, what can you do with it?

SMART MOUSE TRAP

www.xignal.com



AELORA

[www.aelora.nl](http://wwwaelora.nl)





BORA – CHILDREN AIR QUALITY KIT

www.waag.org



FLOOD.NETWORK

www.flood.network/



FLOOD.NETWORK

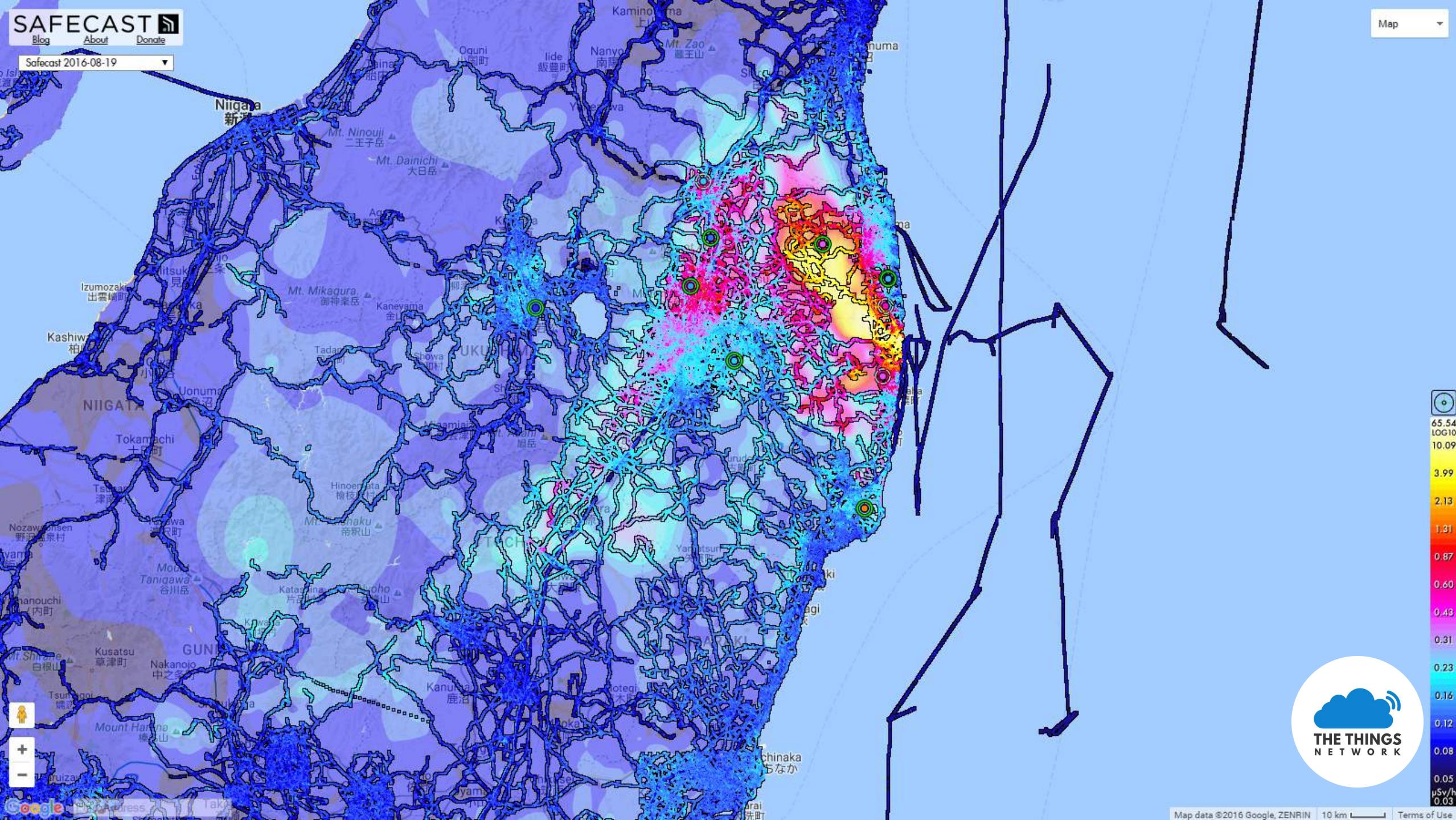




SAFECAST

www.blog.safecast.org/



Safecast 2016-08-19 

WE'RE BUILDING THIS THING TOGETHER!

Join us!



CONNECT
GATEWAYS



CONTRIBUTE
OSS



BUILD YOUR
COMMUNITY



SHARE!

SECURITY

SECURITY

LoRaWAN supports end-to-end encryption from device to application

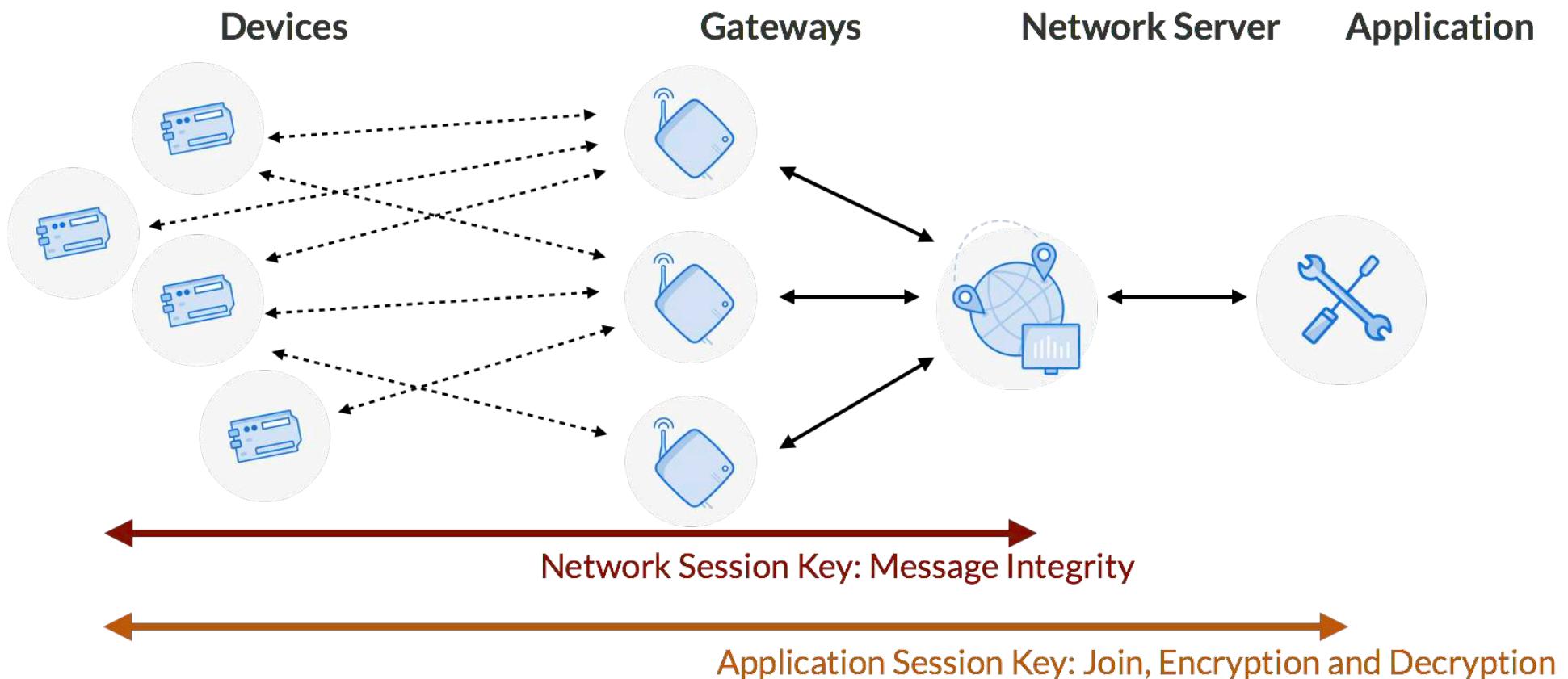
Two layers of security:

- **Network (NwkSKey)**: device authentication
 - Identification
- **Application (AppSKey)**: payload encryption
 - Network operator does not have access to application data

AES 128 (128 bit key length)

Sensitive data can optionally be encrypted on top of this with a stronger algorithm.

LORAWAN SESSIONS



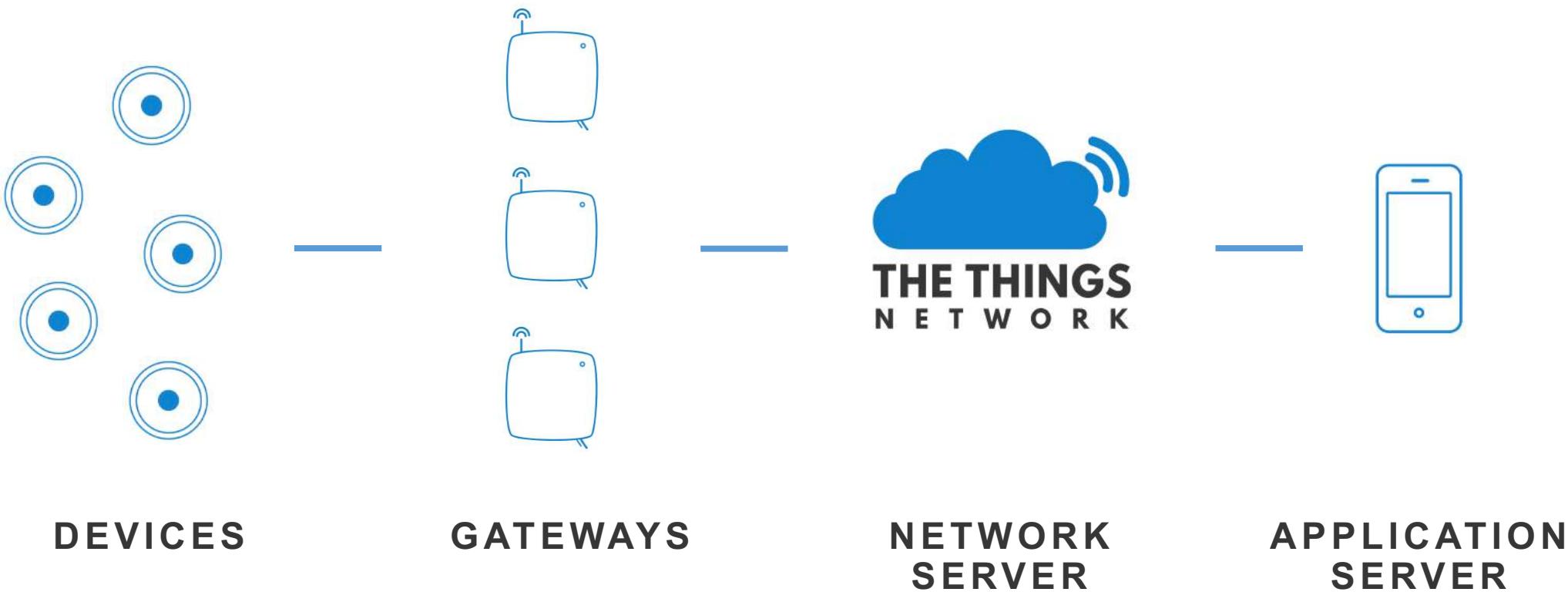
SECURITY

LoRaWAN Security Webinar
by Johan Stokking

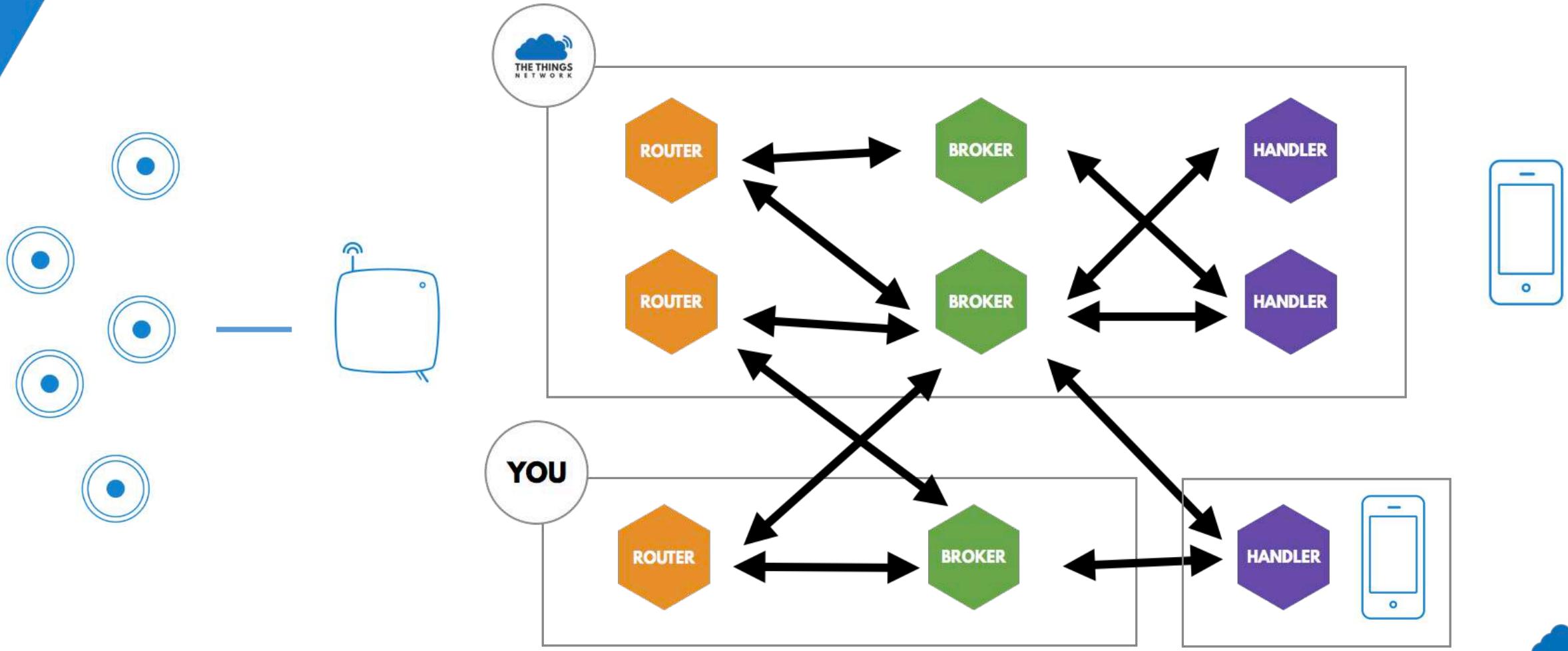
https://www.youtube.com/watch?v=Nu_yZeIDMzI

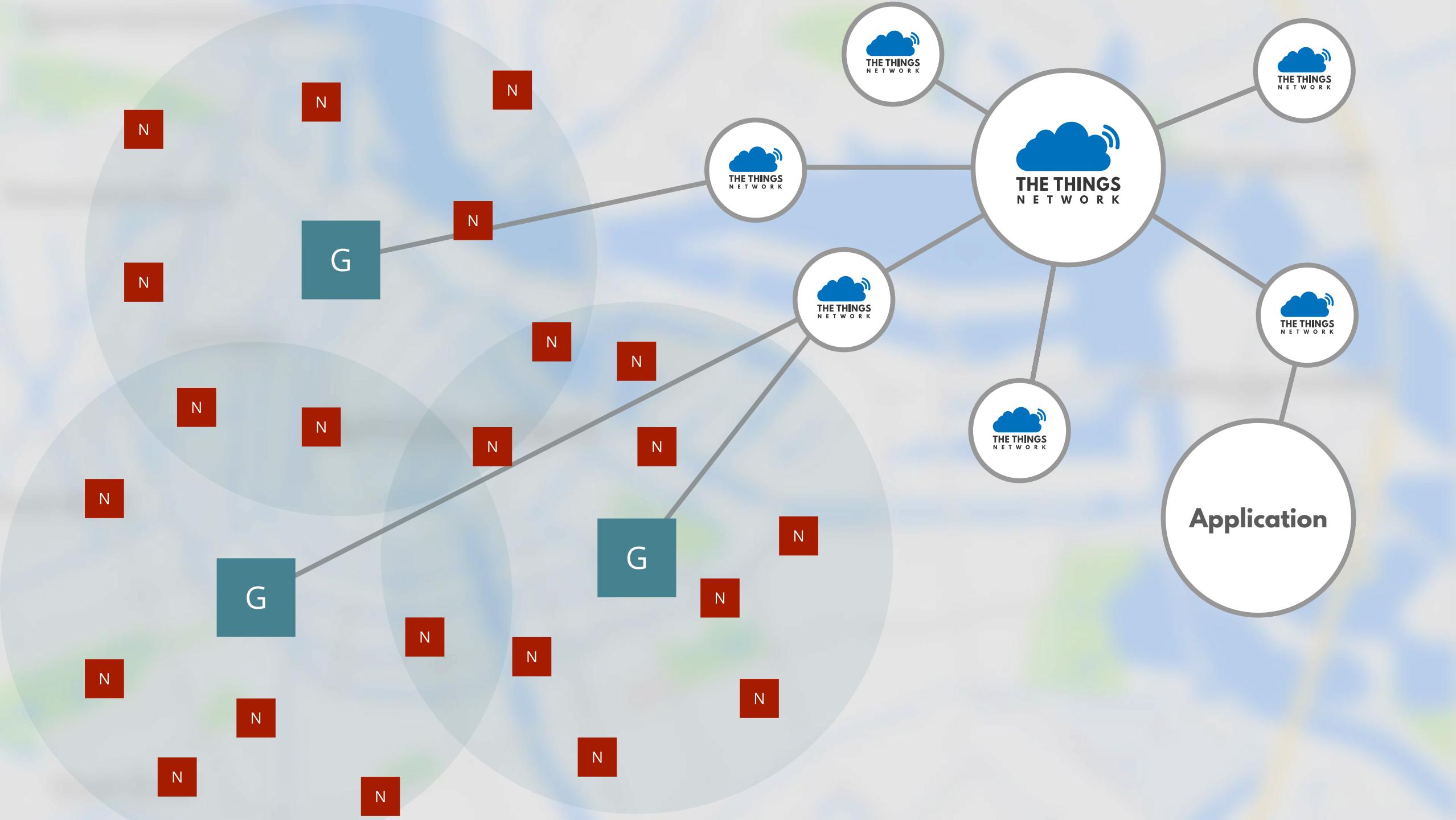


LORAWAN NETWORK



LORAWAN NETWORK







**YOU ARE THE NETWORK
LET'S BUILD THIS THING TOGETHER!**

Laurens Slats

www.thethingsnetwork.org



Long Range Wide Area Network

LPWAN, LORA, LORAWAN..?

LPWAN: Low Power Wide Area Network

- A wireless wide area network technology that is specialized for interconnecting devices with **low-bandwidth** connectivity, focusing on **range** and **power efficiency**.
- Mostly **unlicensed** (but regulated) spectrum under 1 GHz (433, 868, 915 MHz)
- Multiple solutions, including:



sigfox



NB-IOT

LORA?

Wireless modulation technology

Physical layer for long range communications

Low bandwidth

Low battery usage

Operates in the license-free ISM bands all around the world

- 433, 868, 915 Mhz
- Regulated (power, duty-cycle, bandwidth)
- EU: 0.1% or 1% per sub-band duty-cycle limitation (per hour)

Developed by Cycleo, a French company, acquired by Semtech in 2012



LORAWAN

Communications protocol and architecture that utilizes the LoRa physical layer

Data rates are defined that range from **300bps to 5.5kbps**

- with two high-speed channels at **11kbps and 50kbps** (FSK modulation)

Supports

- secure bi-directional communication,
- mobility
- localization

LORAWAN DEVICE CLASSES

Class A

Each device's uplink transmission is followed by two short downlink receive windows.

Class B

In addition to the Class A functionality, Class B devices open extra receive windows at scheduled times.

Class C

These devices have a continuous open receive window, except when transmitting

LORA MODULATION

LORA CHARACTERISTICS

Chirp Spread Spectrum (CSS)

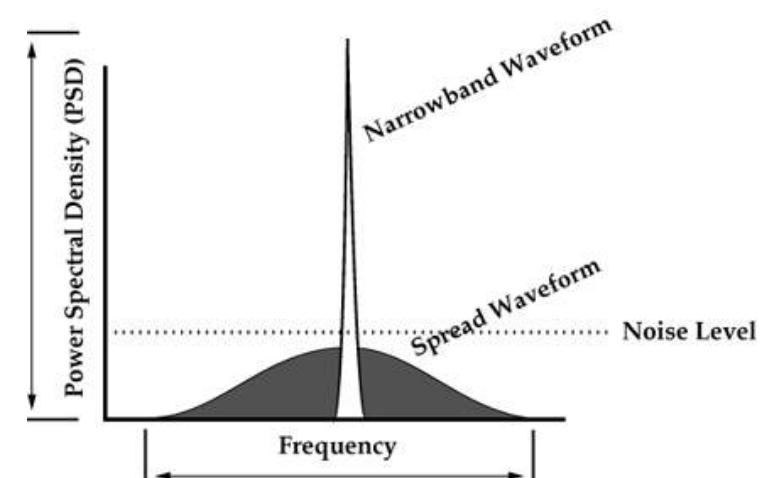
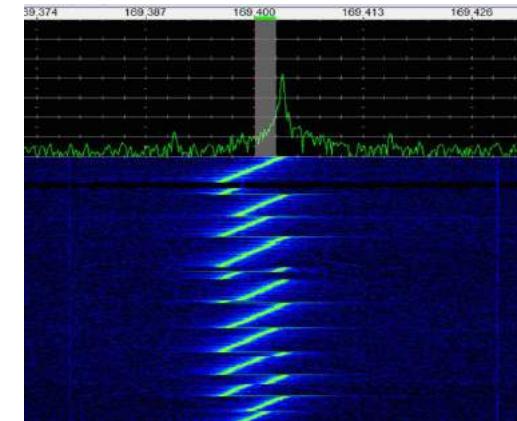
Transmit power: 25mW

Increase reach by increasing energy per bit:

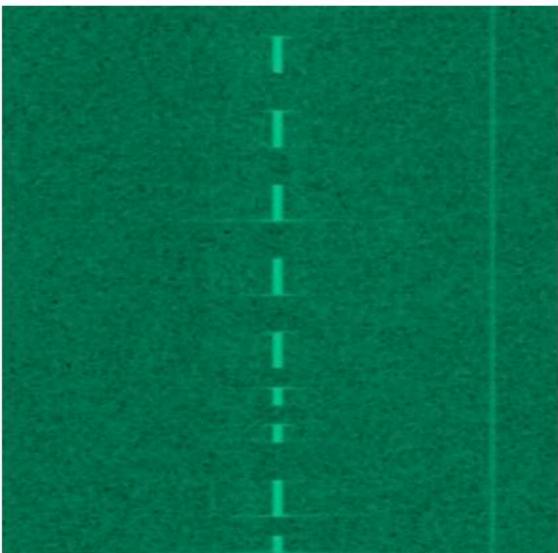
- Transmit power
- Modulation rate

LoRa uses Spreading Factors to set the modulation rate

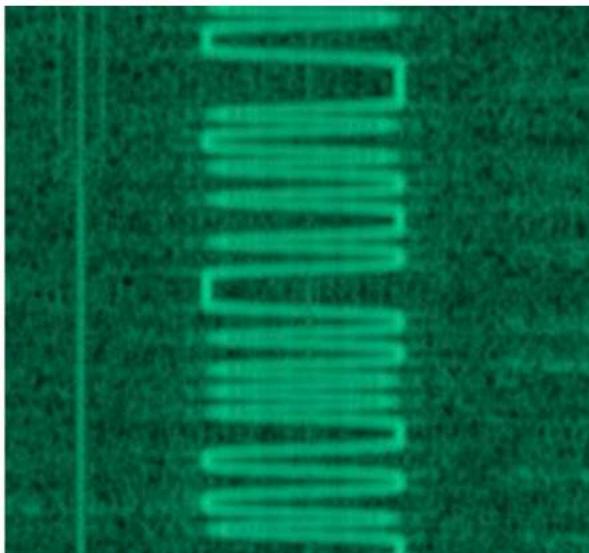
(SF7 to SF12)



SPECTROGRAM LORA



On-Off Keying



Frequency-shift Keying



LoRa

Source: Matt Knight