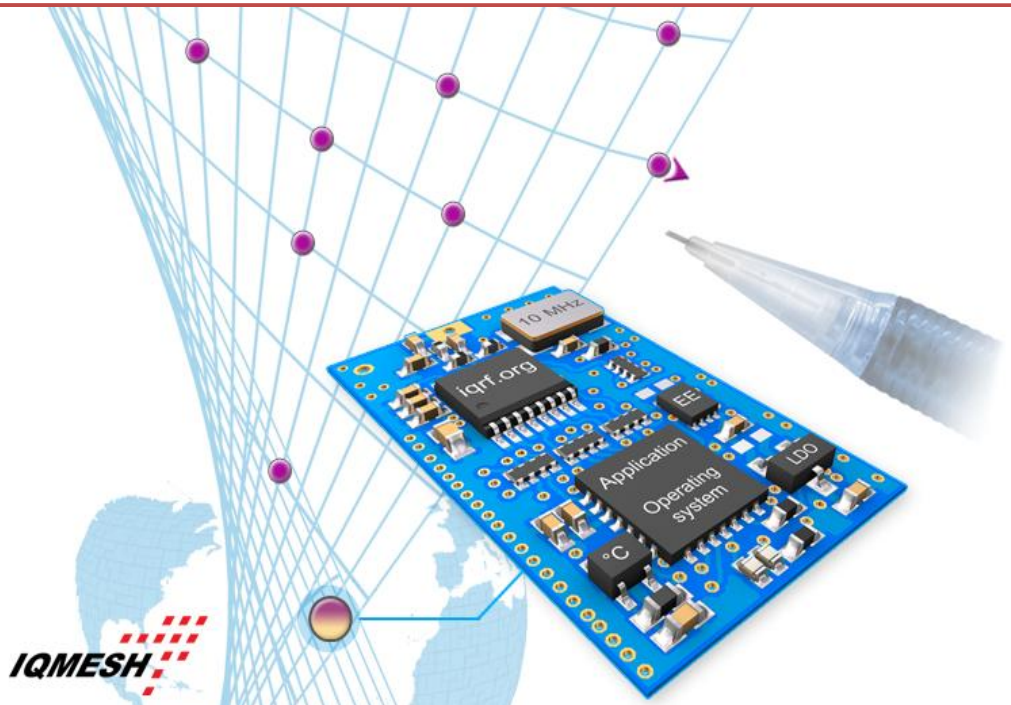
A MESH FAIRY TALE



The Eighths International Conference on Networking and Services

ICNS 2012

March 26, 2012, St.Marteen

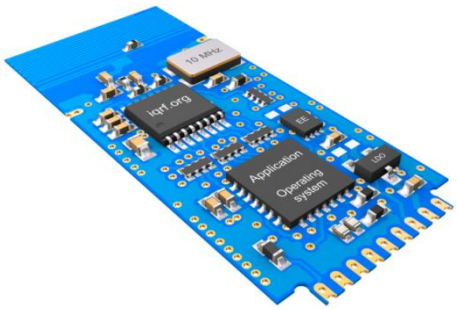
Vladimír Šulc
MICRORISC s.r.o.
Jičín, Czech Republic
sulc@microrisc.com

WHY FAIRY TALE

AGENDA

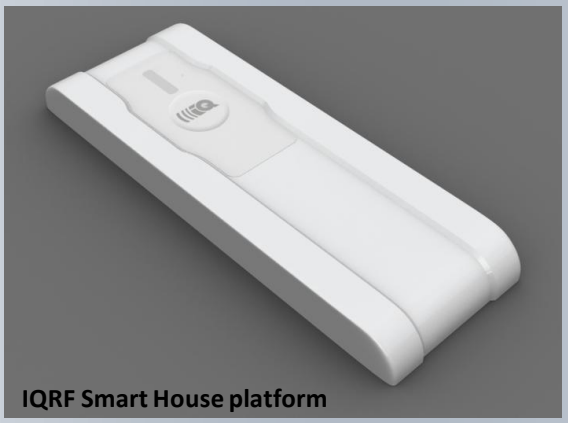
- Introduction
- MESH wiki
- History (biz) trip
- Wireless - low power
- Real challenge?
- IQMESH approach

- Czech Republic, EU
- found in 1991
- R&D, engineering, sales
- Almost 30 patents
- R&D team has over 20 people



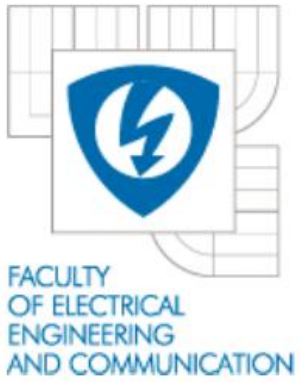
IQRF platform

IQVCP platform



IQRF Smart House platform

- **Technical university found in 1899**
- **The first university in Moravia**



There are 12 departments at the Faculty, with about 190 teachers, 360 Ph.D. students and more than 4,000 students in Bachelor´s and Master´s study programes. The quality of teaching is guaranteed by accreditation procedures, one at the national level by the Czech Ministry of Education, another by the European Association for Education FEANI.

MICRORISC and BUT started their fruitful cooperation in 2006.

AGENDA

- Introduction
- MESH wiki
- History (biz) trip
- Wireless - low power
- Real challenge?
- IQMESH approach

picture from official website: www.side-line.com/

picture from official website: www.side-line.com/

16 MESH = 1 mm

32 MESH = 0.5 mm

Partition of interval

$$a = x_0 < x_1 < x_2 < \ldots < x_n = b$$

The mesh of the partition

$$x_0 < x_1 < x_2 < \ldots < x_n$$

is the length of the longest subinterval

MeSH

Medical Subject Heading

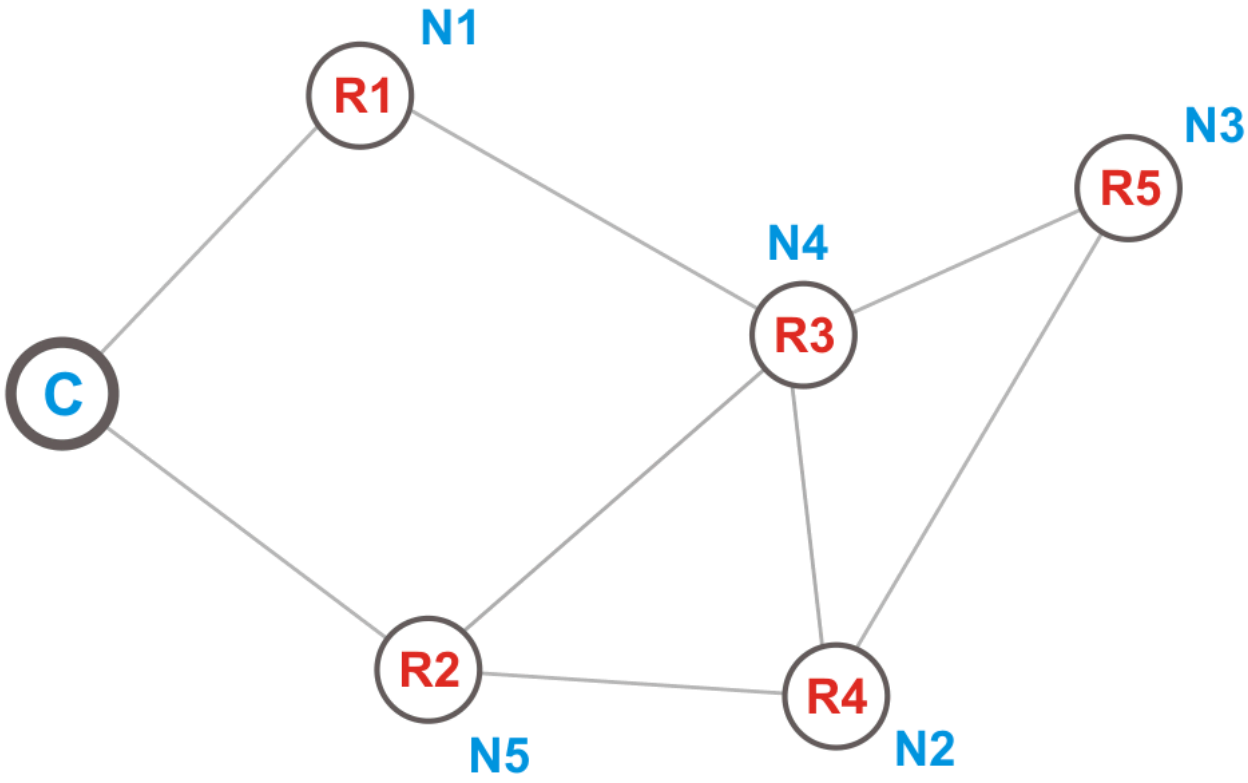
a vocabulary for the purpose of indexing articles and books in the life sciences

MESH – Methanethiol (CH_3SH)

a colorless smelly gas

MESH CIPHER

(based on IDEA)


N1
R1
N3
R5
N4
R3
C
R2
R4
N5
N2

AGENDA

- Introduction
- MESH wiki
- History (biz) trip
- Wireless - low power
- Real challenge?
- IQMESH approach

a word

(nobody took care about)

a strange word

(used by FAE)

a nice word

(used by FSE)

a magic word

(used by sales people)

AGENDA

Introduction

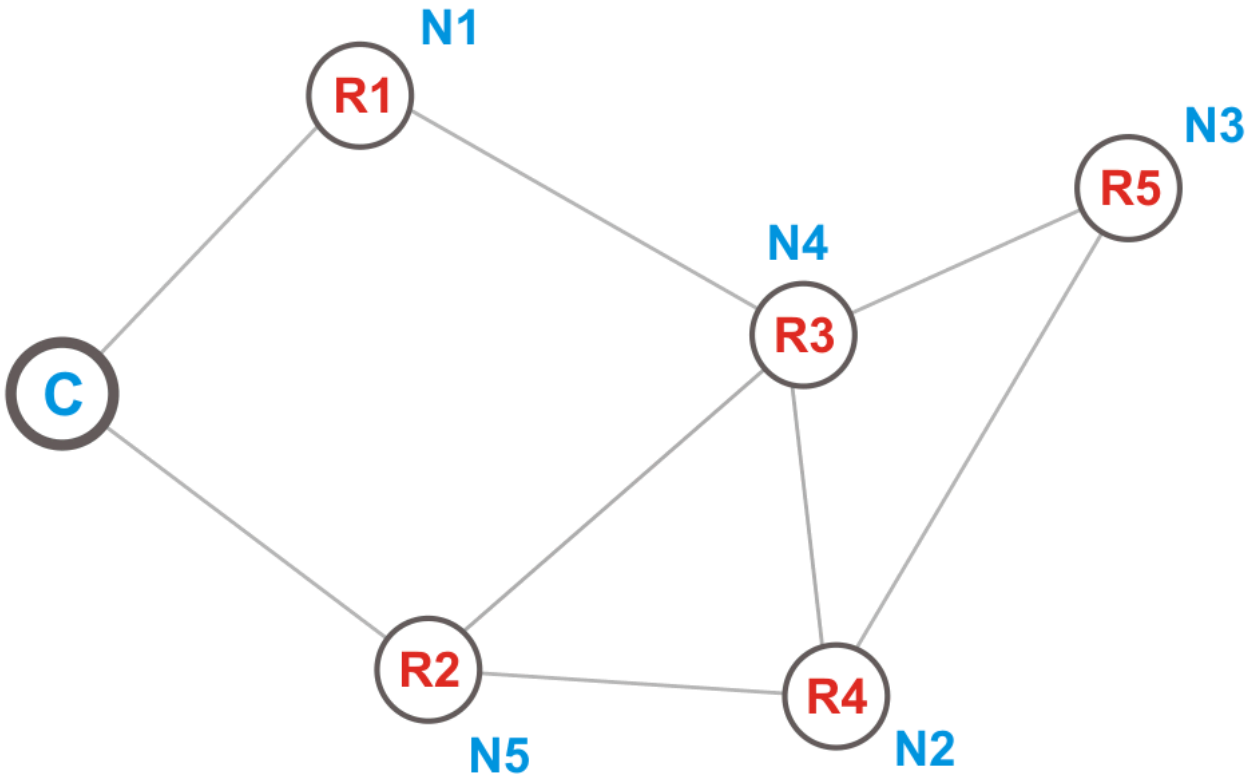
MESH wiki

History trip

Wireless - low power

Real challenge?

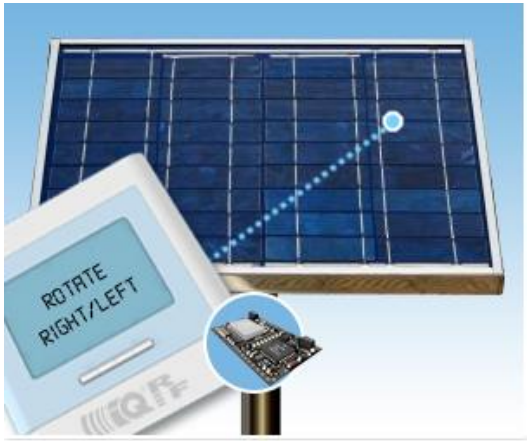
IQMESH approach


N1
R1
N3
R5
N4
R3
C
R2
R4
N5
N2

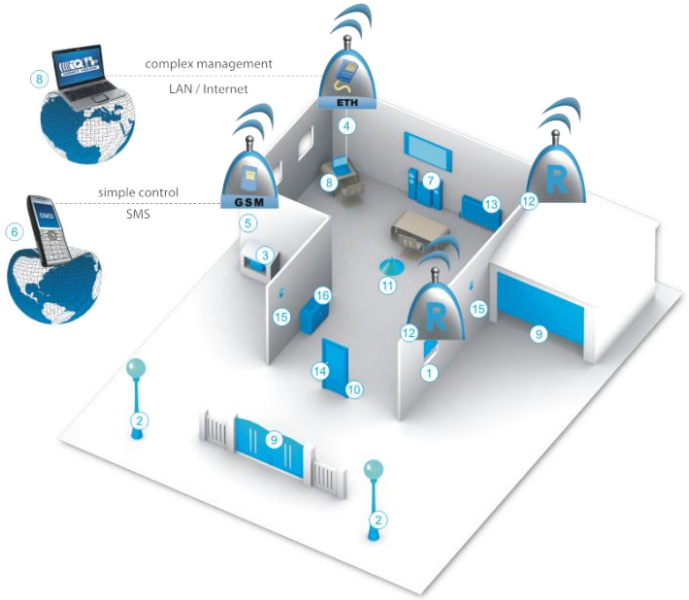
Telemetry

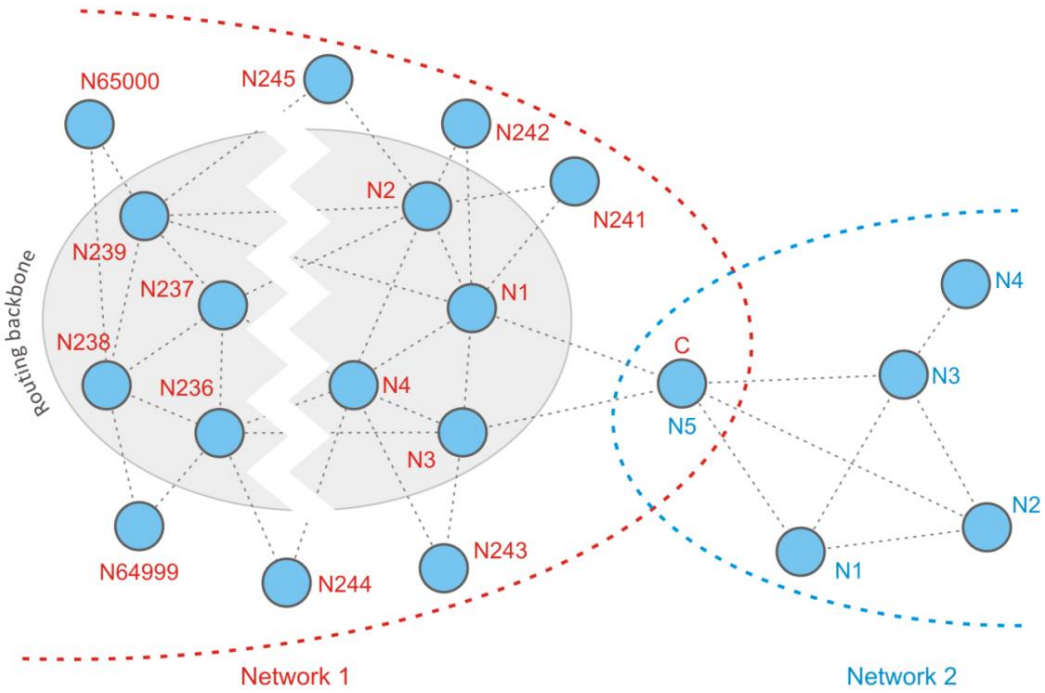
Short range WIRELESS NETWORKS applications

Industrial automation



Building automation





thousands of devices

flexible timing

hundreds hops

concerns

ECONOMY

COMPLEXITY

RELIABILITY

(RT) PREDICTABILITY

wide MESH networks

... where reliability and determinism is a must

AGENDA

- Introduction
- MESH wiki
- History trip
- Wireless - low power
- Real challenge?
- IQMESH approach

ECONOMY

POWER CONSUMPTION

VARIETY OF DIFFERENT DEMANDS

LOW RATE COMMUNICATION

PREDICTABILITY & DETERMINISM

CONCURENCY AND INTERFERENCE

SPECTRUM SHARING

A MESH FAIRY TALE ends

... reality is coming

THEORY OF GRAPHS

IN REAL TIME

IN SHARED SPECTRUM

WITH LIMITED RESOURCES

Number of links

$$N_{MAX} = \frac{n\,(n-1)}{2}$$

Packet can "travel" over the network

by many different ways.

Should network specify the best one(s)?

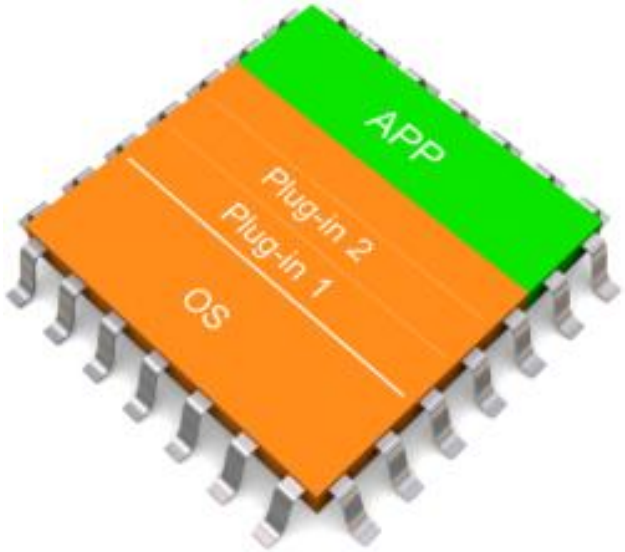
How? When?

ECONOMY & POWER CONSUMPTION

Great algorithms

“battery eaters”

resources demanding



“lower resources”

0.50 USD vs. 50 USD

“higher consumption”

POWER CONSUMPTION & RT

Centralized management?

Distributed services?

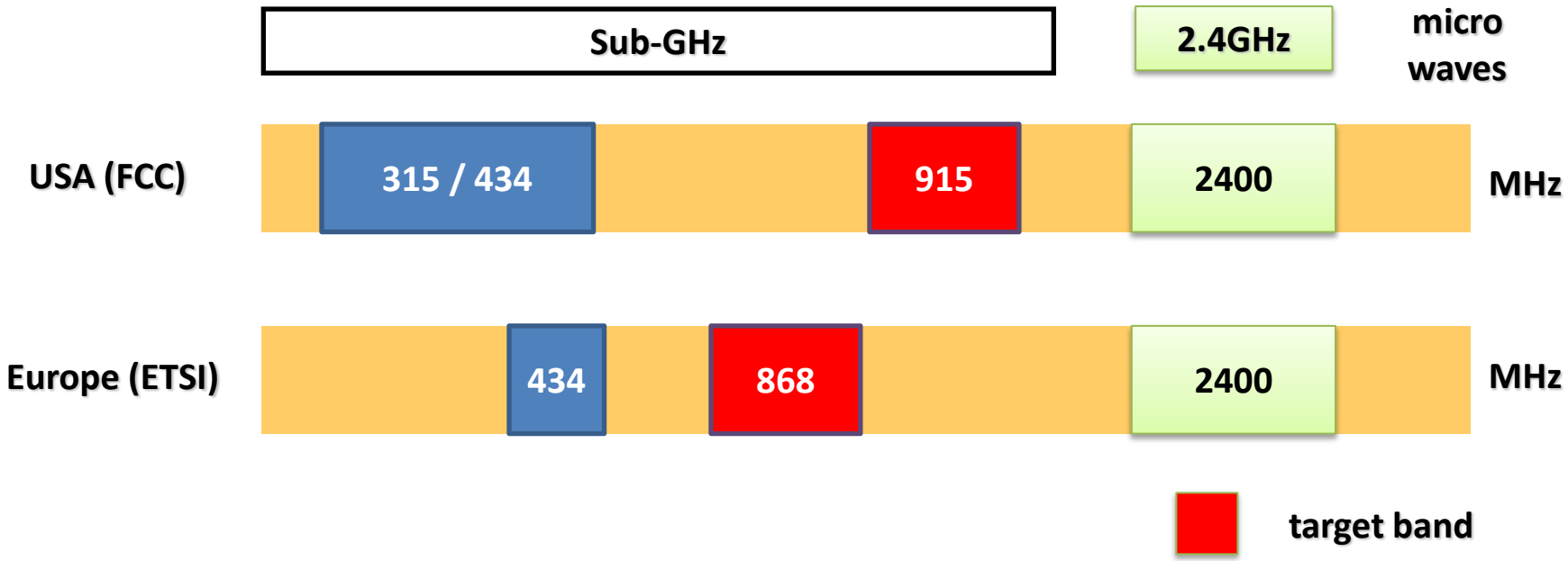
Acknowledgements?

AGENDA

- Introduction
- MESH wiki
- History trip
- Wireless - low power
- Real challenge?
- IQMESH approach

IQMESH Implementation

Supported bands, frequencies?

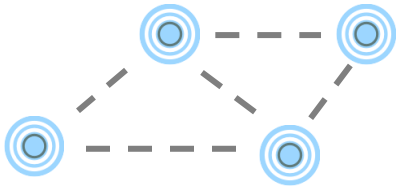


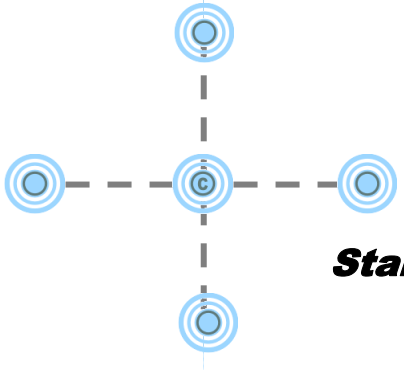
IQRF can work at any band

specializes to sub-GHz ISM bands

Point-to-Point

Point-to-Multipoint





Star

FACTS

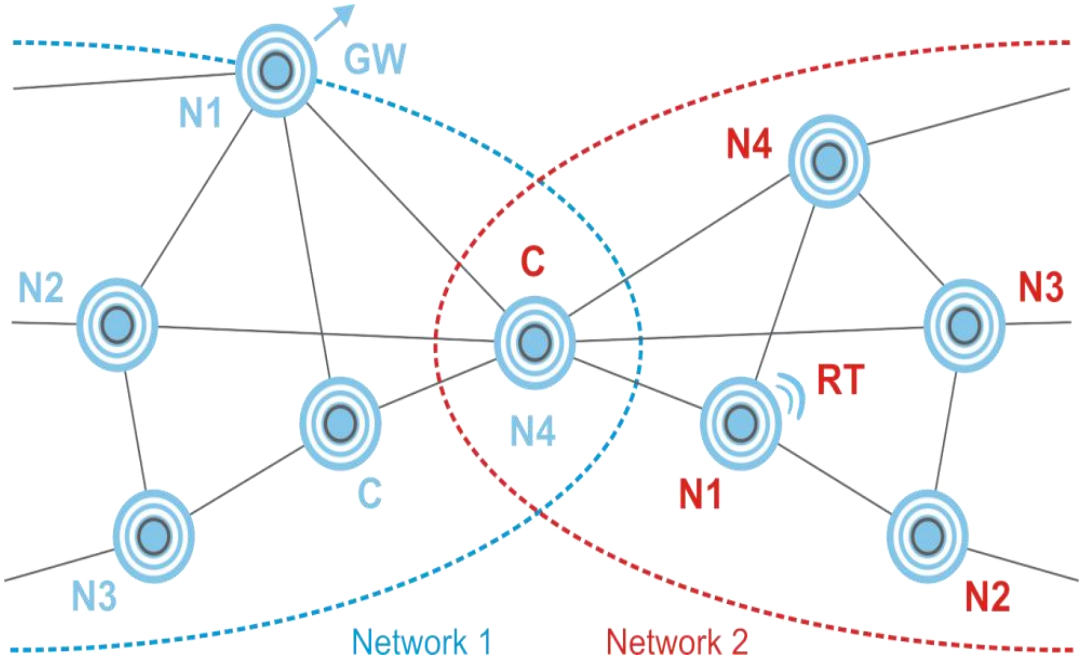
No routing

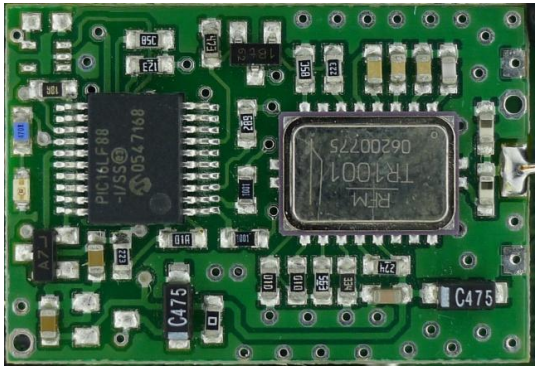
No Discovery

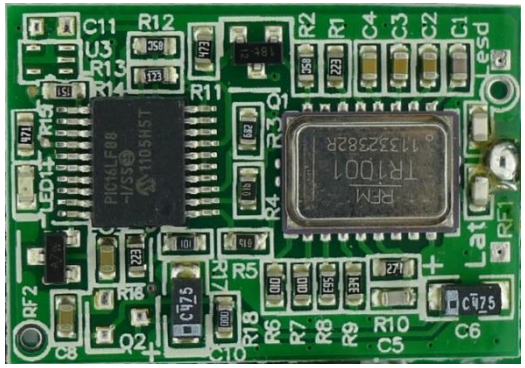
240 devices

Fixed addressing

For smaller applications – home automation, small networks







FACTS

240 hops

No Discovery

Fixed timing

Fixed routing

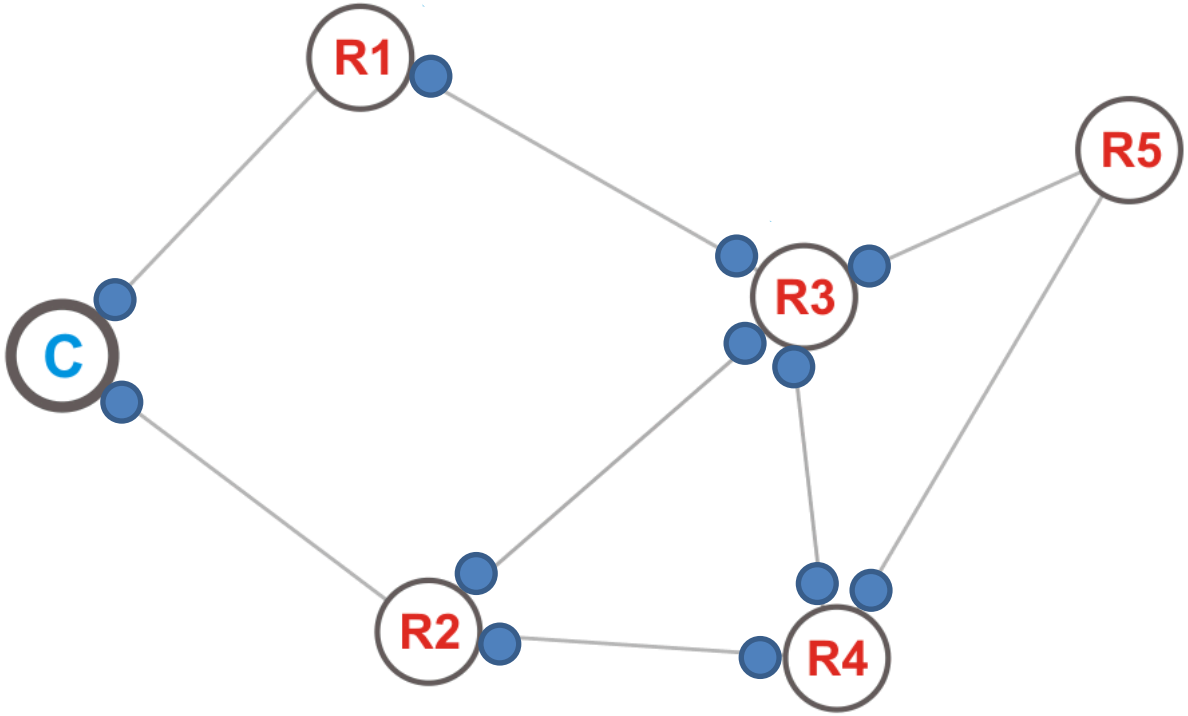
240 devices

Fixed addressing

Networks chaining

For smaller applications – home automation, small networks

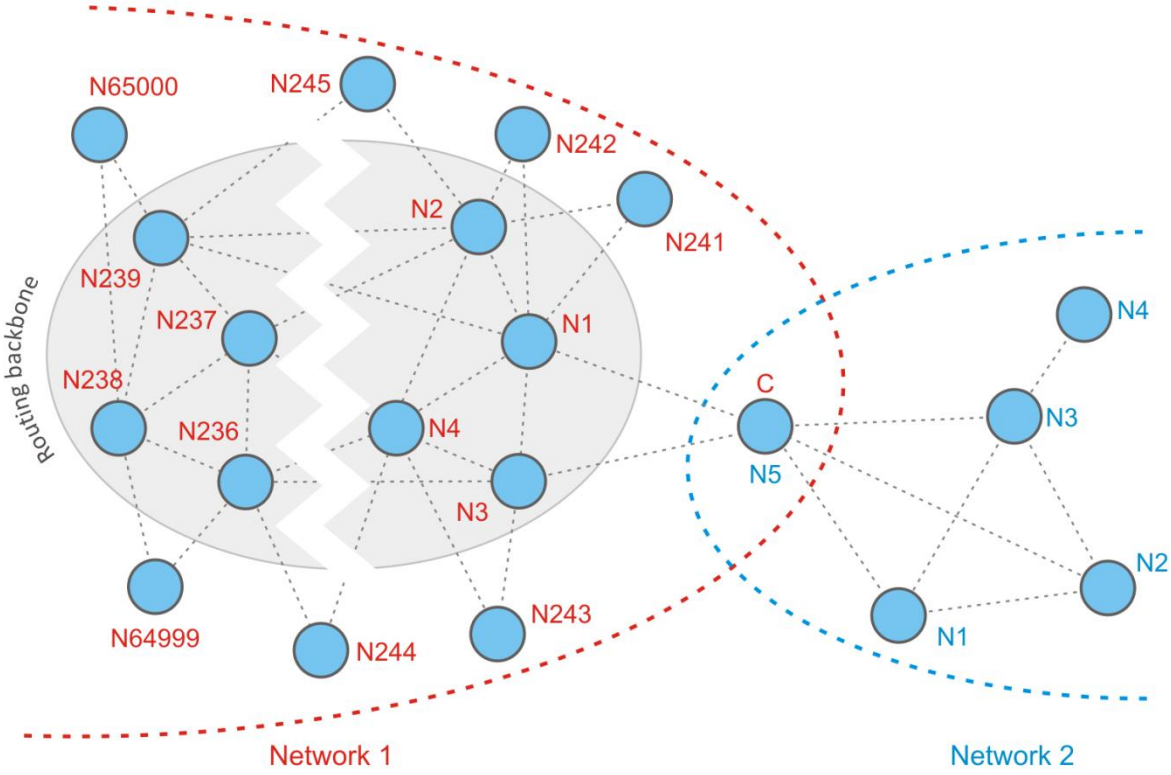
Source routing



FRAME

0	1	2	3	4

Active time slot



FACTS

240 hops

Discovery

Flexible timing

Flexible routing

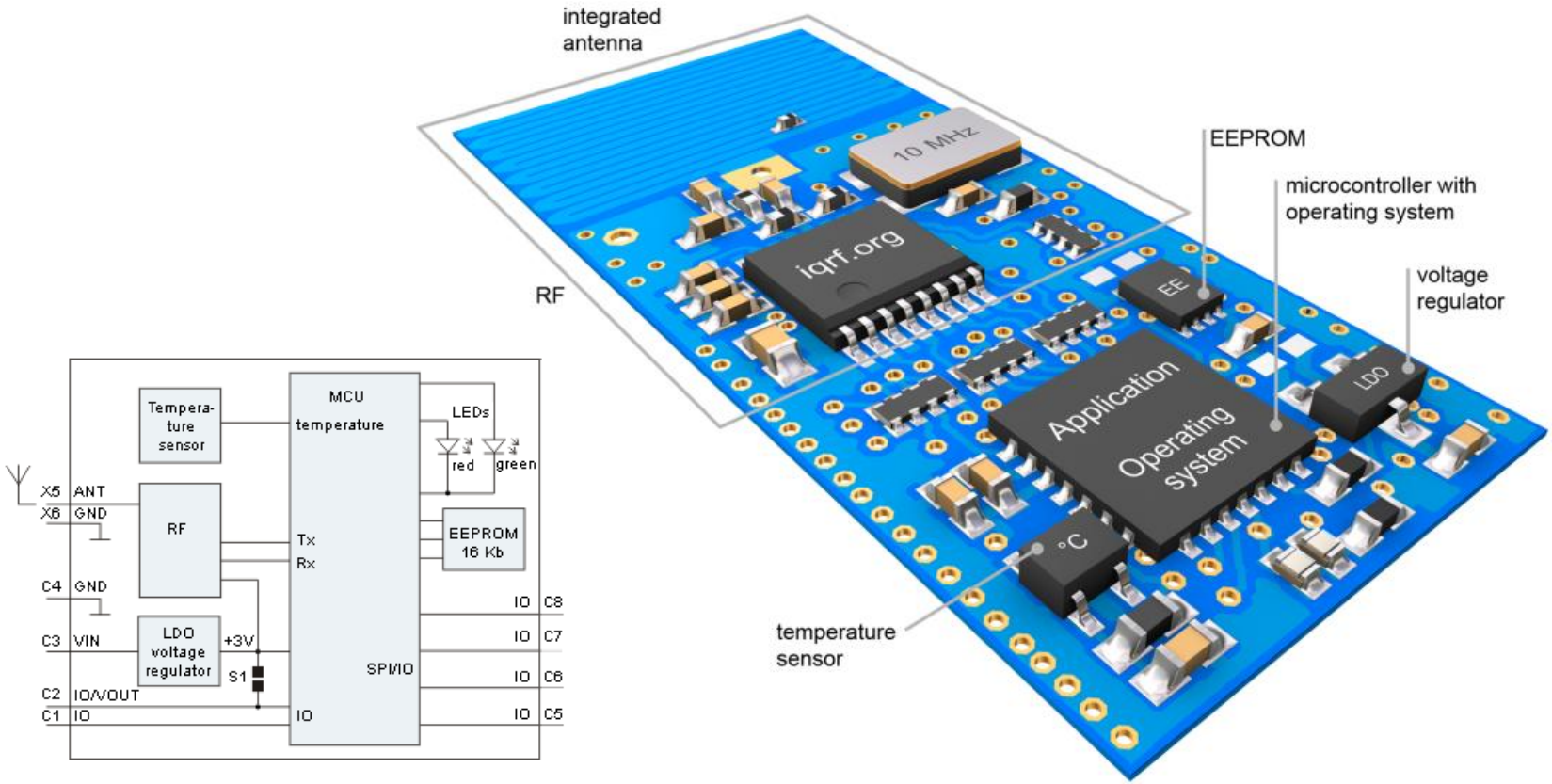
65 000 devices

User's addressing

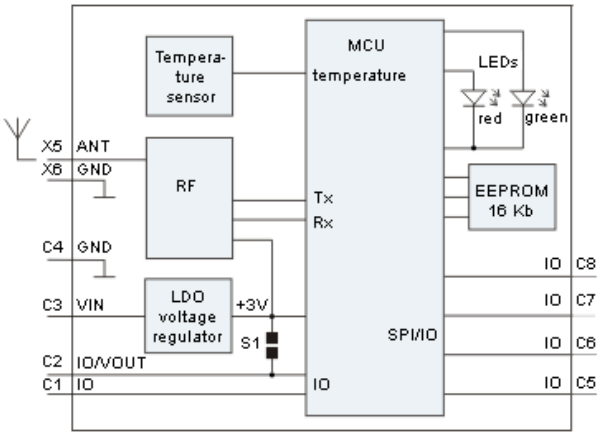
Networks chaining

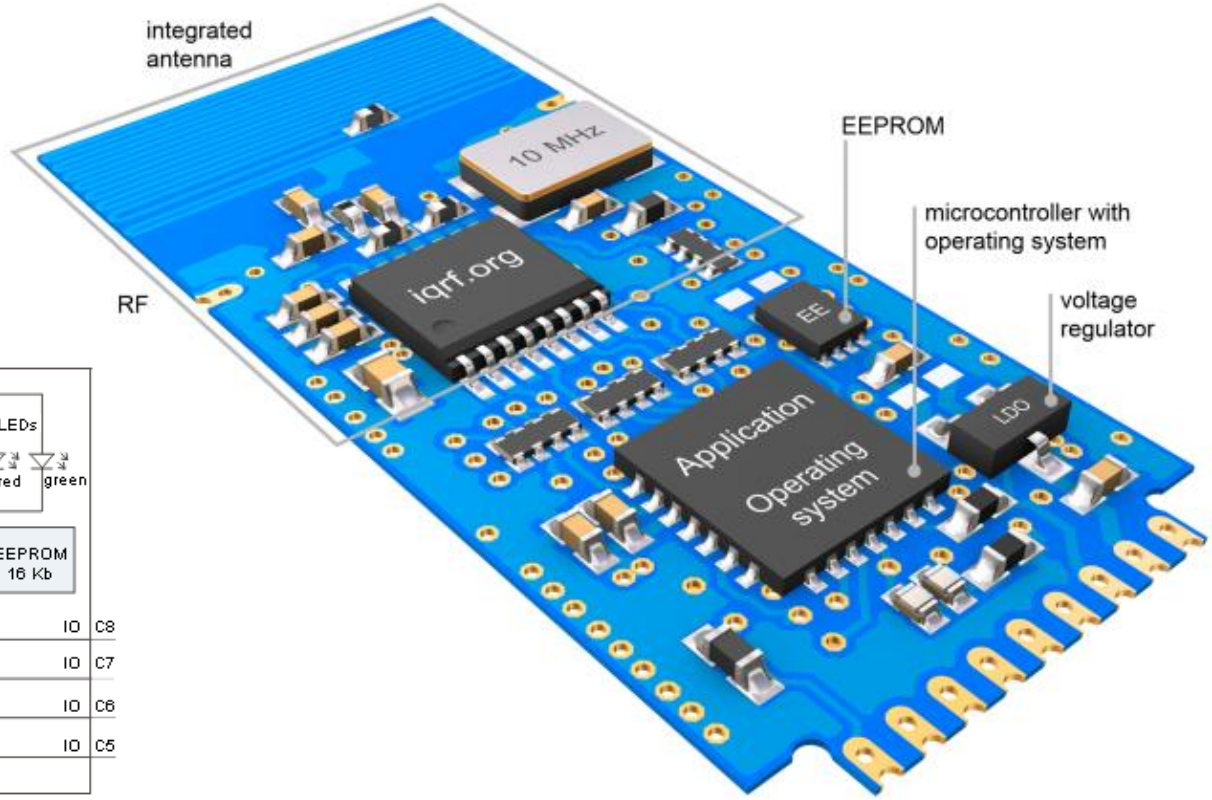
ICWP™

For applications where extra low consumption and flexible routing is requested

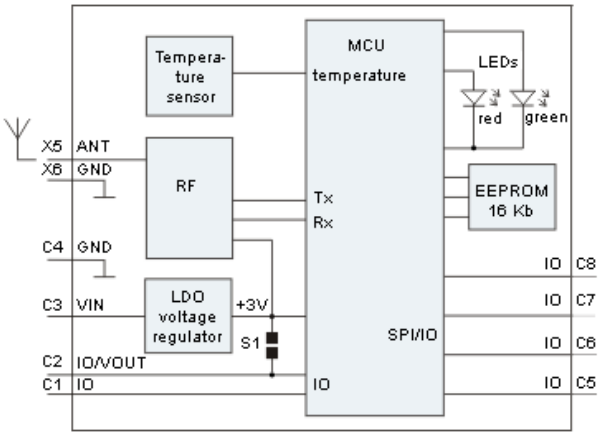


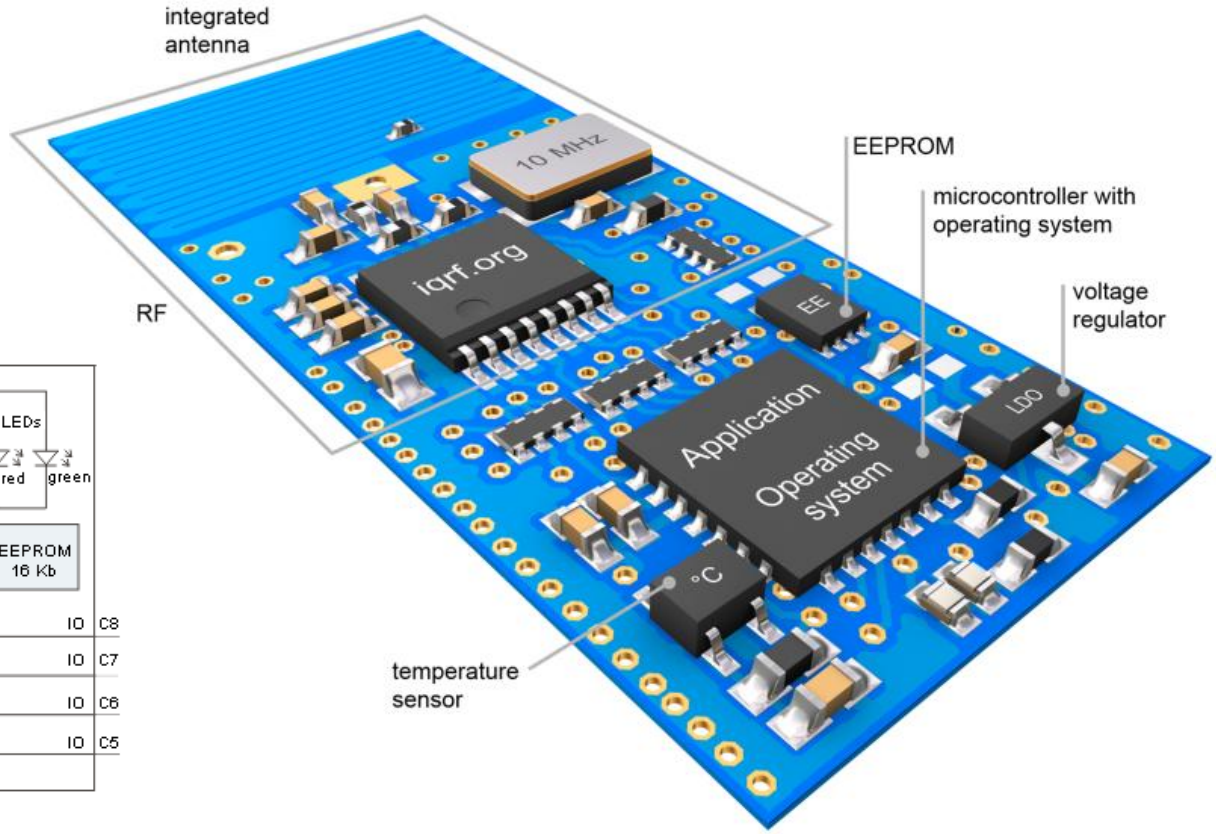
TR-52BA modules ... 600 m @ 3.2 mW



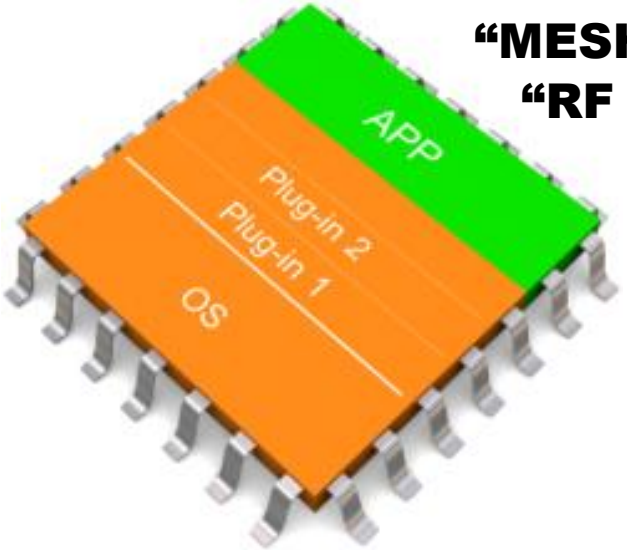


TR-53BA modules … new built-in options, keeping SIM compatibility



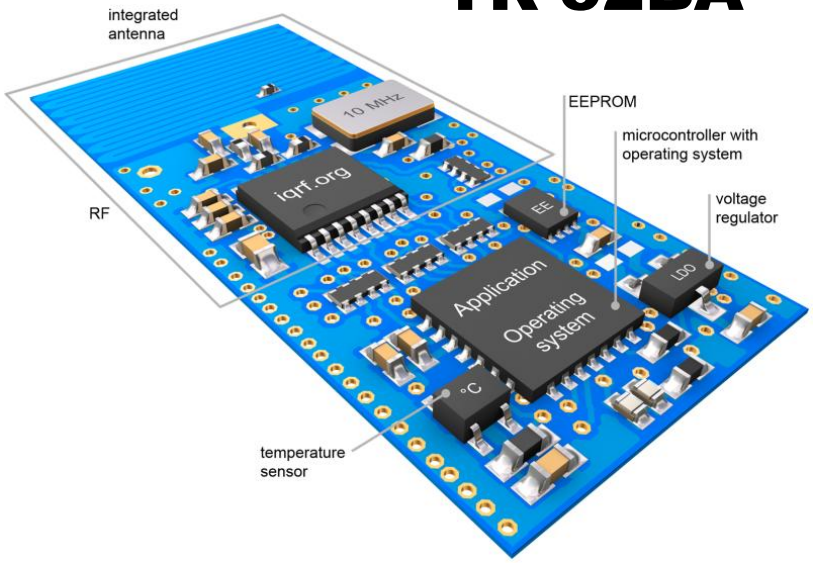


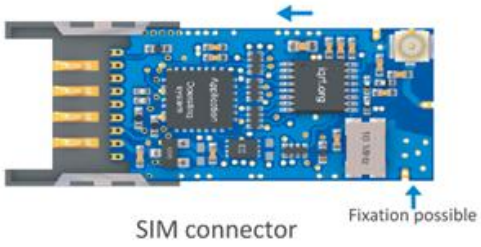
TR-52DA modules … more resources, seamless migration

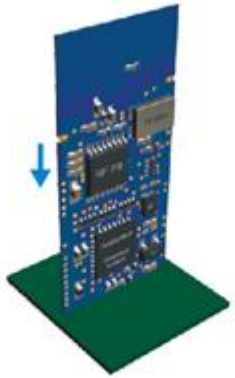


“MESH included”
“RF included”

TR-52BA







>600 m @ 3.2 mW

35 цA @ XLP RX

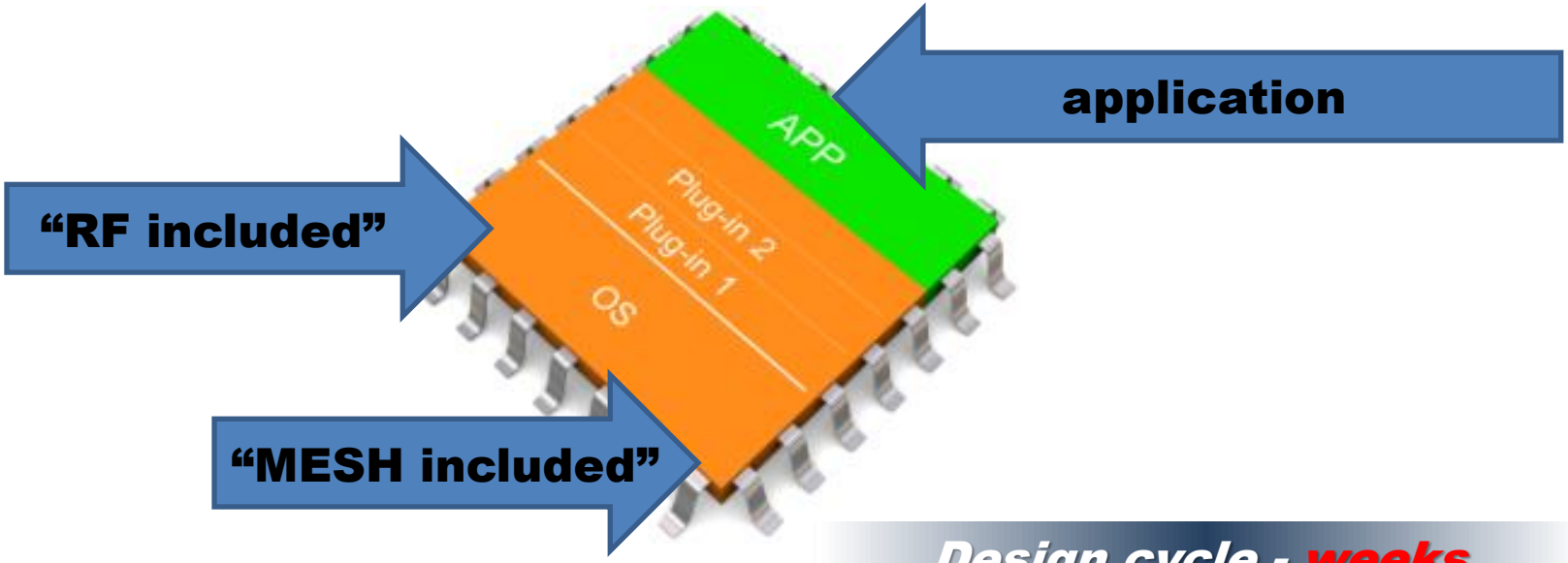
ICWP™

Smart Transceivers modules

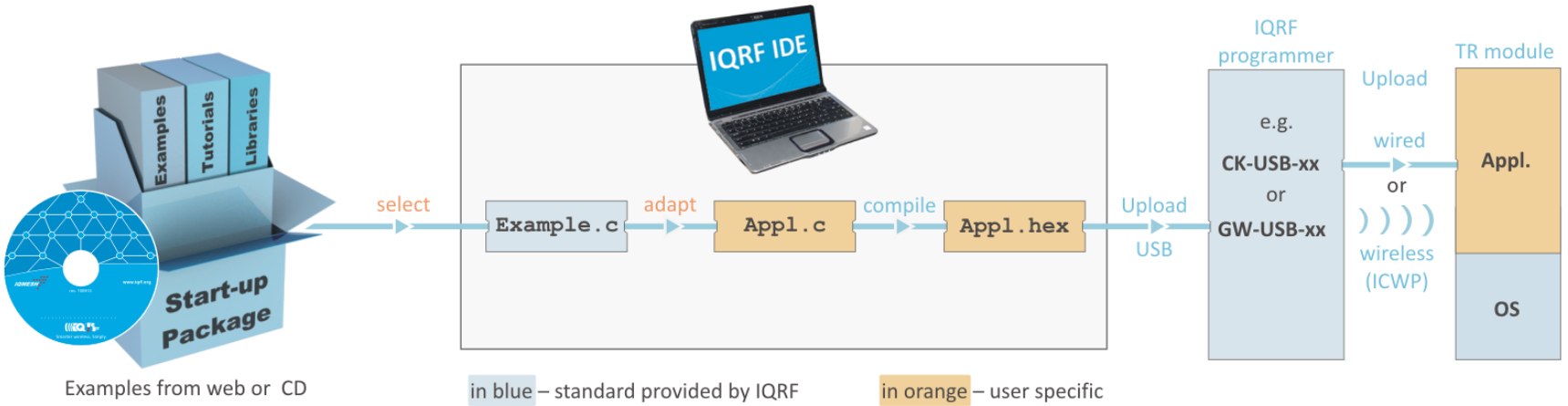
for Wireless Network Communication

IQMESH Implementation

Built-in IQRF OS



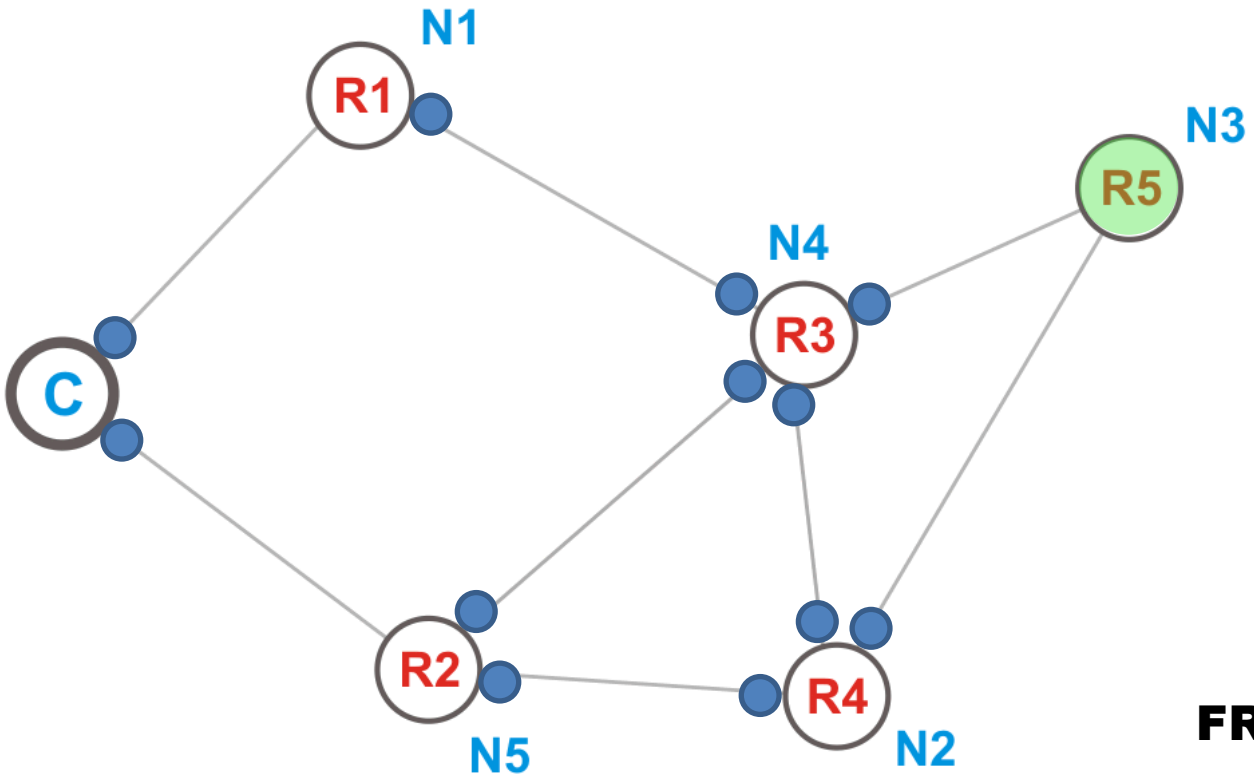
Design cycle - weeks



IQMESH Routing

Coordinator to Node 3

no broken links



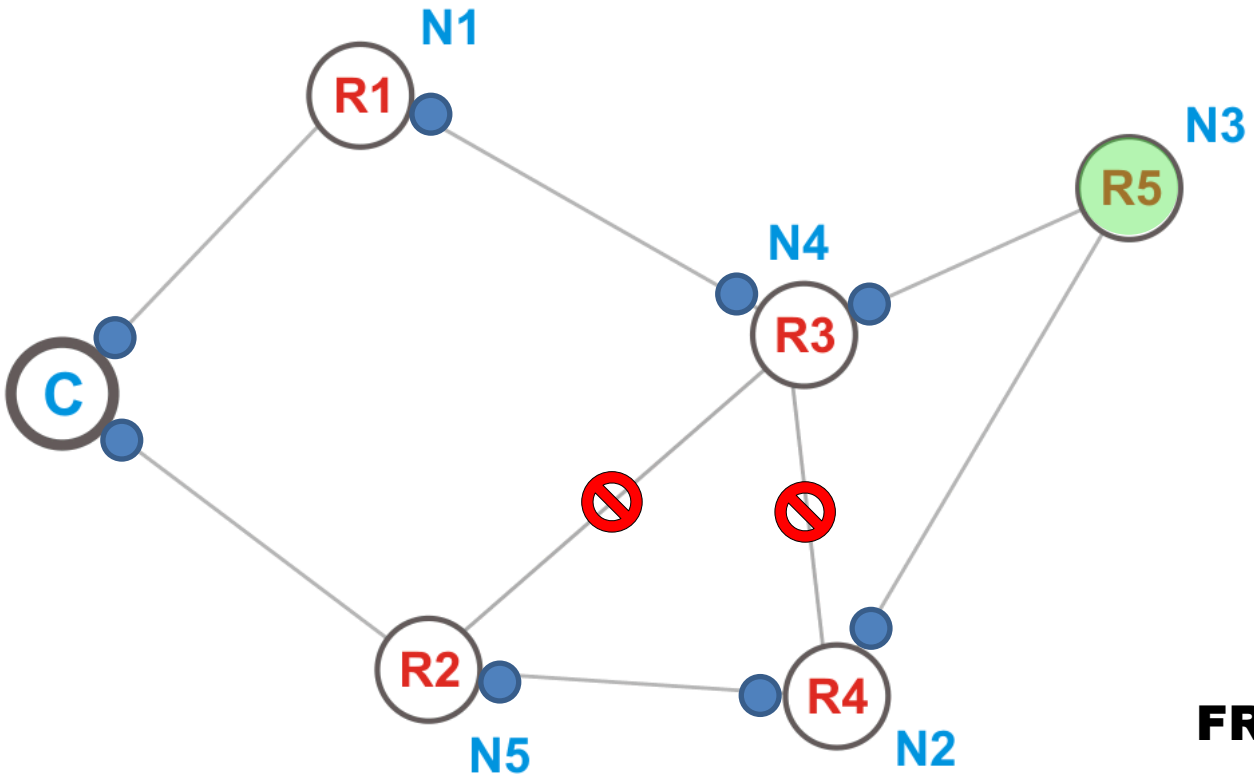
FRAME | 0 | 1 | 2 | 3 | 4 |

Active time slot

IQMESH Routing

Coordinator to Node 3

2 broken links



FRAME

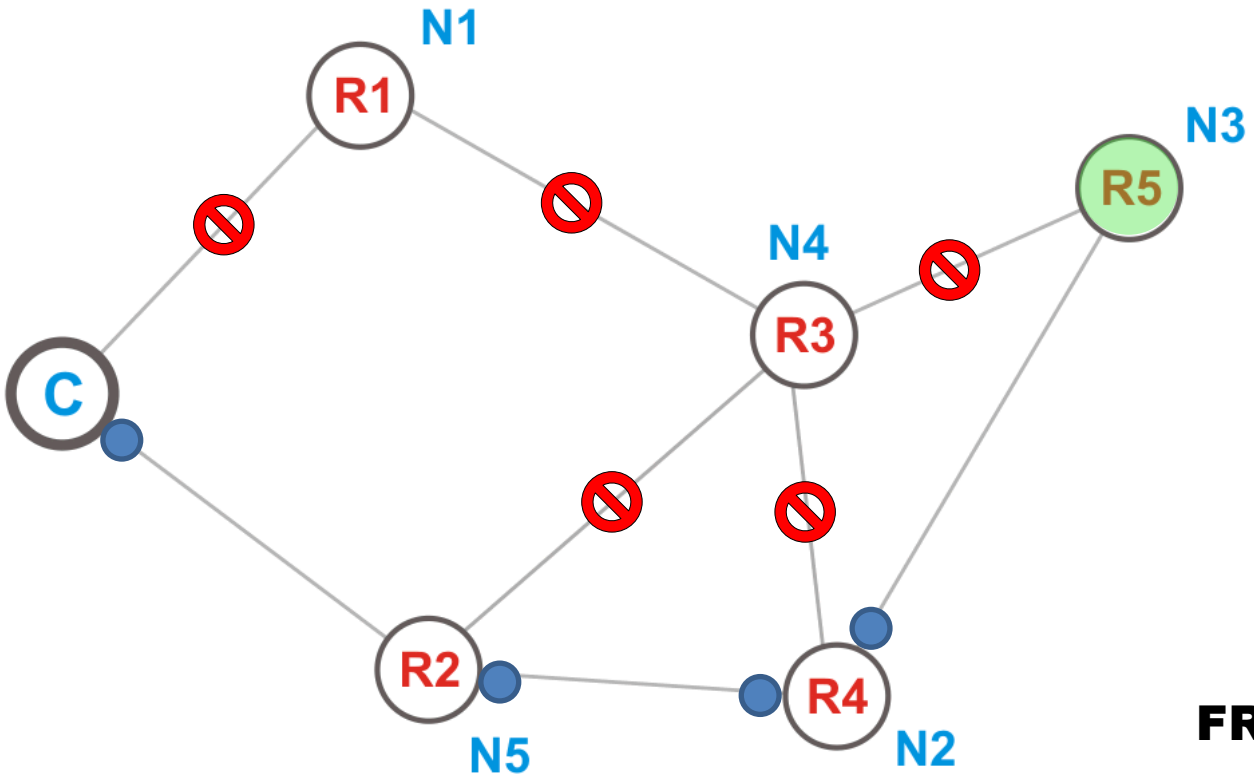
0	1	2	3	4

Active time slot

IQMESH Routing

Coordinator to Node 3

5 broken links

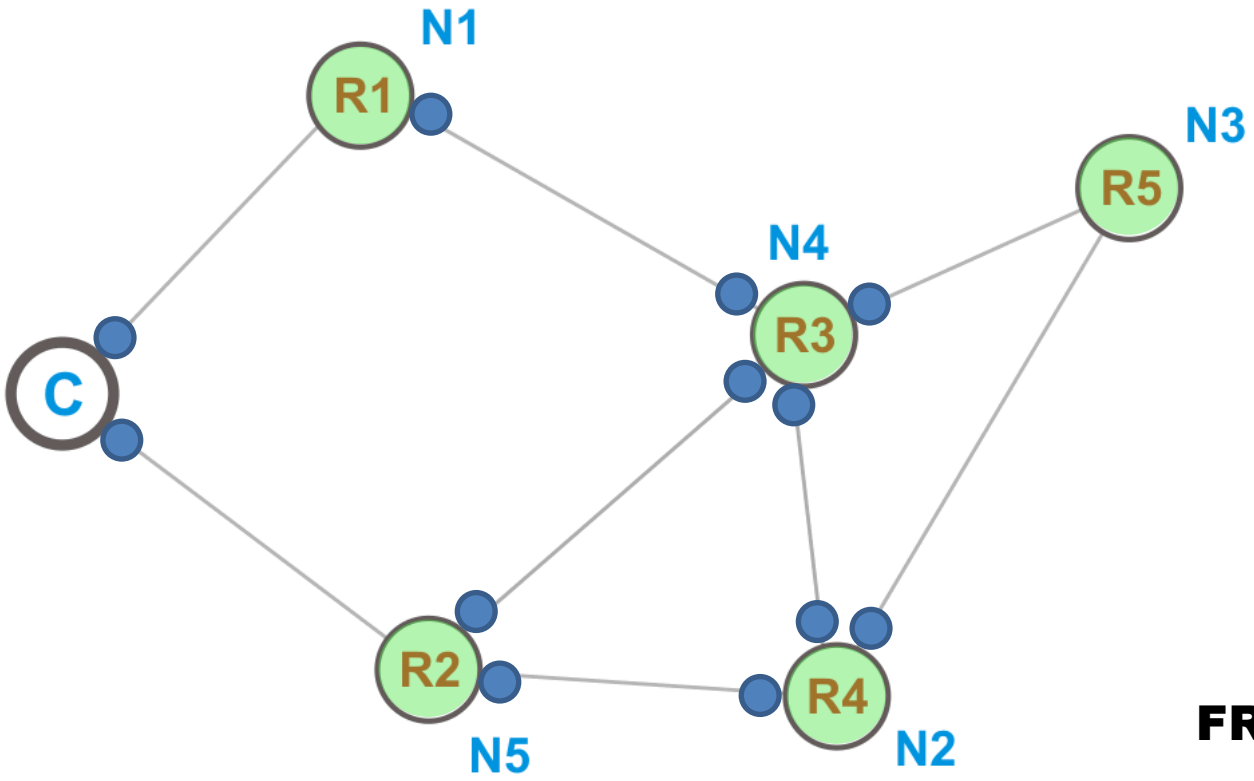


FRAME

0	1	2	3	4

Active time slot

no broken links

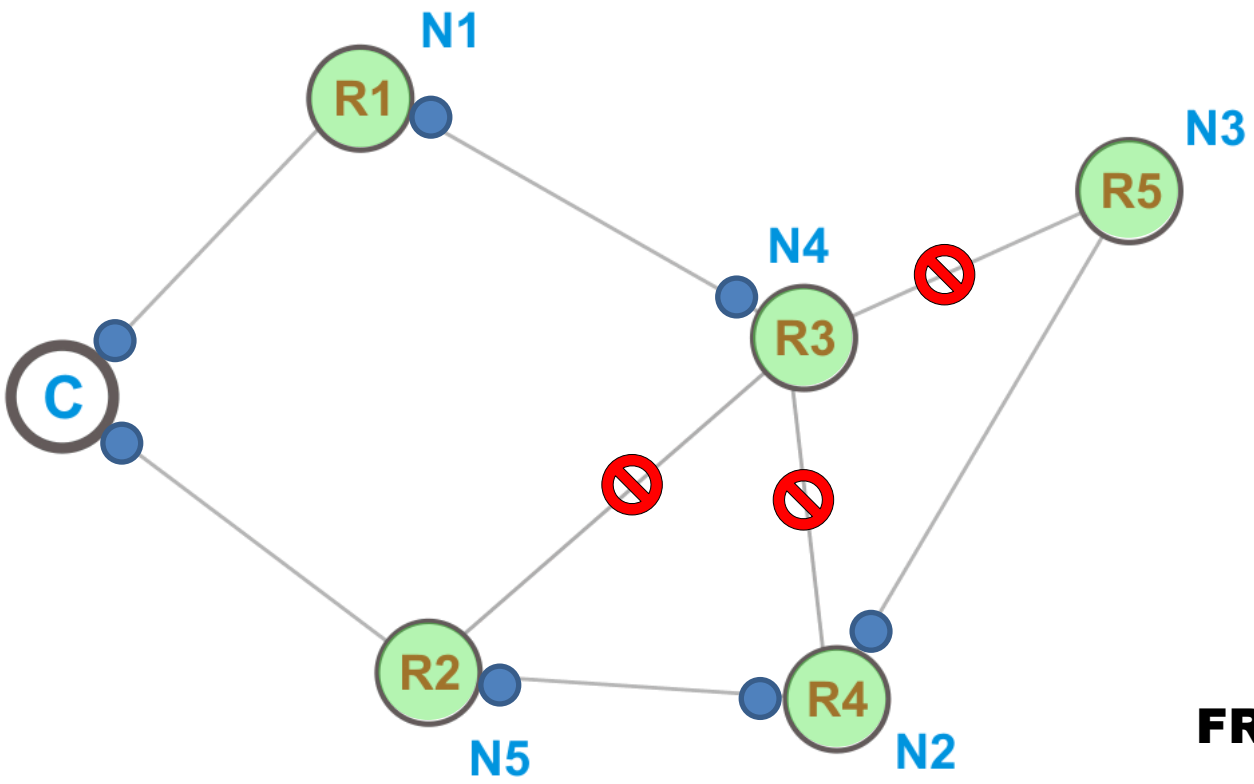


FRAME

0	1	2	3	4

Active time slot

3 broken links

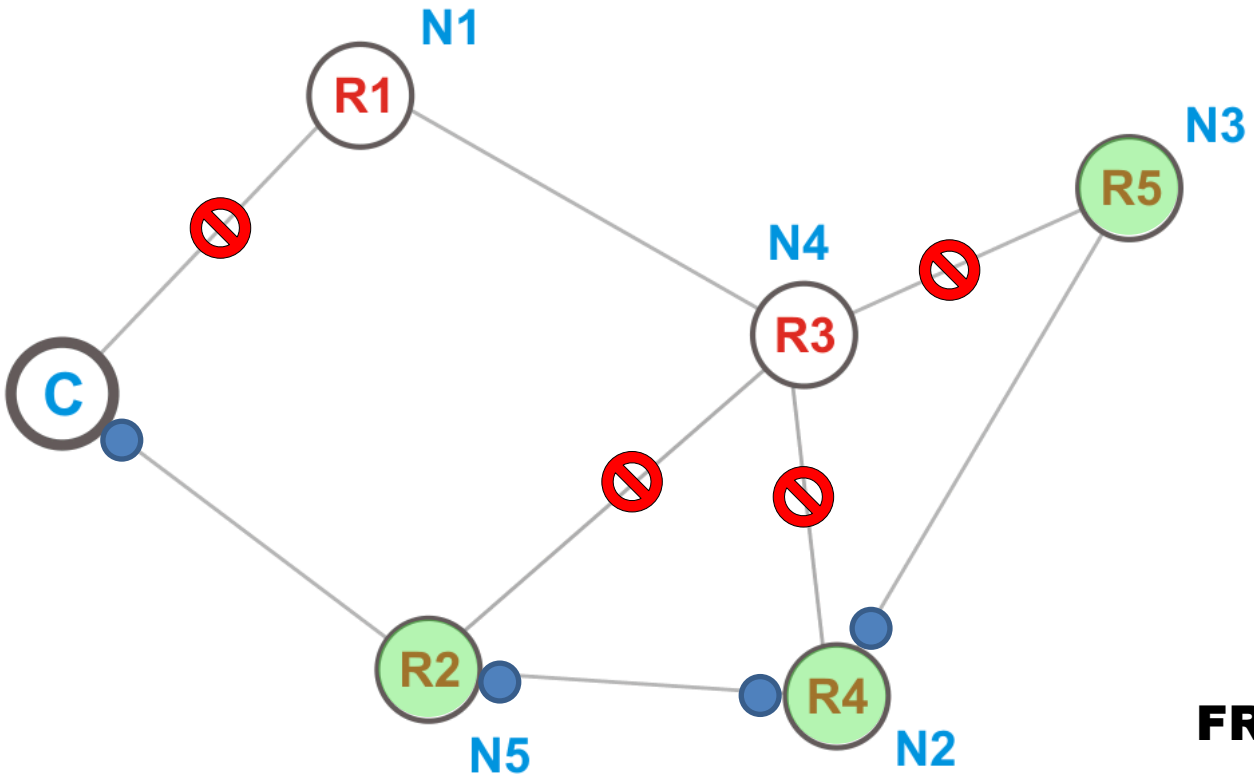


FRAME

0	1	2	3	4

Active time slot

4 broken links



FRAME

0	1	2	3	4

Active time slot

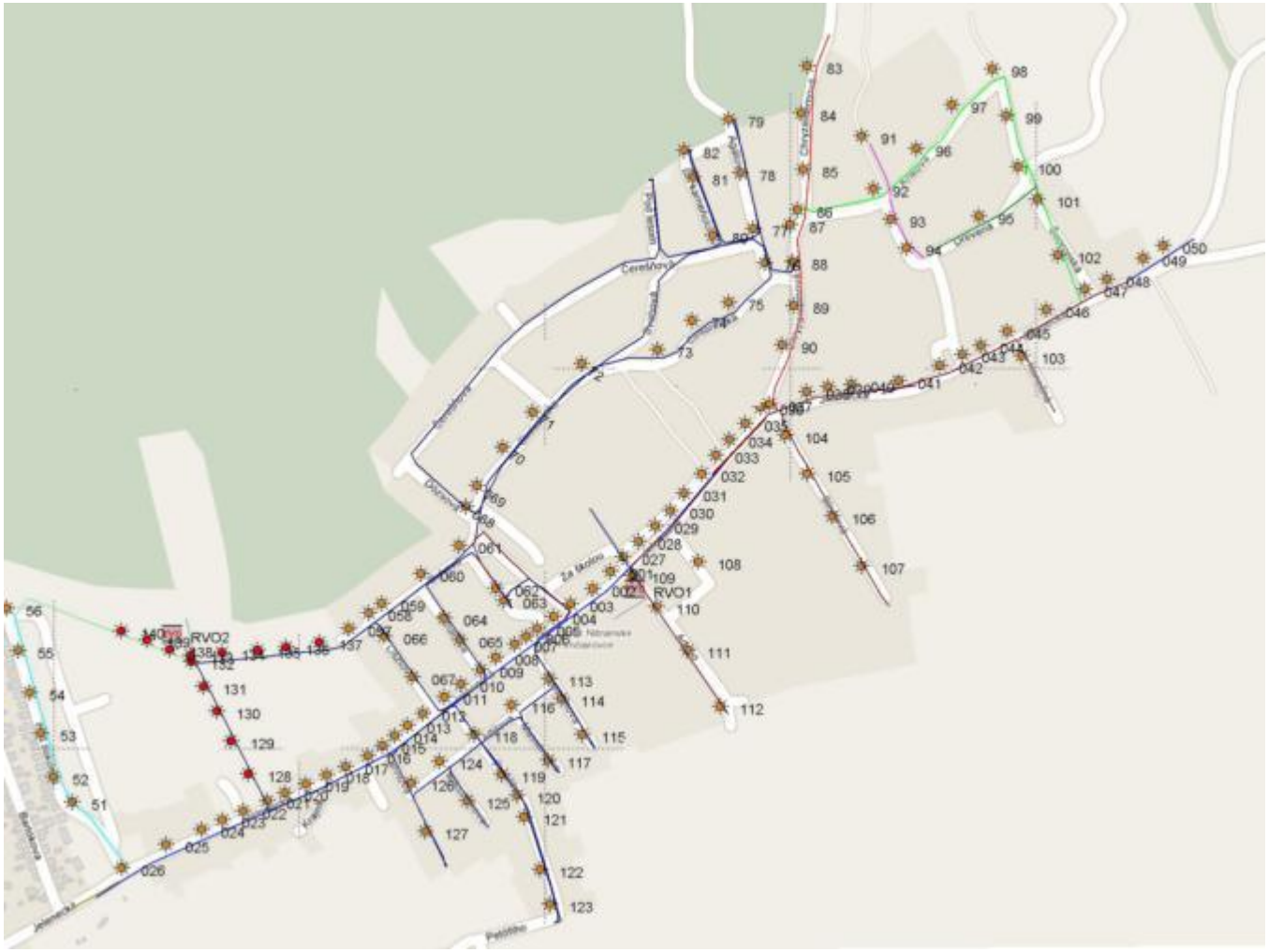
Routed network packet – maximum compatibility

IQRF OS 2.1x

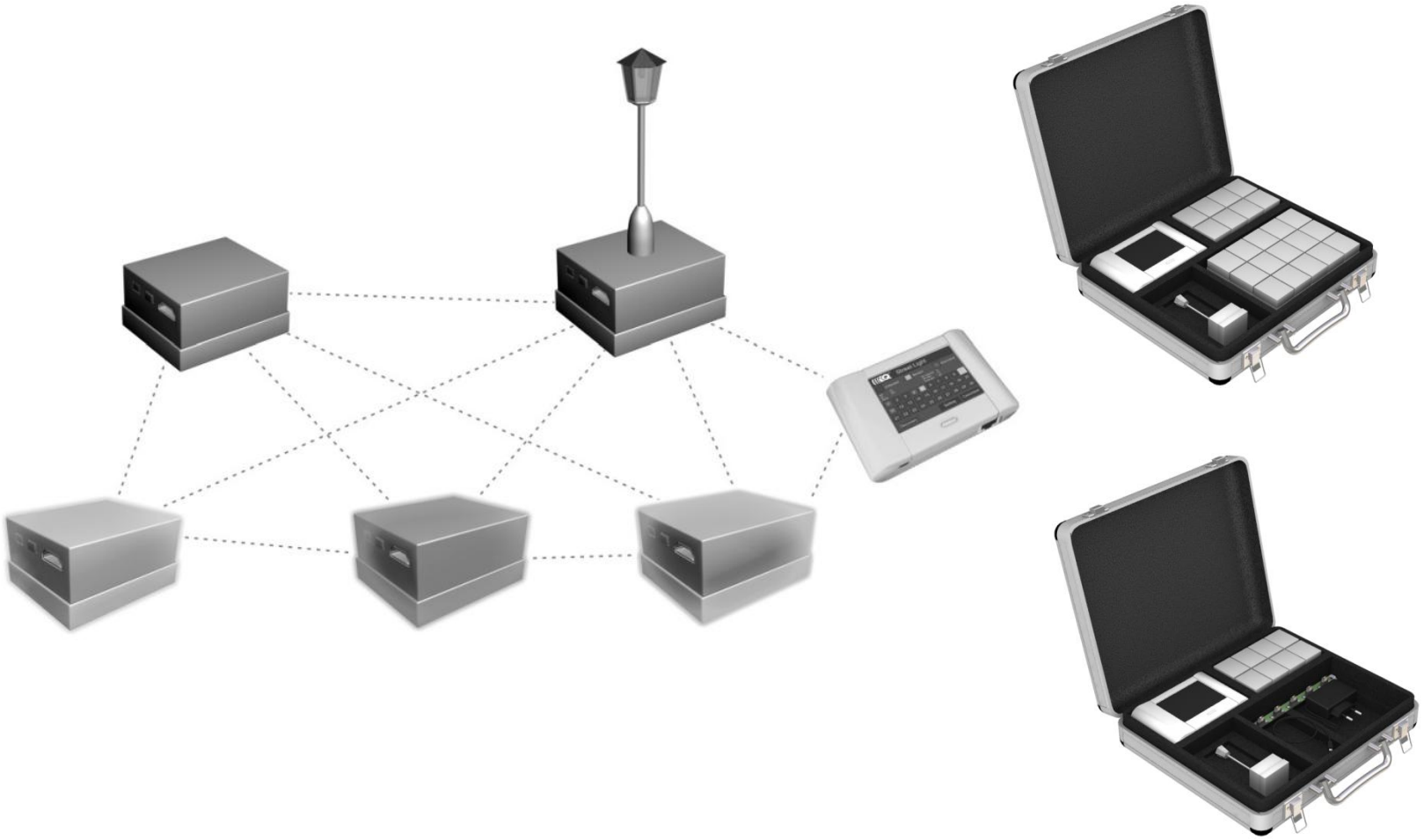
```
DLEN = 64;          // set packet length
_ROUTEF = 1;        // mesh topology
RX = 7;             // set recipient
RTDEF = 0;          // static route "4+1"
RTV0 = 1;           // set routing vector
RTV1 = 2;           //       ||
RTV2 = 3;           //       ||
RTV3 = 4;           //       ||
RFTXpacket();       // send packet
```

IQRF OS 3.0x

```
DLEN = 64;          // set packet length
_ROUTEF = 1;        // mesh topology
RX = 7;             // set recipient
RTDEF = 1;          // SFM algorithm
RTDT0 = 4;          // 4 routes
RTDT1 = 5;          // set time slot
RFTXpacket();       // send packet
```



IQMESH perfectly fits to street lighting applications



RD-SL-01 … presents specific tasks in Street lighting

IQMESH / Zigbee
comparison

Protocol	Nodes *	Routers *	Routers #	Hops *	Hops #
MiWi	1 024	7	7	4	4
Zigbee	65 536	65 536	20	Infinite	6
Zigbee Pro	65 536	65 536	50	Infinite	10
IQMESH	65 000	240	240	240	240

*** ideal value (MCHP)**

 # practical value (MCHP)

Practical value means 'in real life'

... reality disqualifies some systems for some apps.

IQMESH / Zigbee
comparison

Platform	License fees	Open	IP	Complexity
MiWi	No	Yes	No	Low
Zigbee	Yes	No	Routing	High
Zigbee Pro	Yes	No	Routing +	Very high
IQRF	No	Yes	Realization +	Low

Higher complexity results to higher costs

... and longer time-to-market

A MESH FAIRY TALE?

... MESH ... MESH ... MESH

... FUNNY WORLD OF BUSINESS

... MESH MANAGEMENT is a CHALLENGE

... EFFICIENT ORIENTED FLOODING

A MESH FAIRY TALE?

IQMESH CAN HELP IN/TO WMN

IQMESH WILL BE FULLY OPEN

Special thanks to the Ministry of Industry and Trade of Czech Republic, co-financing our projects "IQRF Smart House platform" and "Open Platform for Smart Cities", making our projects feasible.

Thank you for your patience!

IQRF

Smarter wireless. Simply.