



# **Antennas – The key for success in your IoT / M2M application**

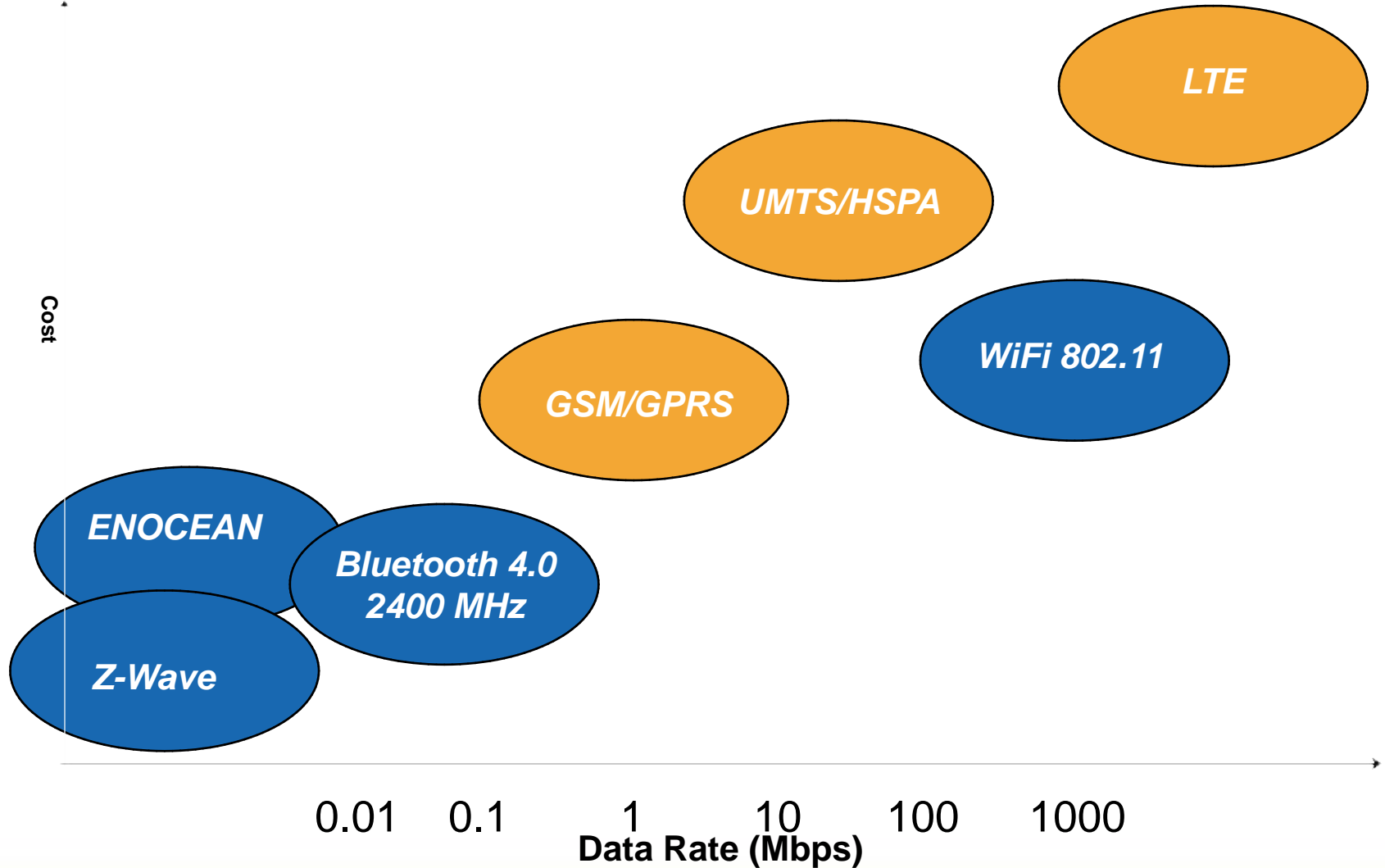
Harald Naumann  
Sales director @ tekmodul GmbH

Author of the  
**IoT M2M Cookbook**  
**How to develop a device based on Wireless Wide Area Network  
modules**

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# Wireless technologies at this presentation

Blue = low range / Orange = Terristic, wide range



# Trapmaster an example for IoT @ Hunting Based GSM module plus self-made PCB antenna



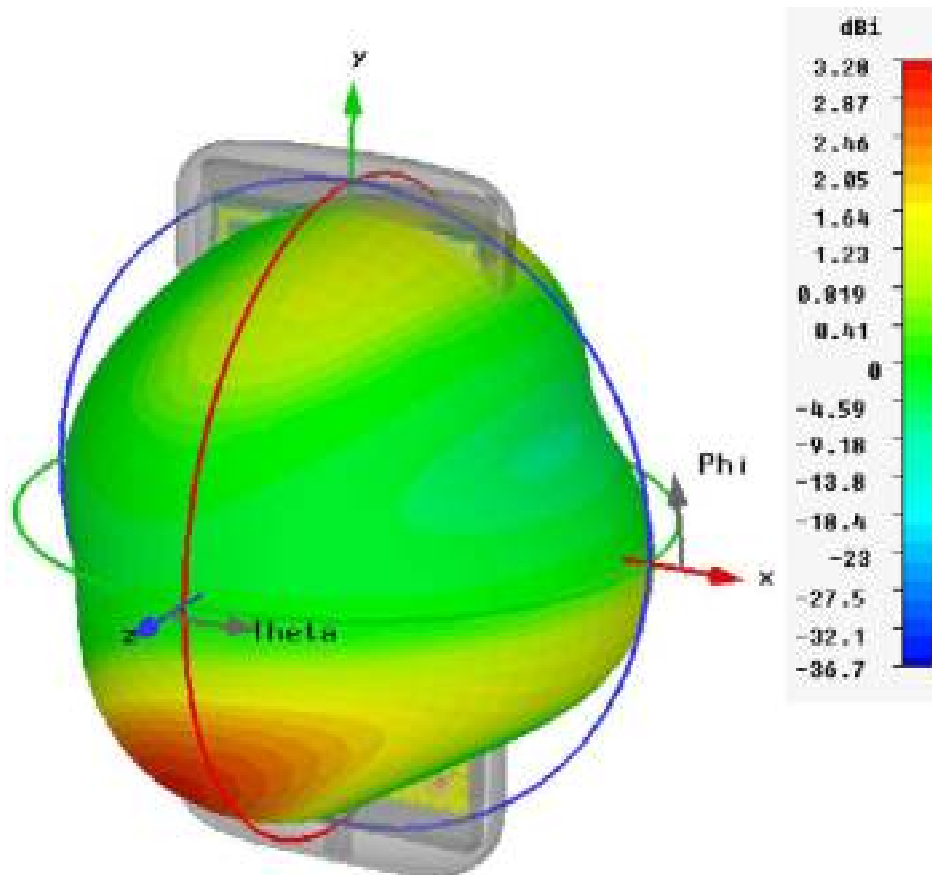
Credits: EBV Electronics GmbH [www.fallenmelder.de](http://www.fallenmelder.de)

# Simulation of PCB GSM quad band antenna



## Out of IoT M2M Cookbook - pattern at 1930 MHz

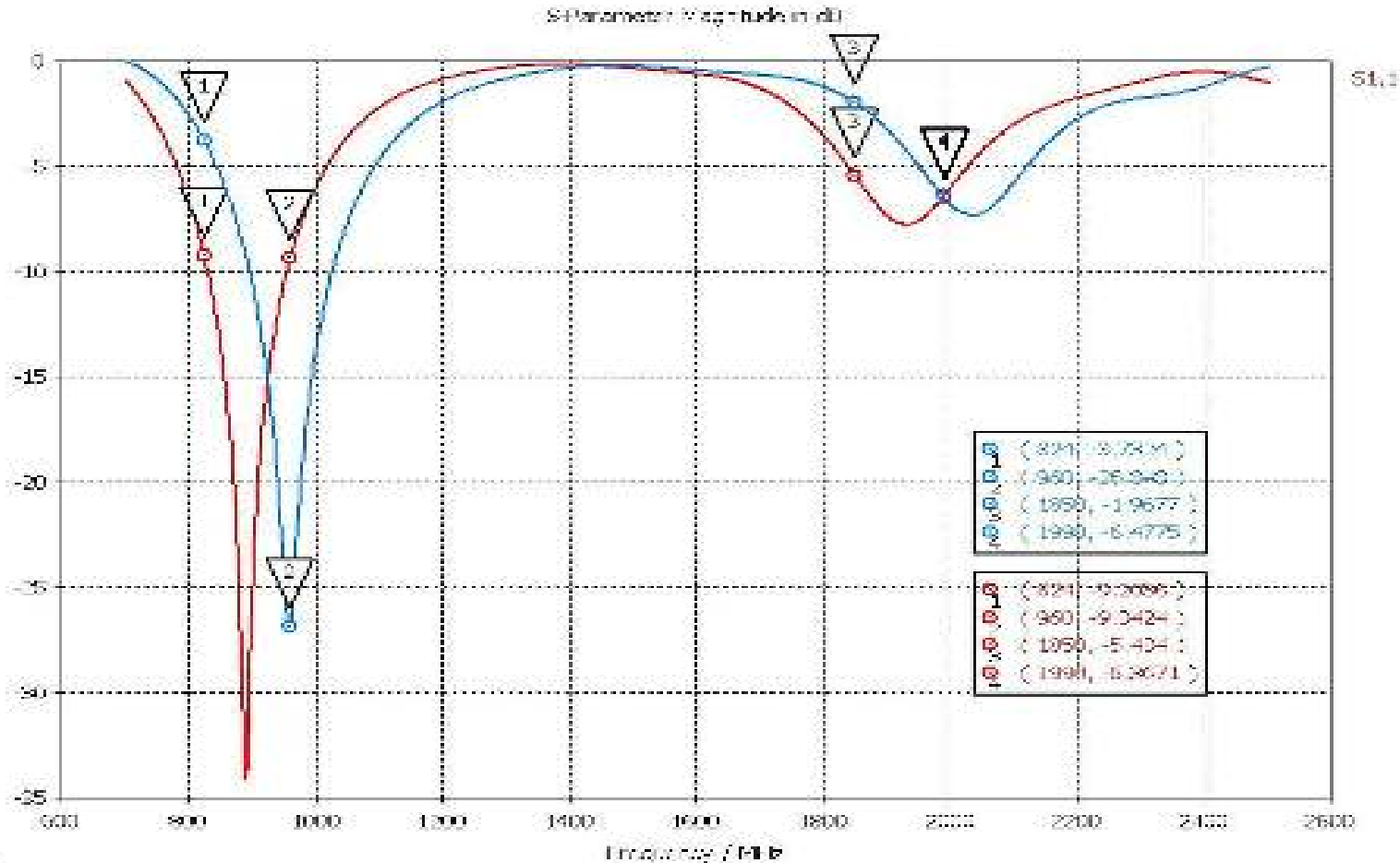
tekmodul



Credits: IoT M2M Cookbook - How to develop a device based on Wireless Wide Area Network modules More: [http://www.gsm-modem.de/M2M/m2m\\_iot\\_cookbook/](http://www.gsm-modem.de/M2M/m2m_iot_cookbook/)

# Interference of the plastic enclosure

Red curve with and blue curve without enclosure

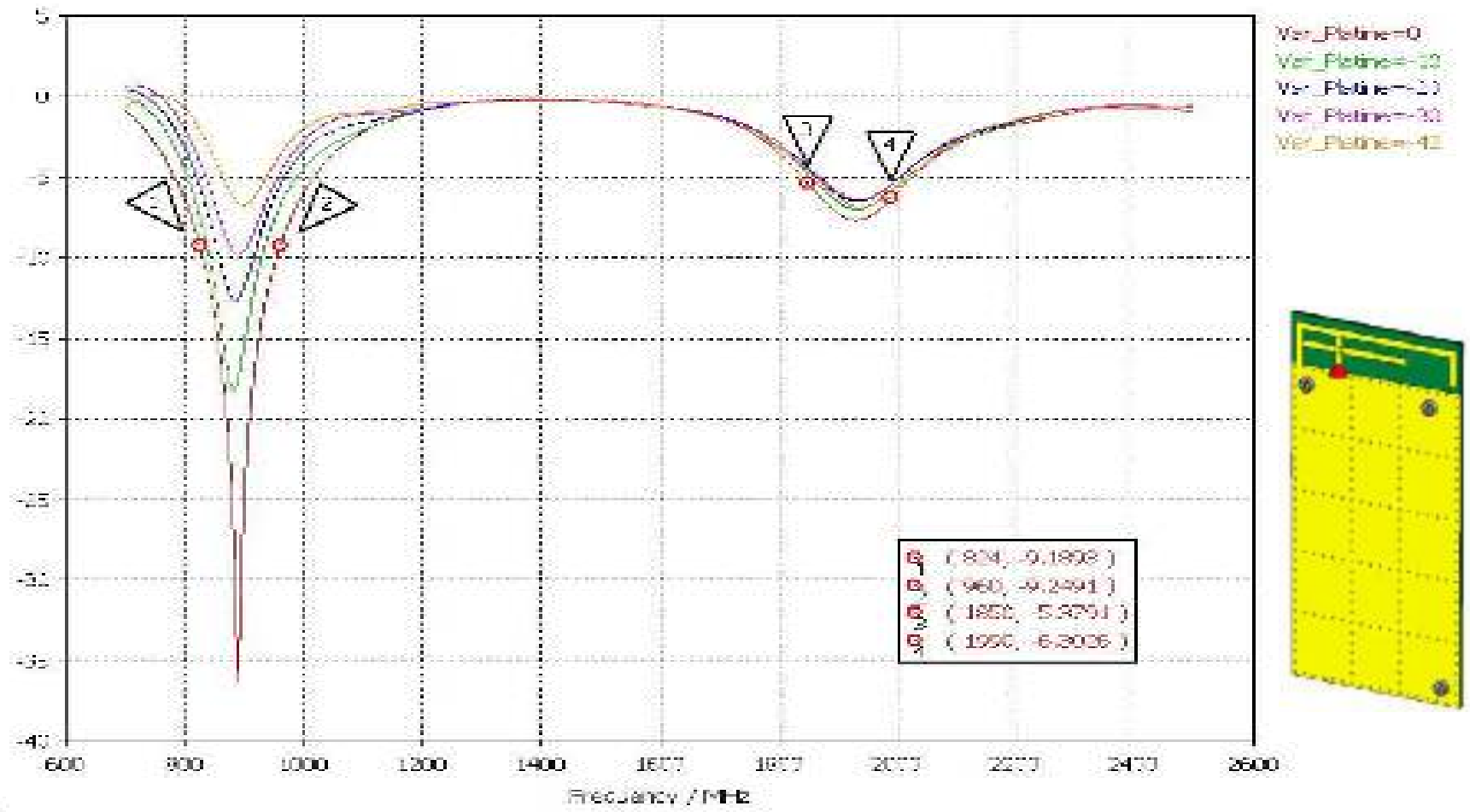


Reflection factor with and w/o plastic enclosure

Credits: IoT M2M Cookbook

# Influence of the length of the PCB

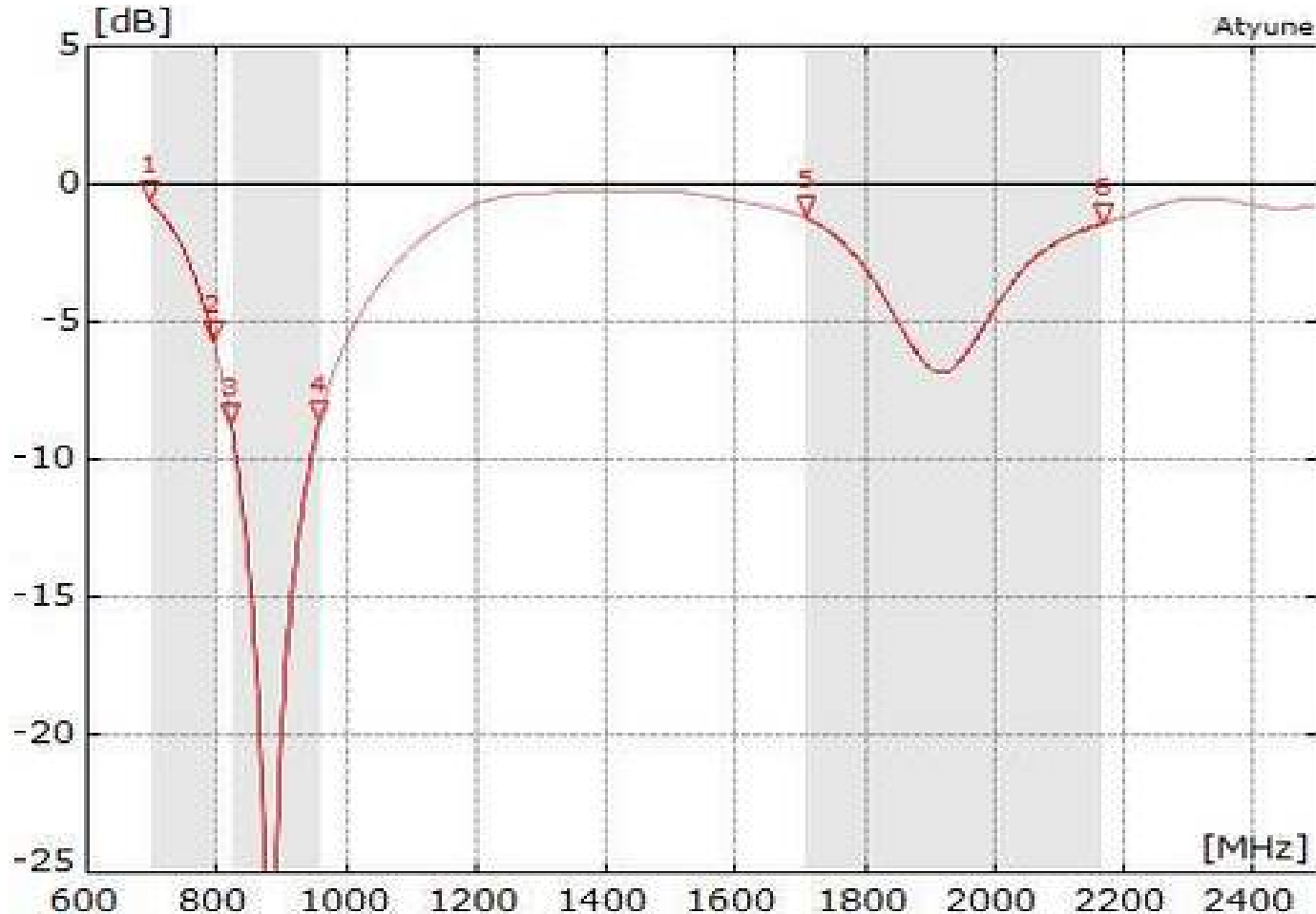
## Marker 1-2 GSM 850/900 and 3-4 GSM 1800/1900



The shorter the PCB the worse is the antenna performance  
Credits: IoT M2M Cookbook

# Trial to tune GSM quad band plus UMTS

1-2 = GSM 850, 3-4 = GSM 900, 5-6 = UMTS 2100

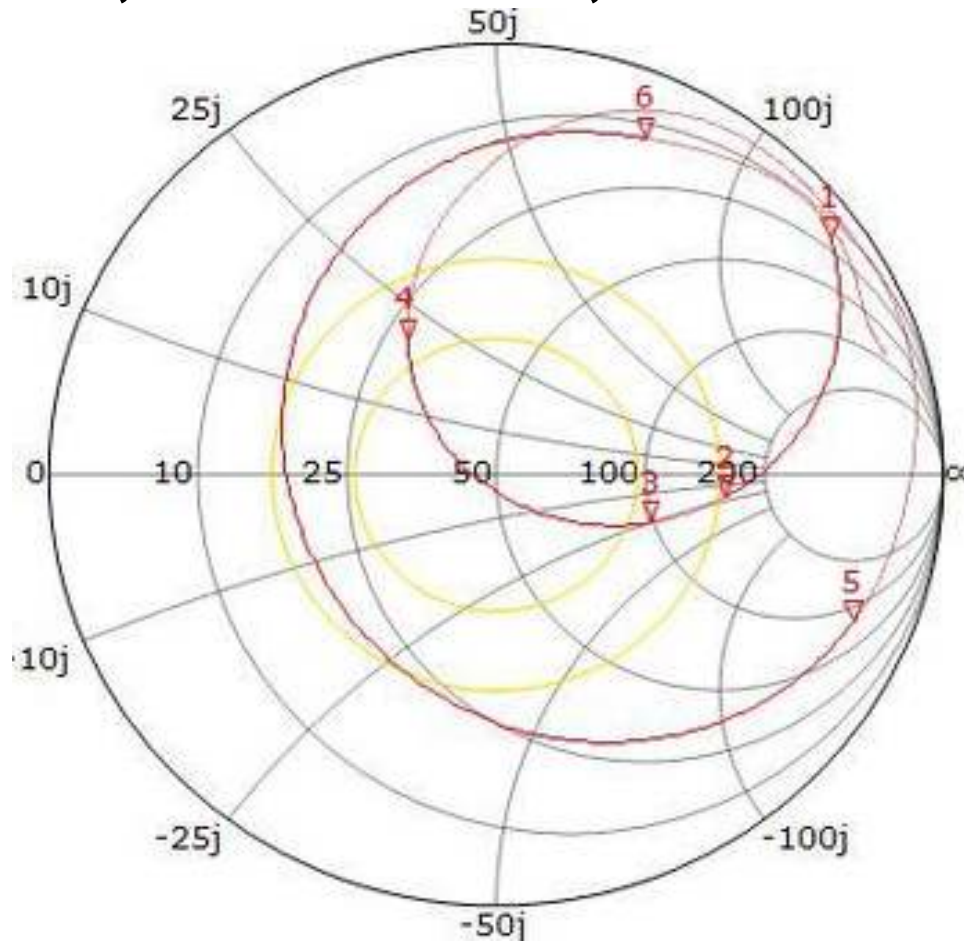


Reflection factor loaded to Atyune

Credits: IoT M2M Cookbook

# Trial to tune GSM quad band plus UMTS

1-2 = GSM 850, 3-4 = GSM 900, 5-6 = UMTS 2100

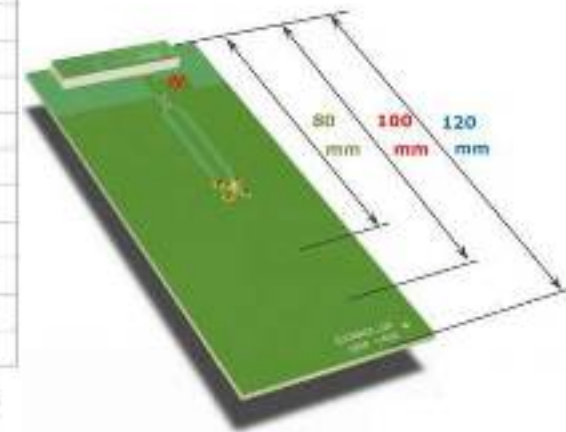
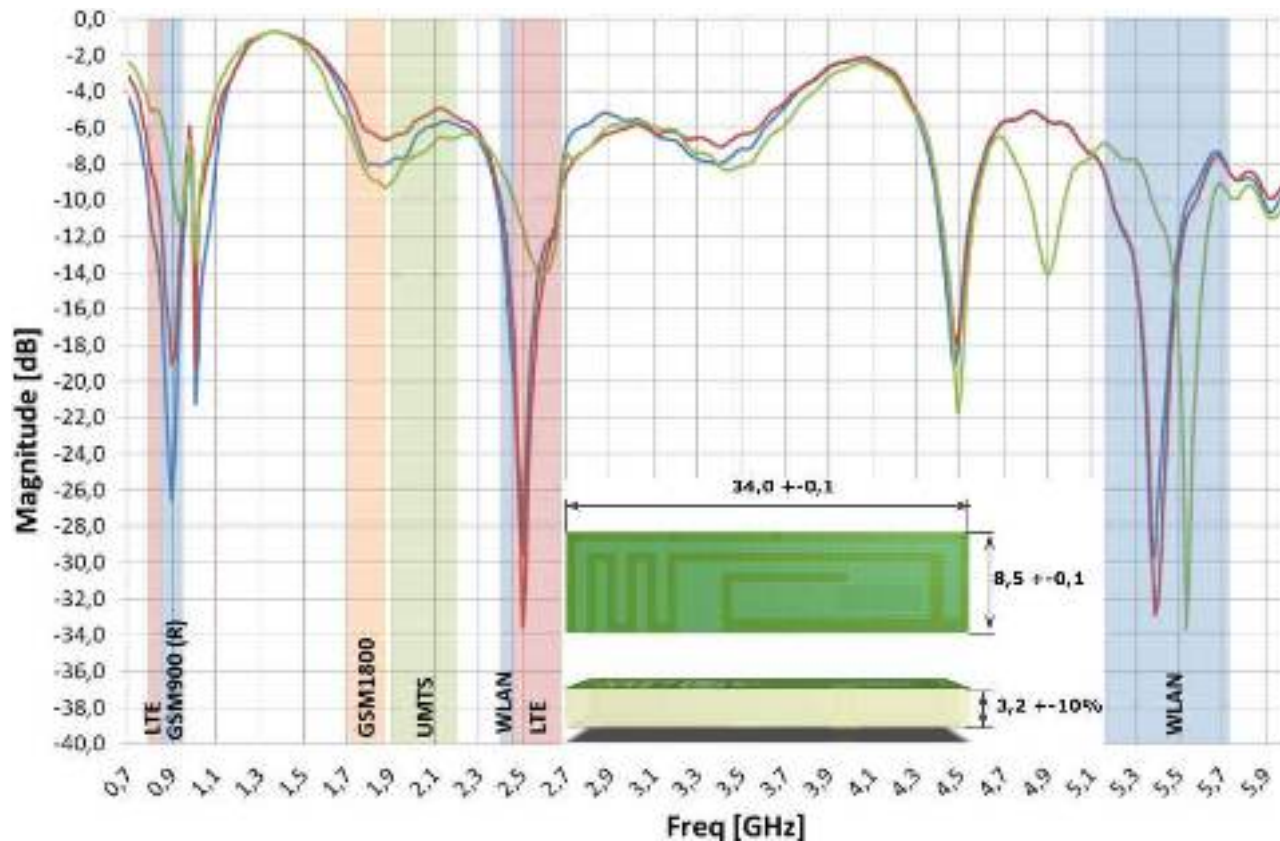


Smith Chart visible at Atyune  
Credits: IoT M2M Cookbook



# Out of the self ceramic LTE antenna

## Multi resonant in different bands



Reflection factor of ceramic LTE antenna on PCB with length of 80 mm, 100 mm and 120 mm

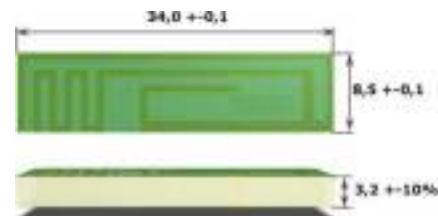
Eval kit with LTE antenna  
Credits: IoT M2M Cookbook

# Off the self LTE ceramic chip antenna

## Antenna efficiency in different bands

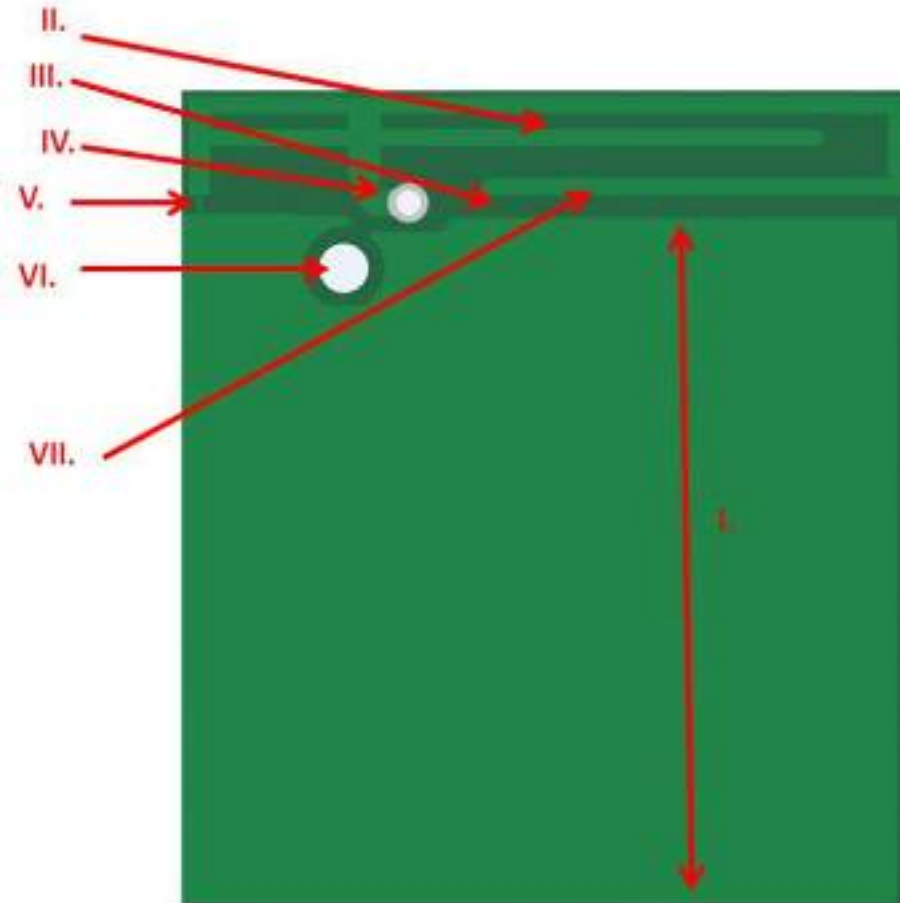
Frequency band	Range [MHz]	Efficiency typ. [%]	Impedance [ $\Omega$ ]	Refection factor typ. [dB]	Gain typ. [dBi]
LTE800 (E-UTRA Band 20)	791-862	75	50	-7,0	2,0
GSM850 GSM900	824-894 870-960				
LTE1800 (E-UTRA Band 3)	1710-1875,4	50		-4,5	2,4
GSM1800 (DCS1800)	1710-1880				
GSM1900 (PCS1900) UMTS	1850-1910 1900,1-2170	80		-9,0	4,5
WLAN IEEE 802.11b/g/n	2400-2483,5				
LTE2600 E-UTRA Band 7	2500-2690				
WLAN IEEE 802.11n/ac	5150-5725	50	-5,0	4,2	

Credits : IoT M2M Cookbook



# GSM PCB antenna

## Design review

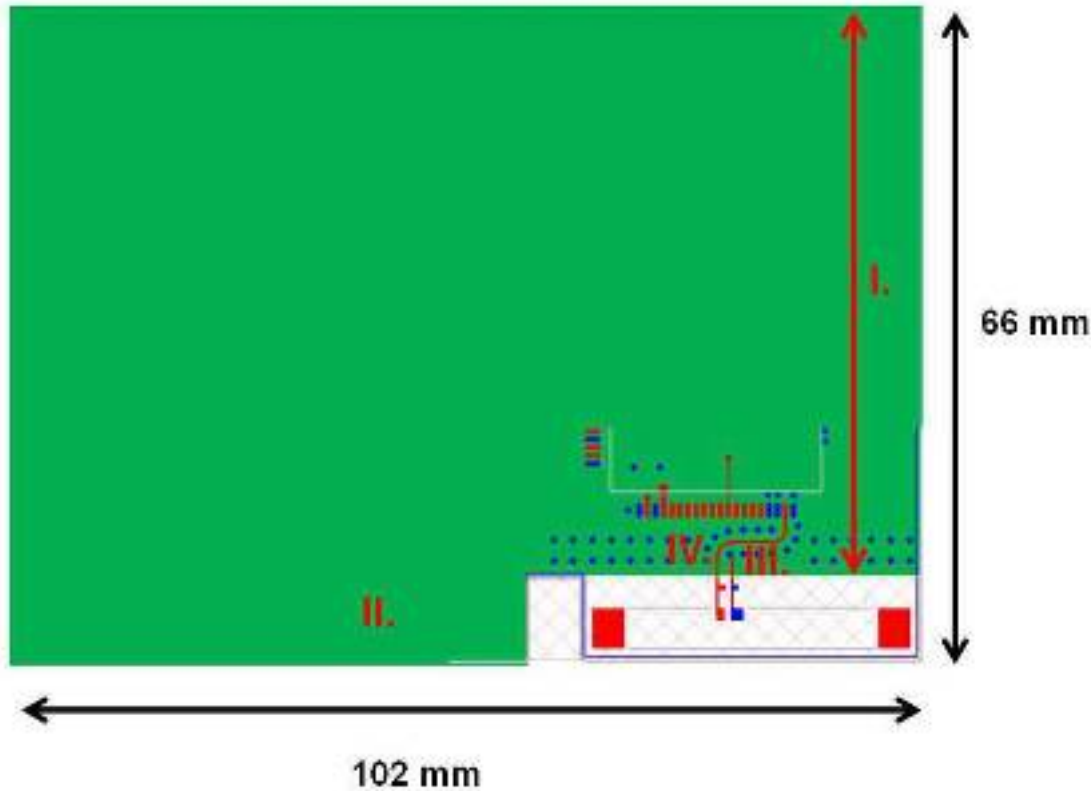


- I. Size of antenna ground plane
- II. Distance between the two GSM antenna radiators
- III. Distance between the GSM antenna radiator for 850/900 MHz
- IV. Via hole in the antenna feeding
- V. Width of PCB structure
- VI. Big via hole close to the GSM antenna
- VII. Bending of the antenna radiator for the lower GSM band

*Credits: IoT M2M Cookbook*

# Ceramic chip antenna

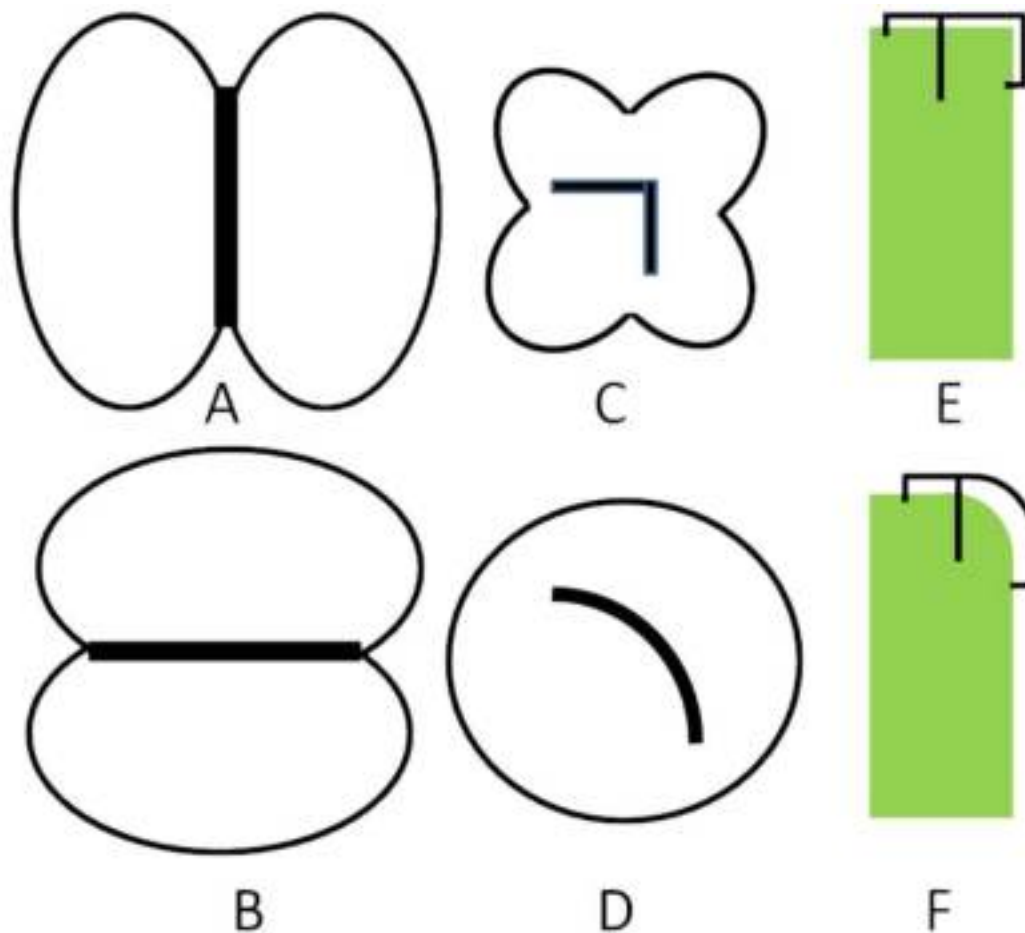
## Design review



Credits : IoT M2M Cookbook

# Example for 433,868 or 2400 MHz antenna

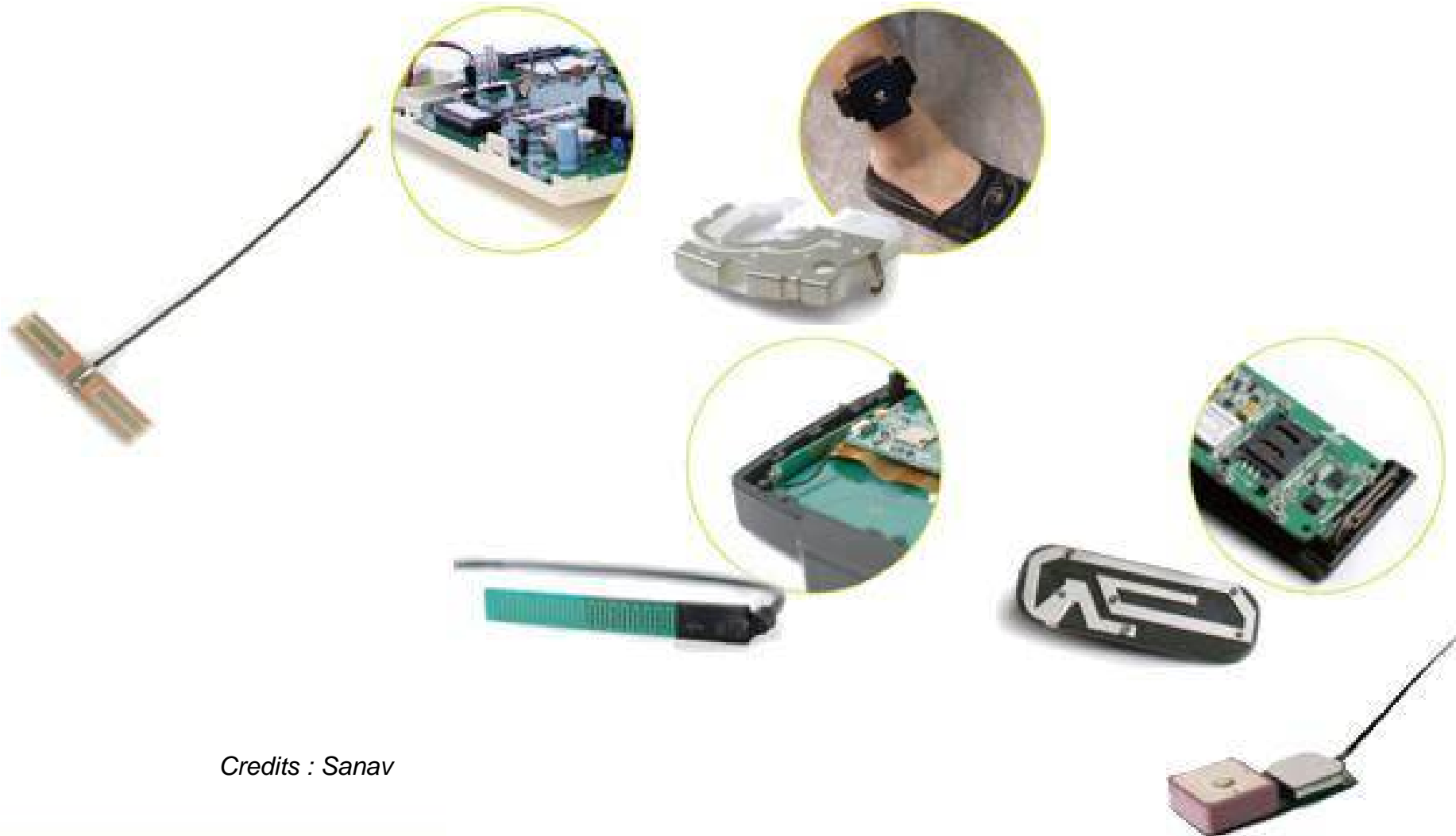
## How to design a nearly omni-directional pattern?



*Credits : Harald Naumann*

# No non-recurring engineering costs

## No NRE costs for your antenna by 10K order




*Credits : Sanav*

# Antenna Hospital @ Europa room, stand 49




tekmodul

## Today we will measure your antenna for free

Antenna Hospital  tekmodul

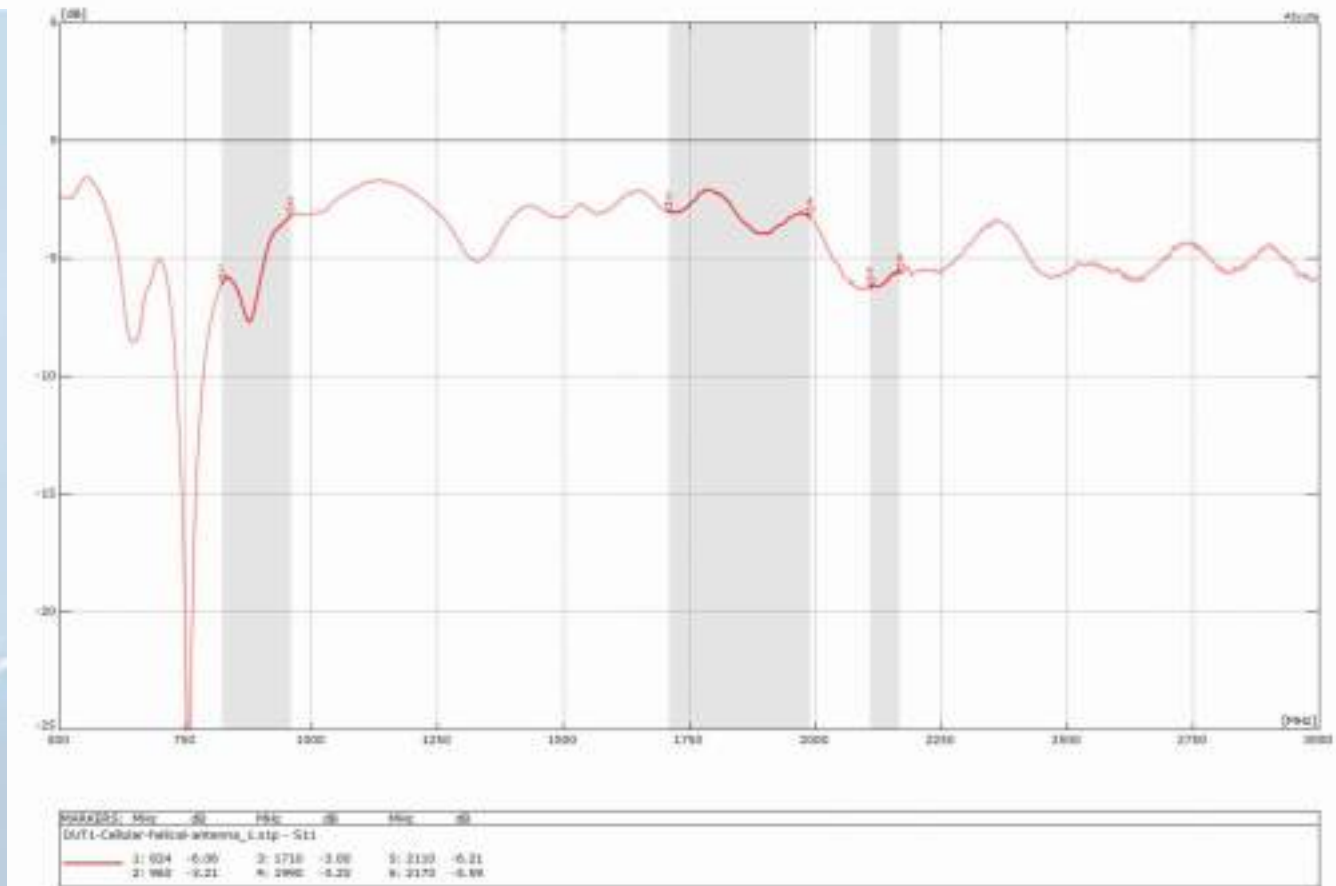
Antenna analysis, design check, customisation ...



good, matched

bad

[www.tekmodul.de](http://www.tekmodul.de)




Red curve bad, several mistakes, impossible to tune

# Antenna Hospital @ Europa room, stand 49




Today we will measure your antenna for free

tekmodul

Antenna Hospital  tekmodul

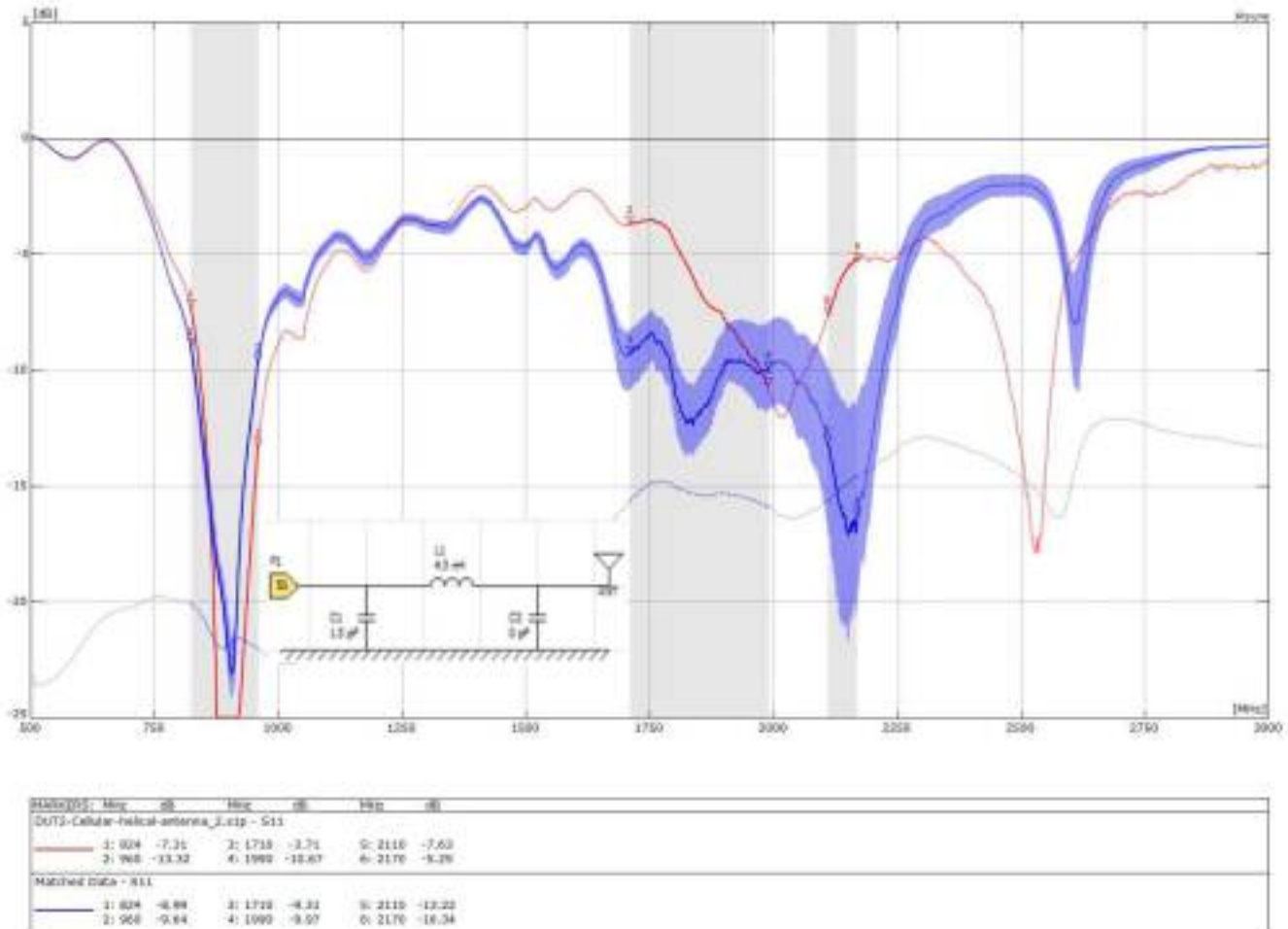
Antenna analysis, design check, customisation ...



good, matched

bad

[www.tekmodul.de](http://www.tekmodul.de)



Red curve good, blue curve better and already matched



# Quectel cellular and GNSS modules

## Examples for cellular and GNSS modules



LTE module EC20 &  
HSPA module UC20



GPRS / BT module  
M66



LTE module EC20 &  
HSPA module UC20  
(Mini PCIe)



GNSS module L76

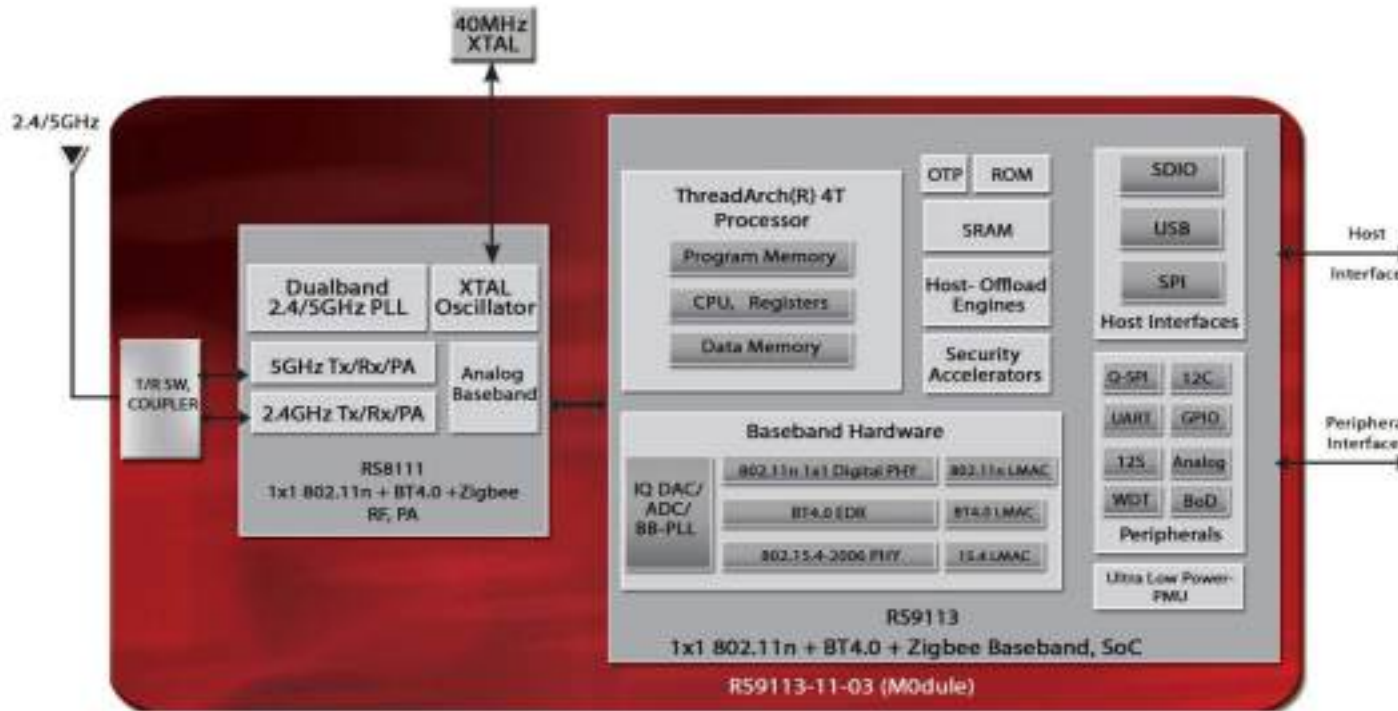


GNSS module L86

*Credits Quectel*

# Combined Wi-Fi module

## Wi-Fi + 802.15.4 + Classic BT + BLE

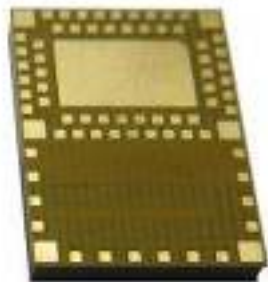


Credits: Redpine Signals

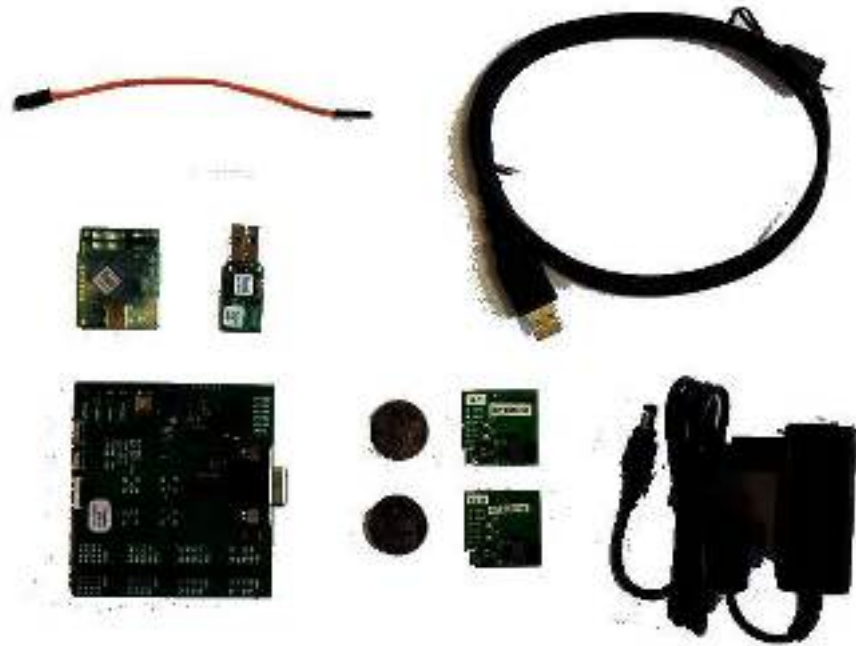


# Bluetooth Low Energy Eval kit

## Including source code for application



BLE module with  
embedded antenna



BLE module sensor evaluation kit

*Credits: Insight SIP*

# Components for your IoT M2M application

## Let's talk about wireless modules & antennas



**Antennas**

LTE, UMTS, HSPA, GPRS, Wi-Fi, BT, GNSS, ISM ...

- LTE MIMO
- LTE
- LTE
- UMTS
- LTE
- GPRS
- GPS/Glonass
- BT/Wi-Fi
- Customised

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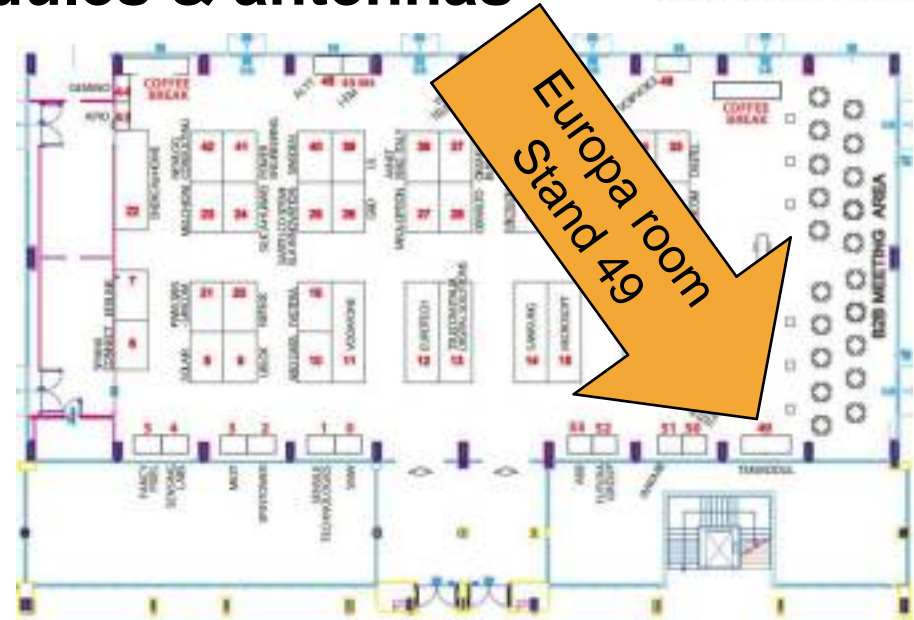


**Wireless modules**

LTE, UMTS, HSPA, GPRS, Wi-Fi, BLE, BT, GNSS, ISM ...

- LTE
- GPRS
- Bluetooth LE
- GPRS
- GPS/Glonass
- UMTS

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