On the coexistence of satellite – UMTS and Galileo with SDR receiver

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Desired system:

- ✓ Reconfigurable – able to treat different signal at the same time.
- ✓ Multi-services – offer more services with no additional hardware costs for the receiver.

Possible solution:

SOFTWARE DEFINED RADIO (SDR)

Software Defined Radio technology can offer:

- ✓ Flexible architecture controlled and programmable via software.
- ✓ Digital elaboration instead radio functionality
- ✓ Dynamic reconfigurability by software download.
- ✓ Multimodal and multi-standard terminal.
- ✓ Complete control of all radio parameters.

Target: **coexistence**, in the same receiver, between Global Navigation Satellite Systems and telecommunication systems.

Proposal: develop a **unique receiver** employable for communication and satellite navigation.

GSM, UMTS, GPRS, WLAN

GPS, Galileo, GLONASS, NAVSTAR

Integration

mobile services:
GSM, UMTS, S-UMTS

positioning services:
GPS, Galileo

INTEGRATION

flexibility

modularity

Positioning + mobile communication services:

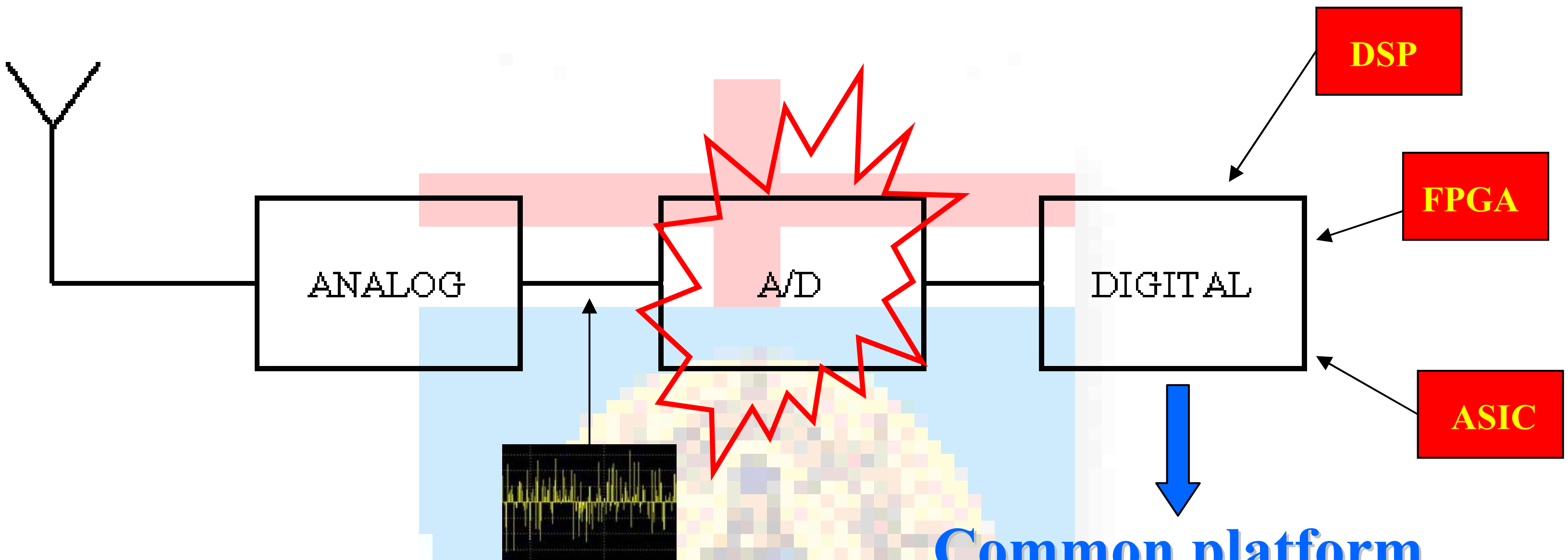
TECHNOLOGY

SOFTWARE RADIO

Reconfigurable receiver

ISIP 40

SDR forum



Common platform adaptable *via* software

Analog part is limited to high-frequency modules

Deployment of software modules instead of hardware ones

The most critical part is A/D converter

Satellite UMTS provides worldwide access to UMTS services even in areas where terrestrial networks are technically or economically not feasible.

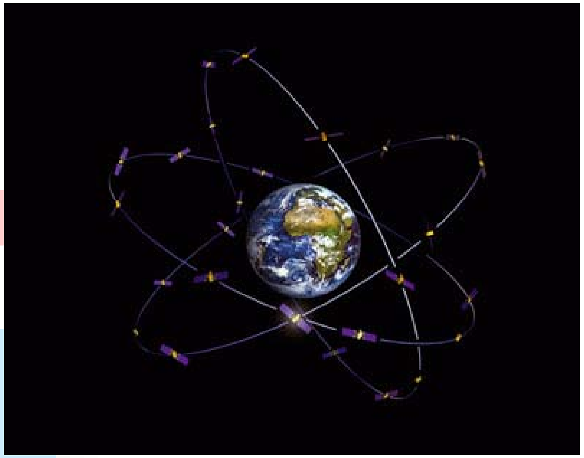
Two operating modes were identified

Satellite Wideband Code Division Multiple Access (SW-CDMA)

Satellite Wideband Code and Time Division Multiple Access (SW-CTDMA)

Adaptation of T-UMTS for satellite: specifications are still evolving at ITU

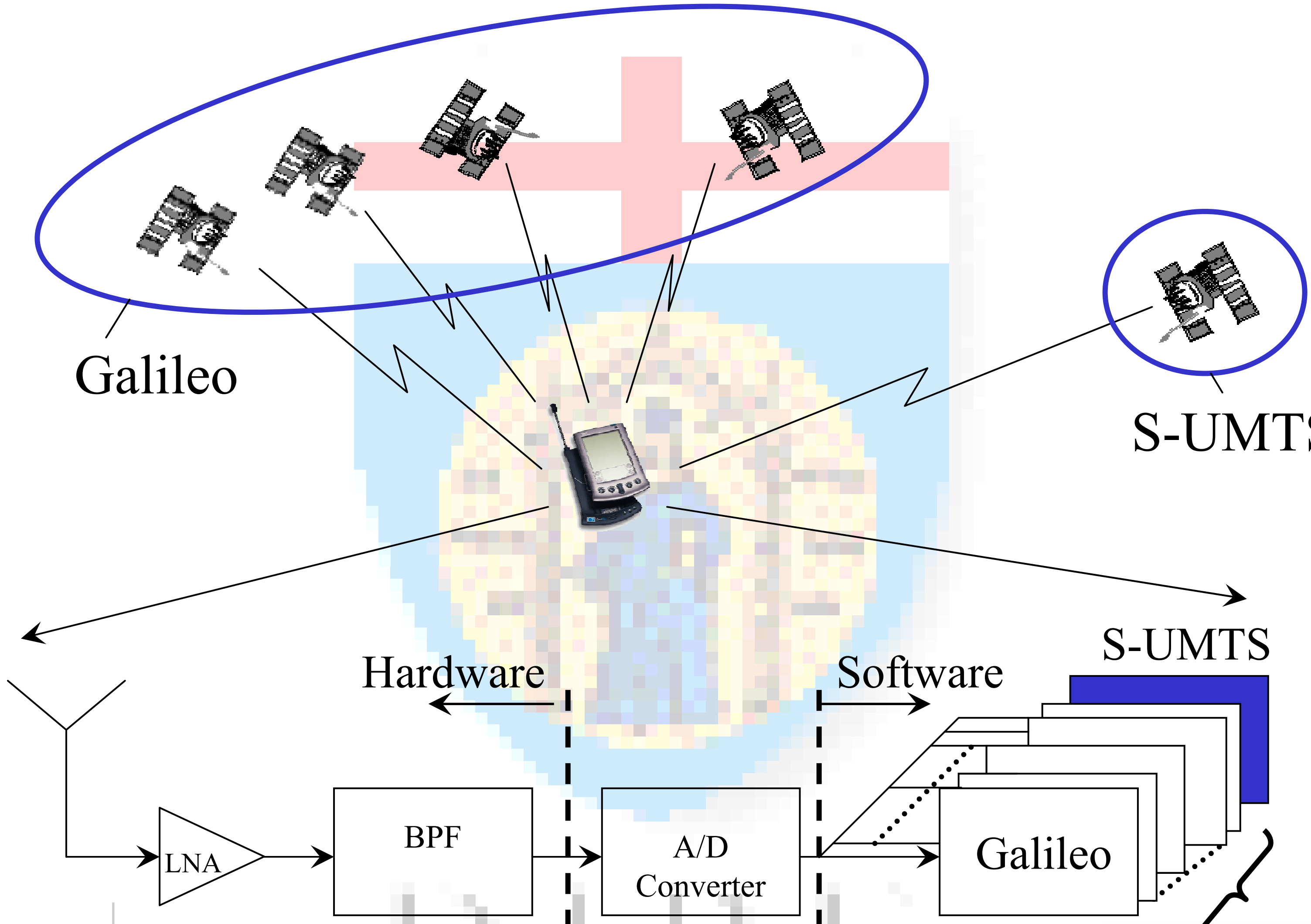
Multiple access scheme	WCDMA
Duplex scheme	FDD
Chip rate	3.84Mchip/s
Carrier spacing	4.4-5.0MHz (200 kHz raster)
Modulation type	QPSK



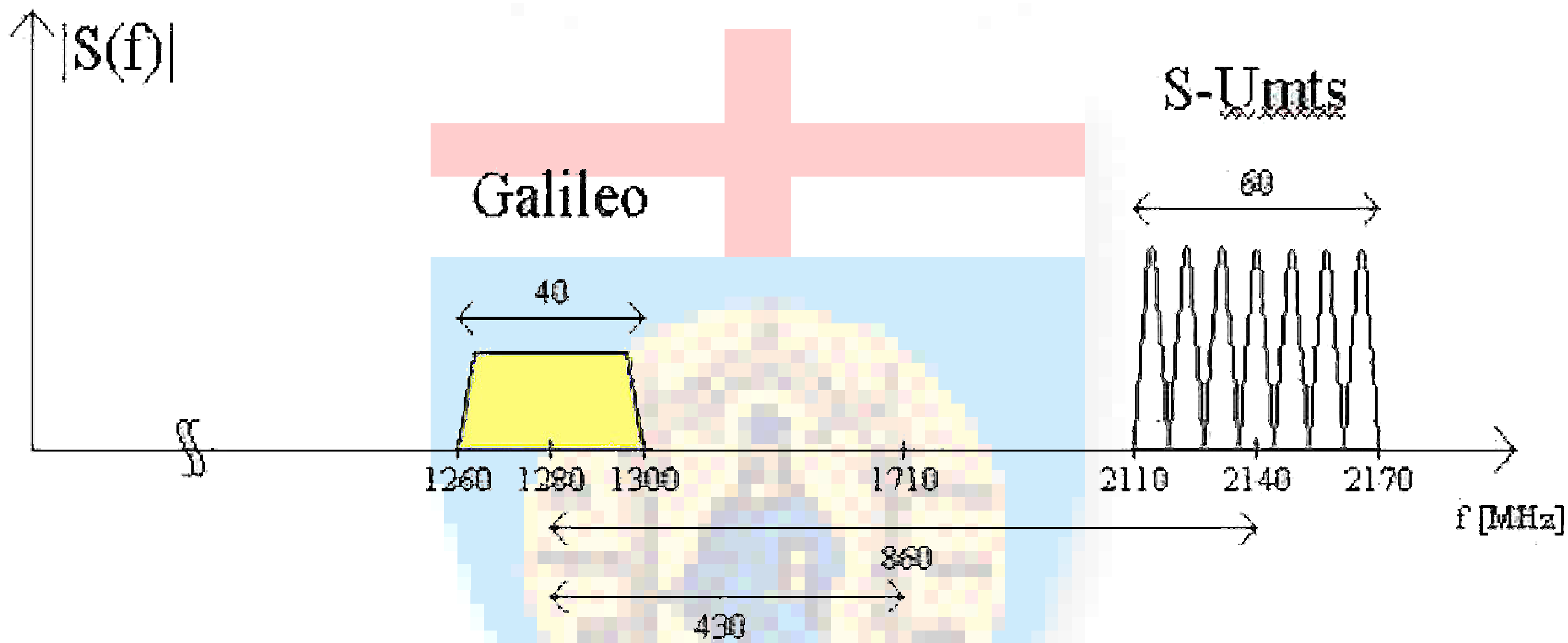
- ✓ Constellation of MEO satellites.
- ✓ CDMA transmission.
- ✓ In the “European standalone scenario”:

Modulation	QPSK
Data message bit-rate	125 bps in the in-phase signal
Pilot signal	In the quadrature signal
Pseudo-noise codes	Gold sequences: chip-rate 20.46 Mchip/s and length 8184
Central frequency	1280 MHz (E6 band)
Received power level	-159.6 dBw

Proposed Method

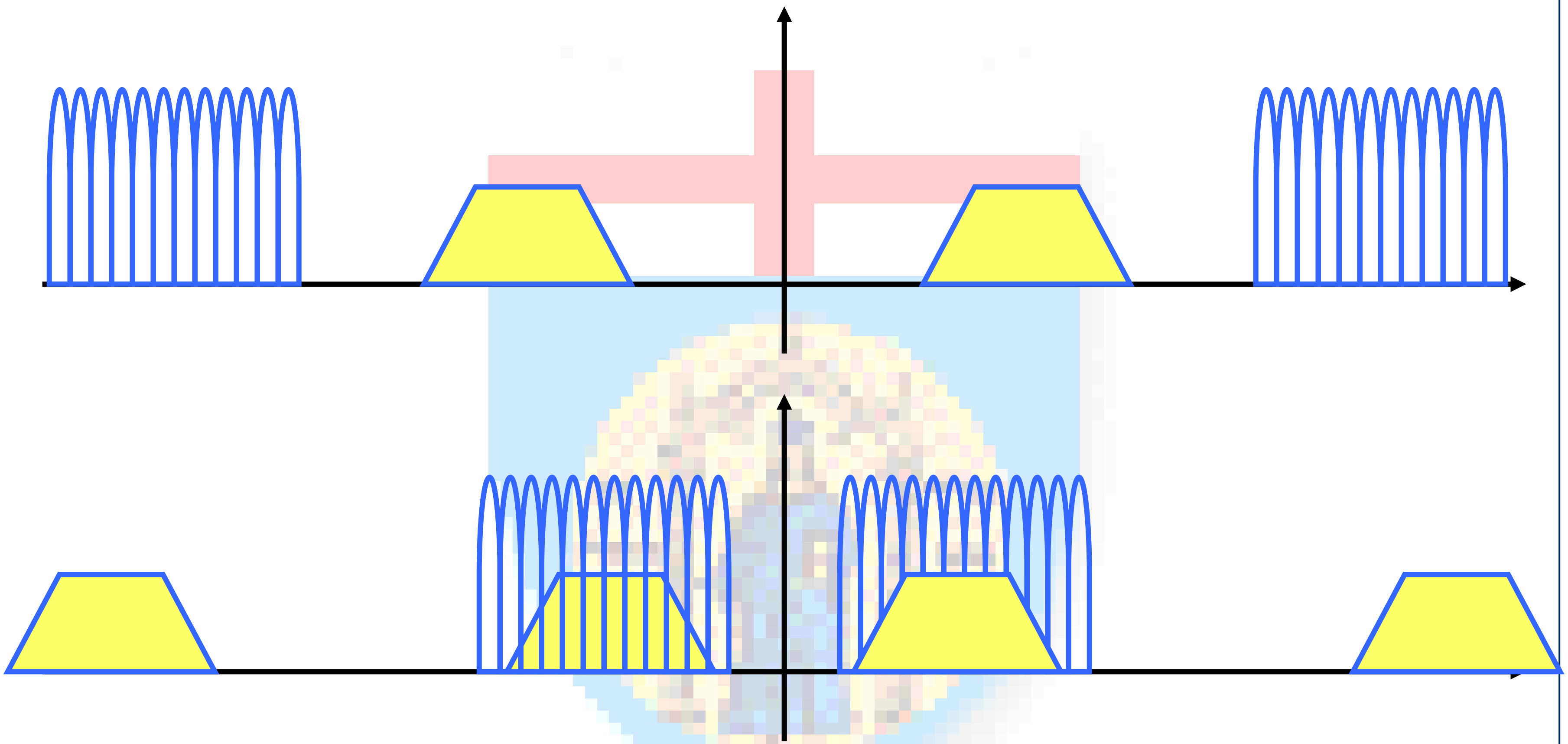


Frequency Allocation



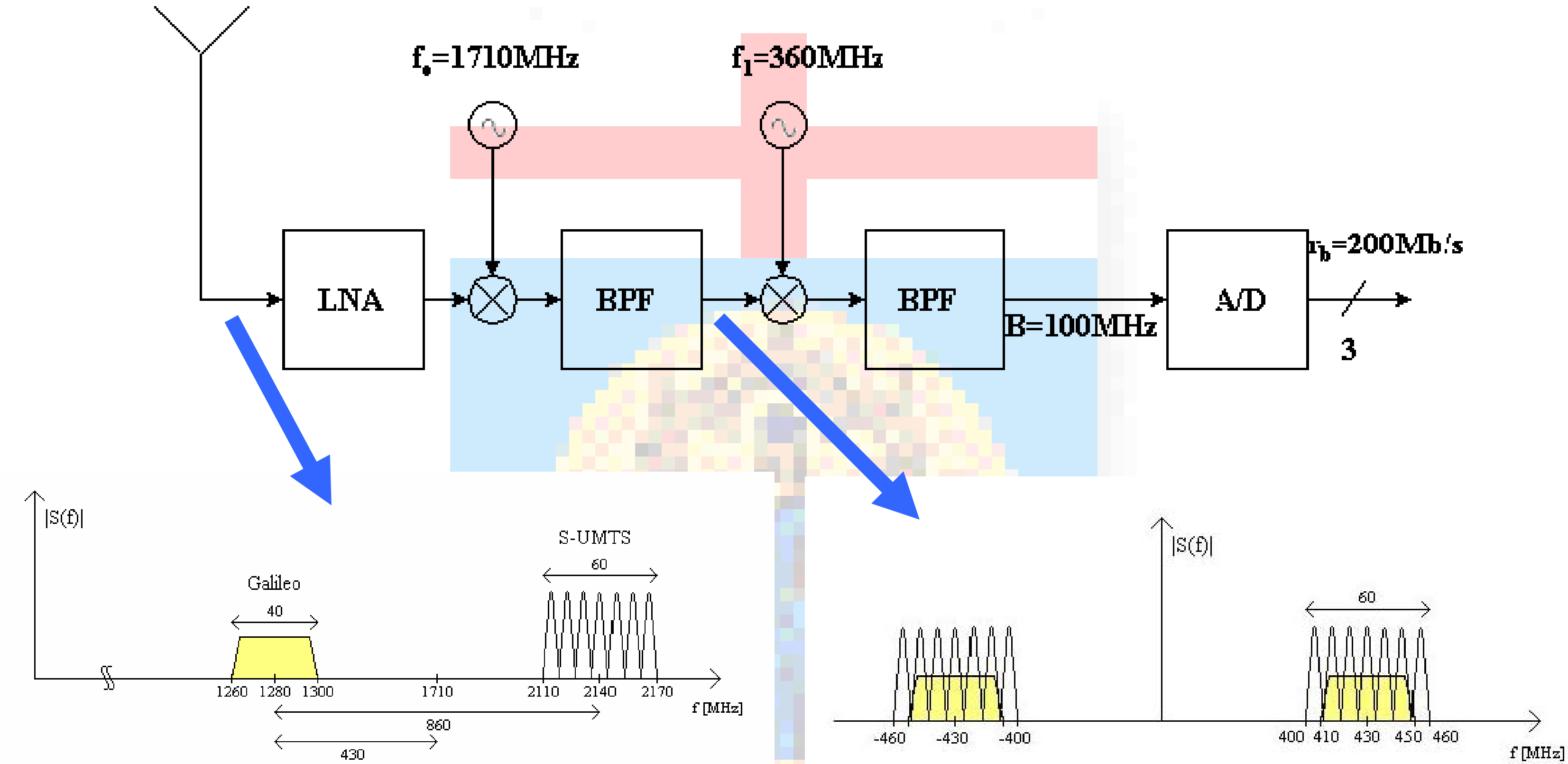
Due to the huge distance among the frequencies of the two standards a conventional super-heterodyne receiver cannot have great performances

Down-conversion Proposed Method



Two demodulation stages are used: the first stage overlap UMTS and Galileo signals at an Intermediate Frequency (IF) of 430 MHz, using image frequency instead of filtering signal before modulation to suppress it

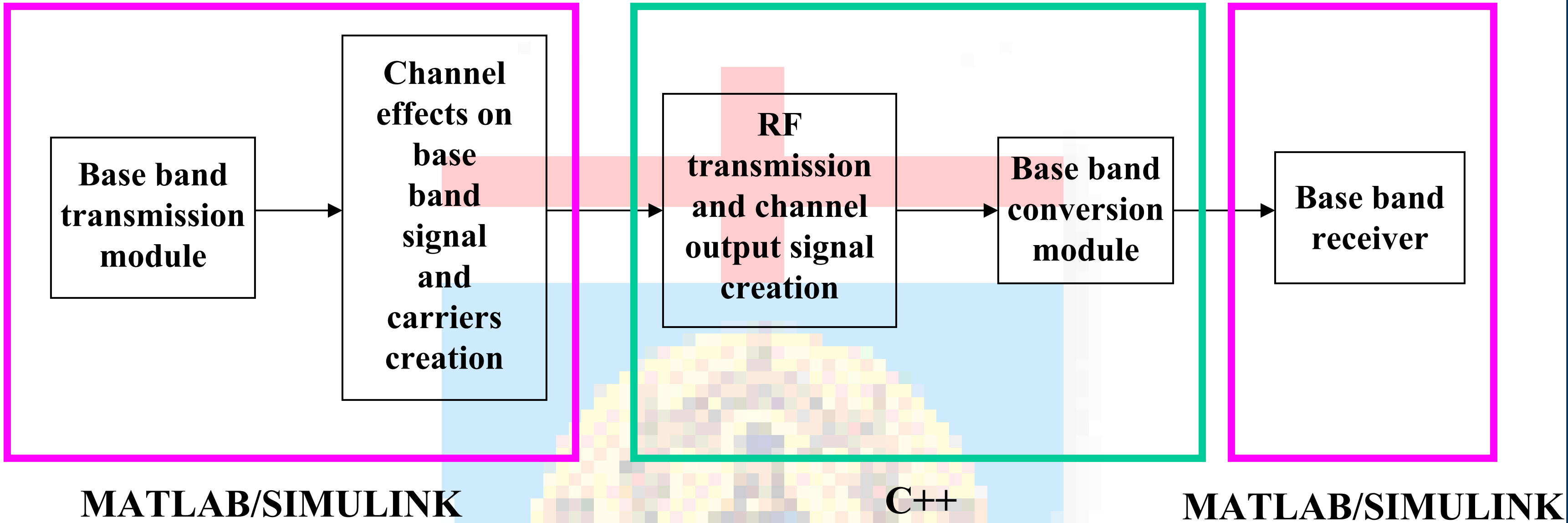
Proposed Receiver



Received signal

First stage demodulated signal

Simulation method



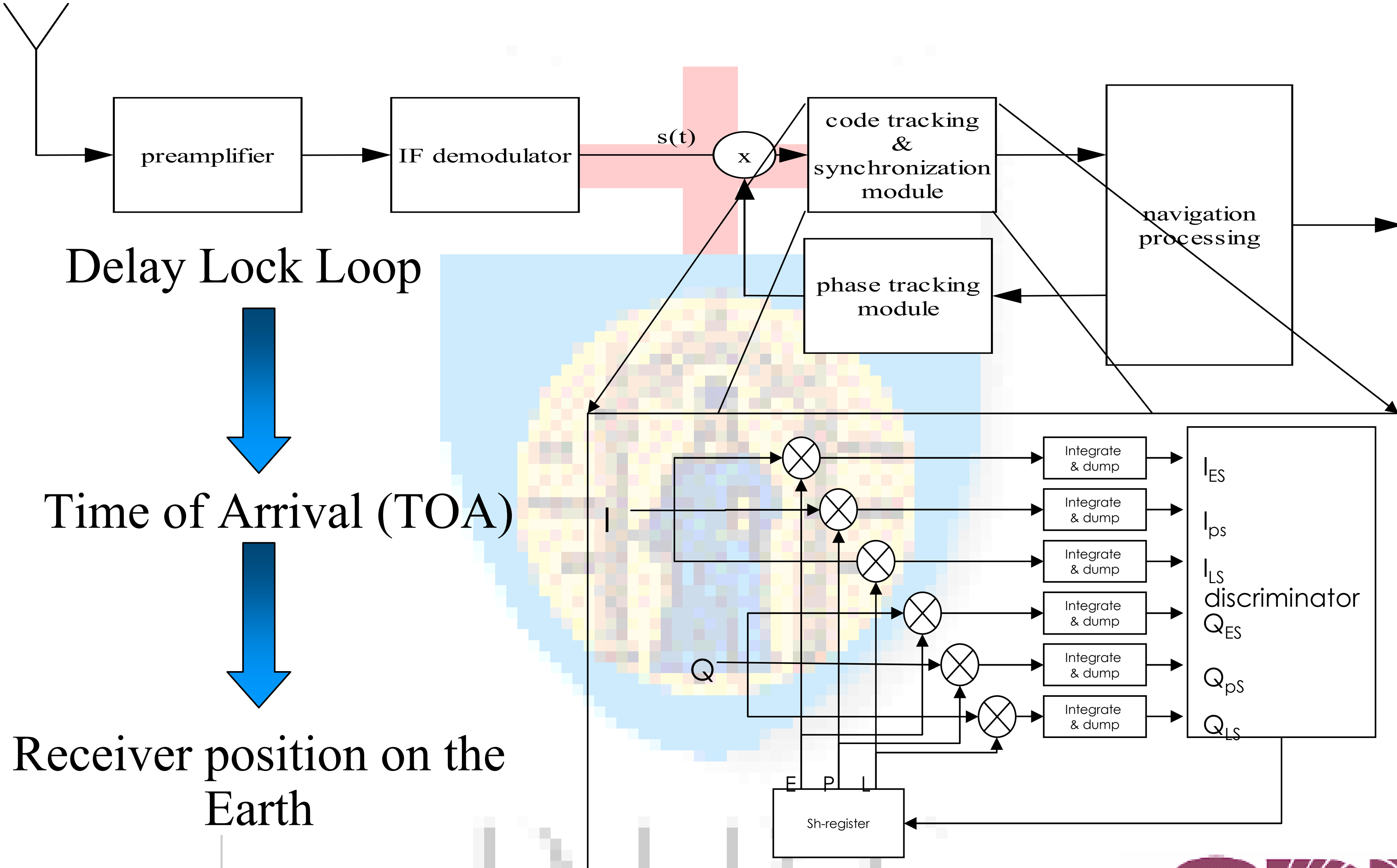
To demonstrate effectiveness of the proposed approach a simulation environment has been developed:

- ✓ Whole UMTS and Galileo transmitter and channel effects have been simulated using MATLAB™ SIMULINK™ 6.0 environment
- ✓ RF transmission and demodulation effects has been simulated using C++
- ✓ Whole Galileo receiver has been implemented using MATLAB™ SIMULINK™ 6.0 environment

Simulations are done by using low pass equivalent signals and assuming:

- ✓ Four satellites in view for the Galileo system;
- ✓ AWGN channel;
- ✓ UMTS transmission from LEO satellites at 3KW power;
- ✓ 12 UMTS channels in the considered bandwidth;
- ✓ For every UMTS channel 3 overlapped coded channels, one at bit-rate 16 Kb/s and the other two at bit-rate 8 Kb/s, are considered;
- ✓ UMTS frequency spacing 5 MHz.

Receiver Model



Delay Lock Loop

↓

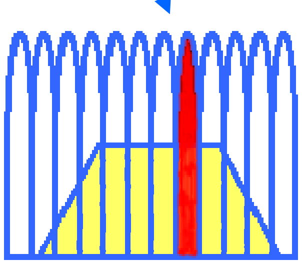
Time of Arrival (TOA)

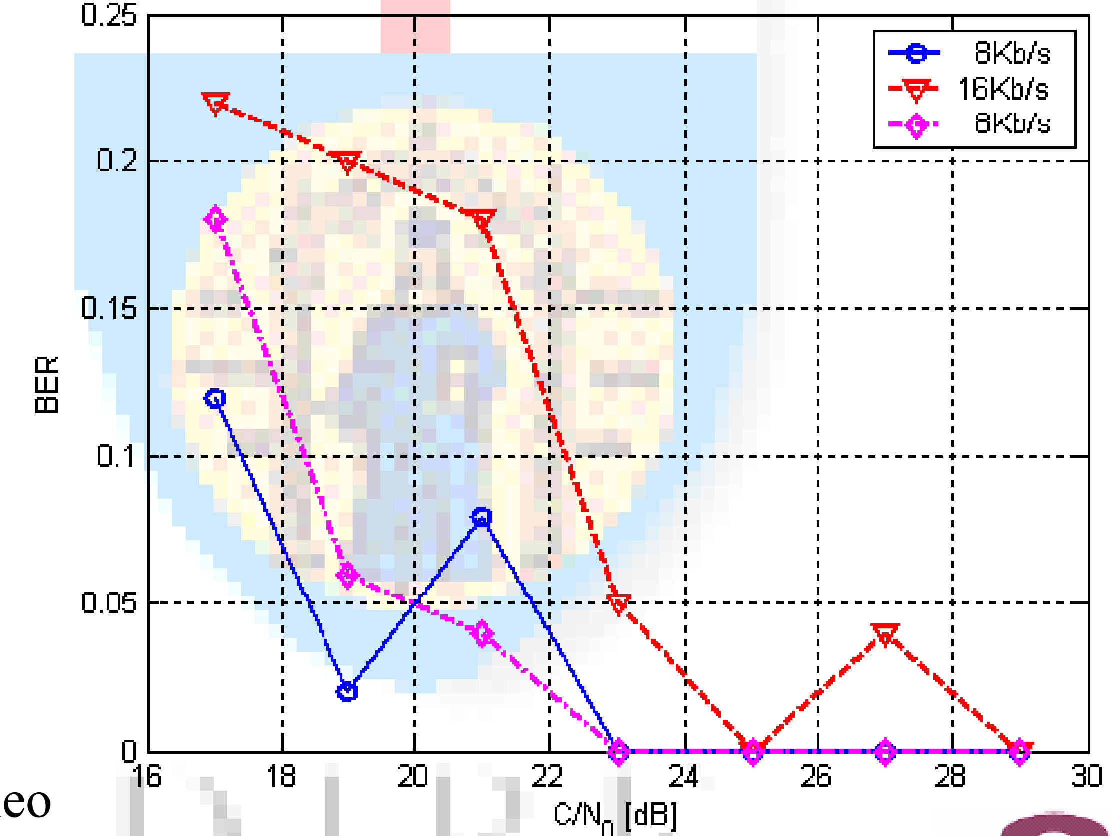
↓

Receiver position on the Earth

UMTS BER in case of central channels
(7,5 MHz from the central frequency)

Presence of Galileo signal



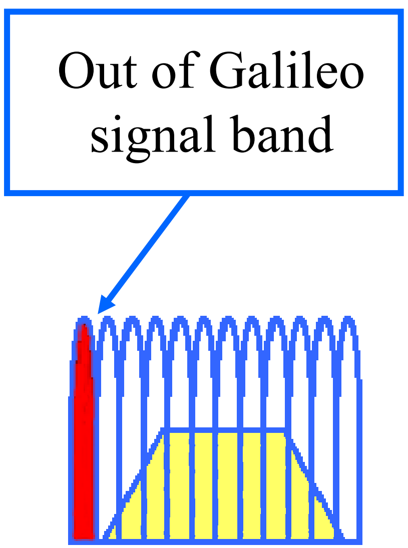


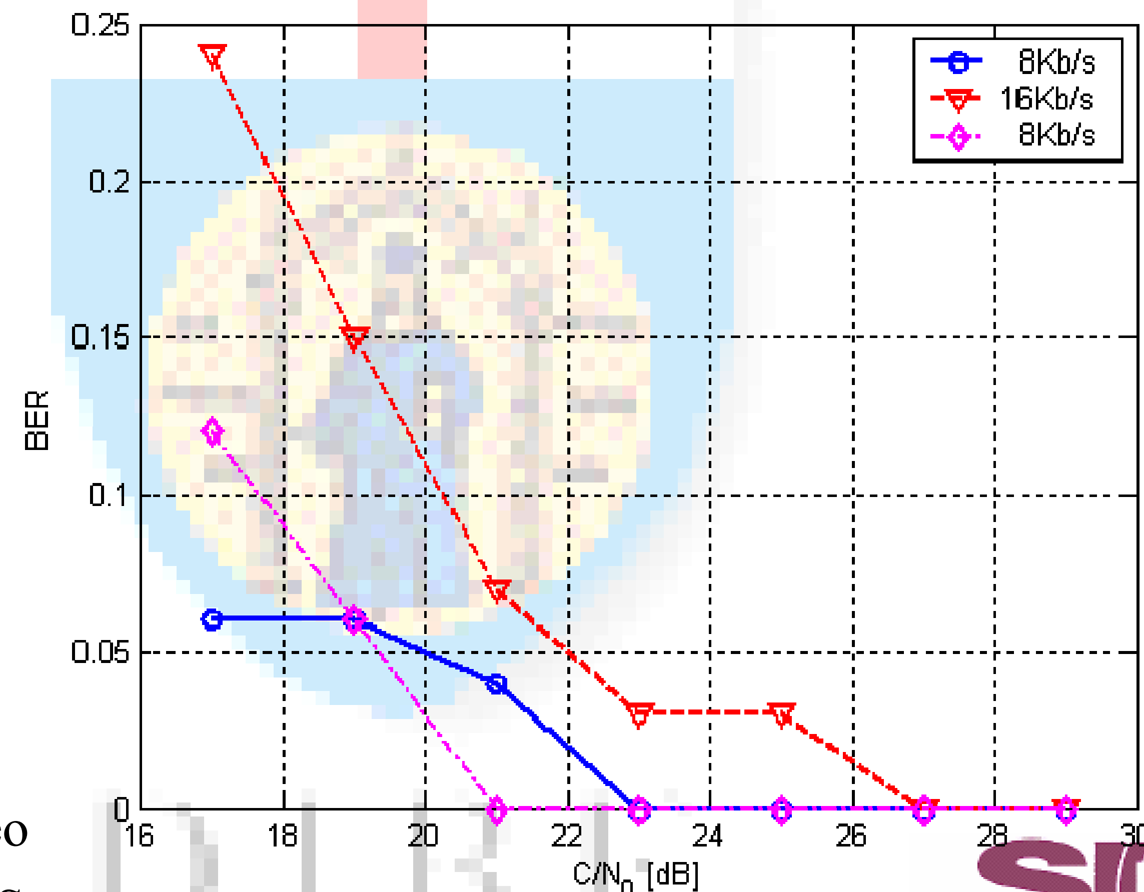
Galileo

UMTS

UMTS BER in case of external channels

(27,5 MHz from the central frequency)





- Galileo
- UMTS

•A method to **integrate positioning and cellular services** is presented. This method permits to model an A/D converter with less stringent properties.

•The achieved results shows that the **integration of UMTS and Galileo services is a traversable method**.

•The **S-UMTS performances are not reduced** by the presence of a Galileo signals.

•Future works will deal with the study of possible methods to recognised the transmission standard present on the channel.

Proposers

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