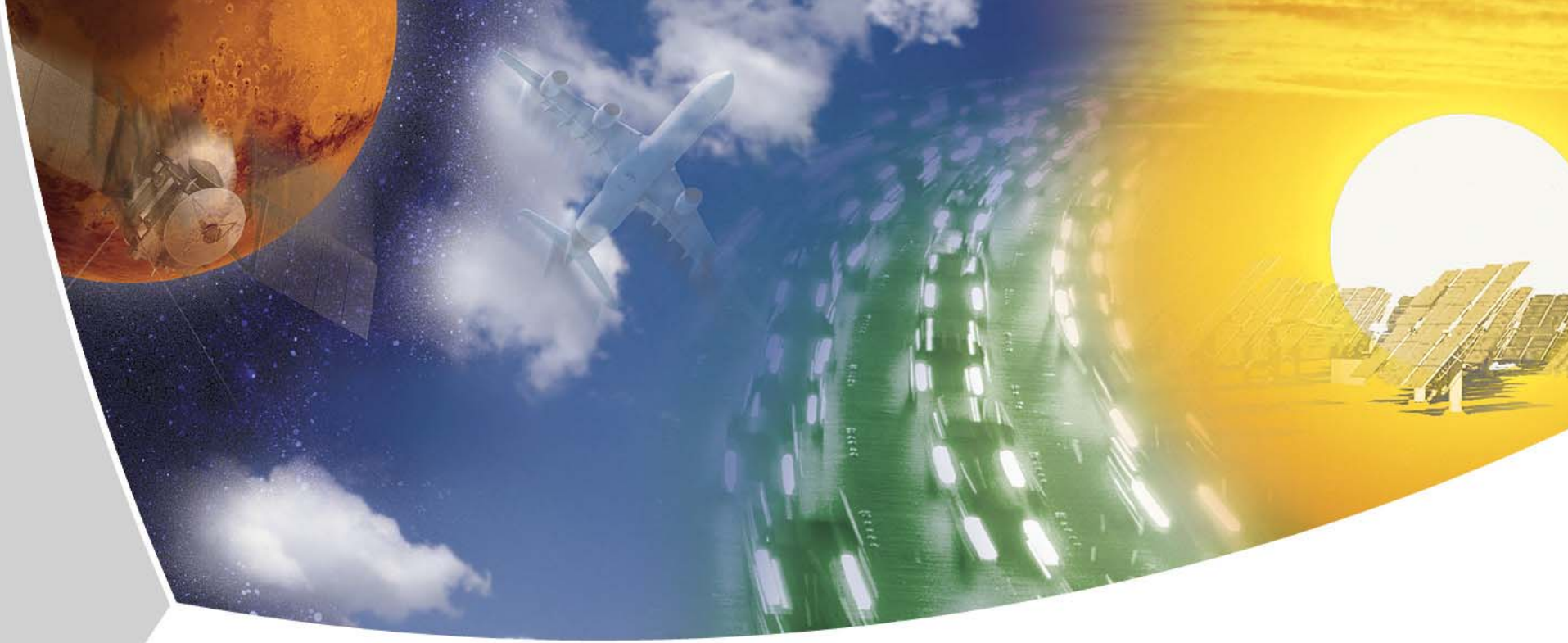

GSOC's GNSS-R INSTRUMENT FOR THE ZOIS EXPERIMENT

R. Rivas, A. Grillenberger, M. Markgraf,
R. Stosius, G. Beyerle, M. Semmling, J. Wickert

Deutsches Zentrum
DLR für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

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- Introduction.
- GSOC‘s GNSS-R Rx roadmap.
- GNSS-R Rx Instrument overview.
- Problems.
- Basic functionality description.
- Campaigns data.
- Planned upgrade.
- Future campaigns.

Introduction

- GNSS-R Rx being developed at GSOC‘s “GNSS Technology and Navigation“ group.
  - Spaceborne GNSS Rx Technology (e.g. Phoenix Rx).
  - Spacecraft Formation Flying (e.g. PRISMA).
  - GNSS Based Precision Navigation (e.g. CONGO).
- GFZ extended invitation to participate in ZOIS.
- Oct-Dec 2009.
- Certification process.

Roadmap

- Ground based Rx.
  - Namuru II.
  - Namuru II + Stratix III board.
- Airplane based Rx.
  - ZOIS 2010.
  - ZOIS 2011?.
  - GEOHALO(2011-2012).
- Spaceborne Rx.
  - ...

GNSS-R Rx Instrument Overview

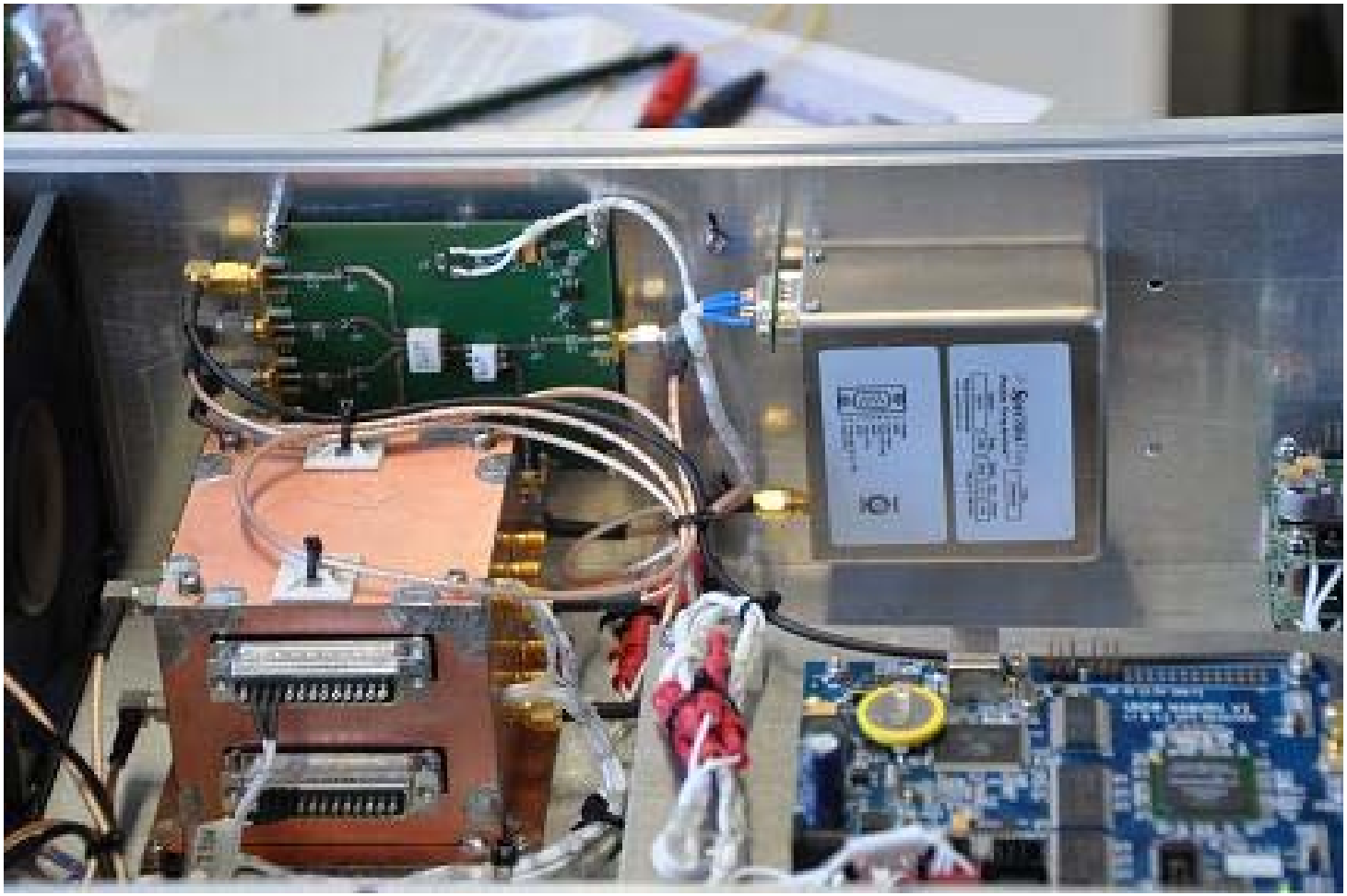
- Namuru II board.
  - Altera Cyclone II 50K LE grade 6.
  - 2 GP2015 Zarlink frontends.
- Altera Stratix III dev. board.
  - Altera Stratix III 150K LE grade 2.
- 3 RS232 datalogger.
- 2 MAXIM GNSS MAX2769 dev. board frontends.
- Rubidium Clock source.
- Custom interface board.
- Custom Clock conditioning board.
- Pasive 2x2 LHCP/RHCP L1/L2 antenna array.

GNSS-R Rx Instrument Overview(2)

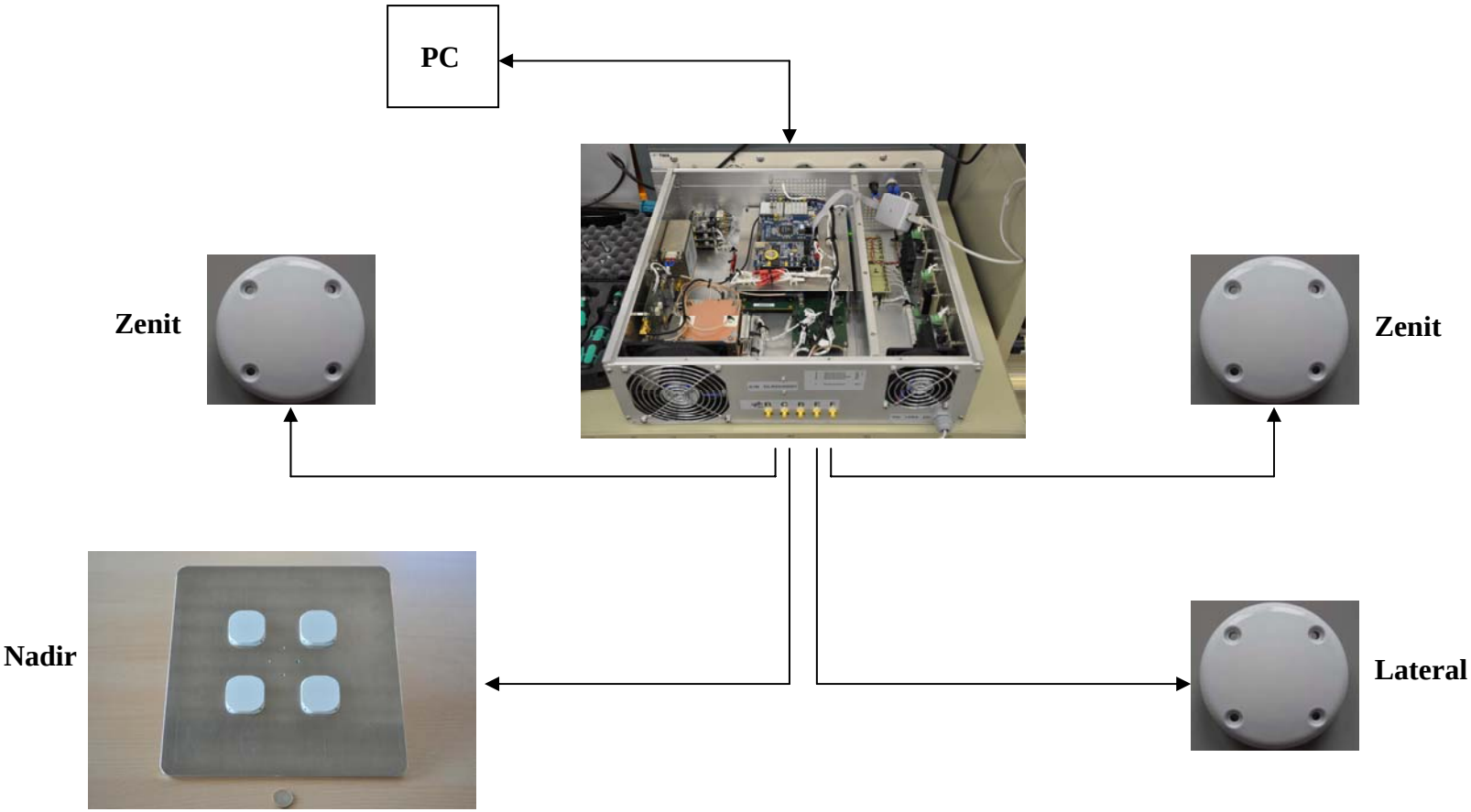
- Prefered architecture:
  - Each board has a GPS Rx.
  - Advantages:
    - System robustness.
    - GNSS-R Rx and GPS Rx close integration.
  - Disadvantage:
    - FPGA resources.
- Namuru II and Stratix III boards works independently.
- Future optimization:
  - Eventually only one GPS Rx would be used (tests needed).

GNSS-R Rx Instrument Overview(3)

GNSS-R Rx Instrument Overview(4)



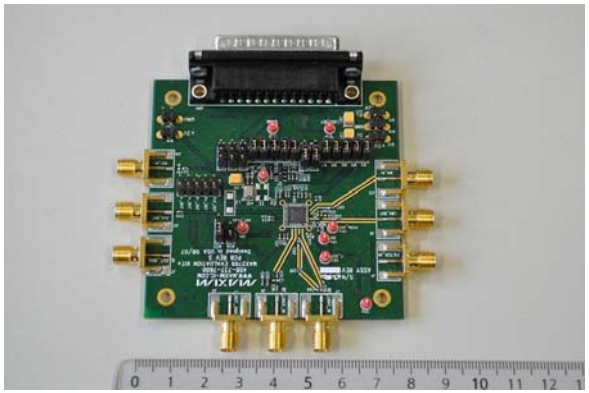
GNSS-R Rx Instrument Overview(5)

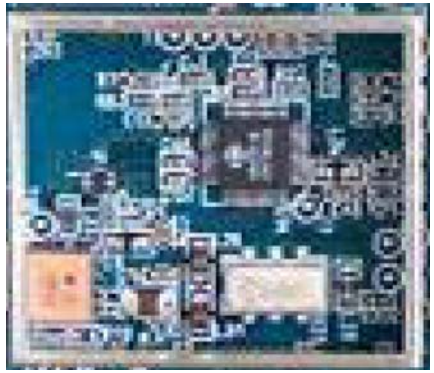


GNSS-R Rx Instrument Overview(6)

GNSS-R Rx Instrument Overview(7)

GNSS-R Rx Instrument Overview(8)





- MAX2769.
  - 1 to 3 bits.
  - L1 carrier.
  - 2.5MHz to 18MHz.
  - 1 mixer.
  - AGC ON/OFF.
  - fs max. 50MHz.
- GP2015.
  - 2 bits.
  - L1 carrier.
  - 2MHz.
  - 3 mixers.
  - AGC ON.
  - fs 5.714MHz.

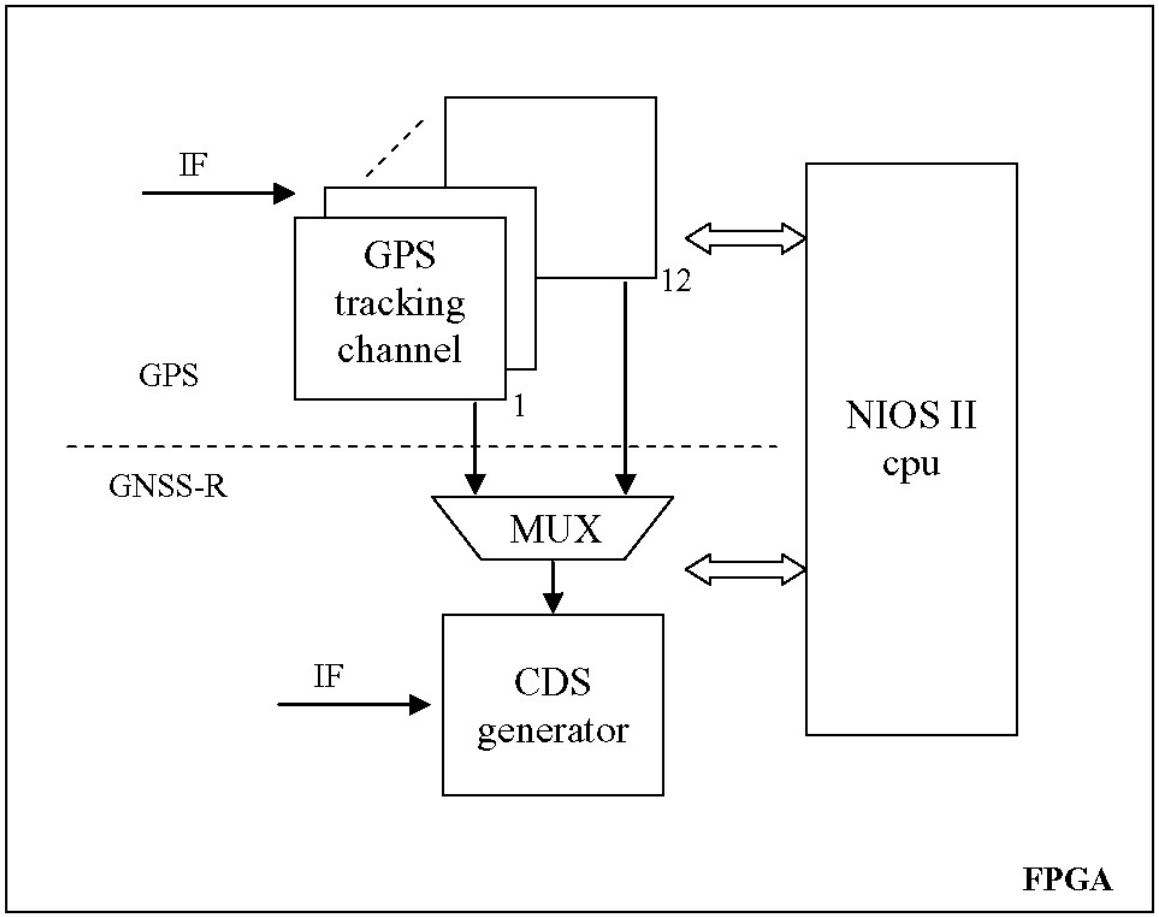
Problems

- MAX2769 poor documentation.
- MAX2769 dev. board EMC.
  - Shielding.
  - Custom frontend board(upgrade).
- MAX2769 dev. board ESD.
  - Custom frontend board(upgrade).
- MAX2769 dev. board + interface circuit time constant.
  - Custom frontend board + custom interface board(upgrade).
- MAX2769 + Stratix III GPS Rx Frame Lock oscillation.
  - Asynchronous to synchronous interface mode.
  - GPS Rx DLL settings.

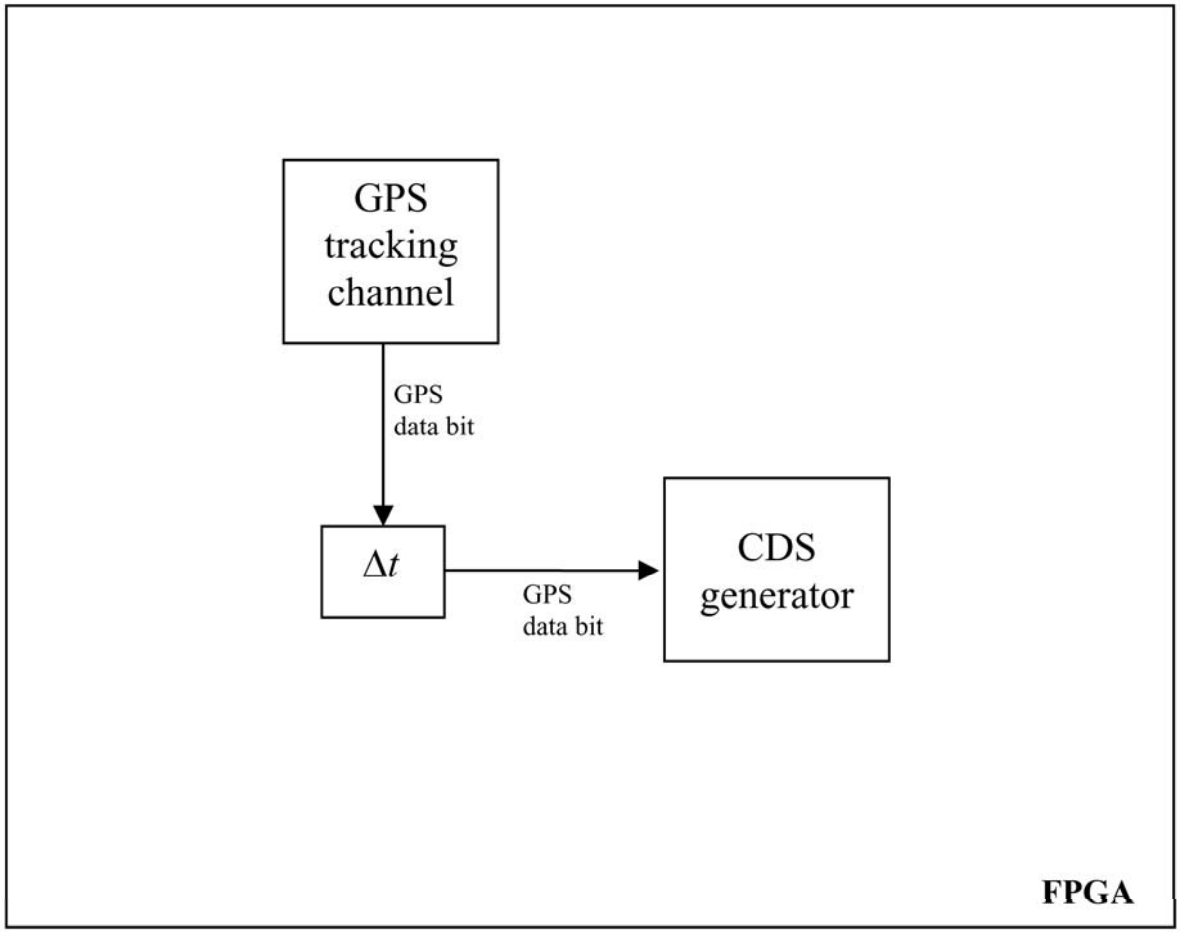
Problems(2)

- RS232 datalogger data rate.
  - 115k baud instead of 460k baud.
- One RS232 datalogger burned.
- RS232 datalogger not too reliable.
  - Datalogger redundance.
  - 12 fold effective data reduction.
  - USB or Ethernet datalogger(upgrade).

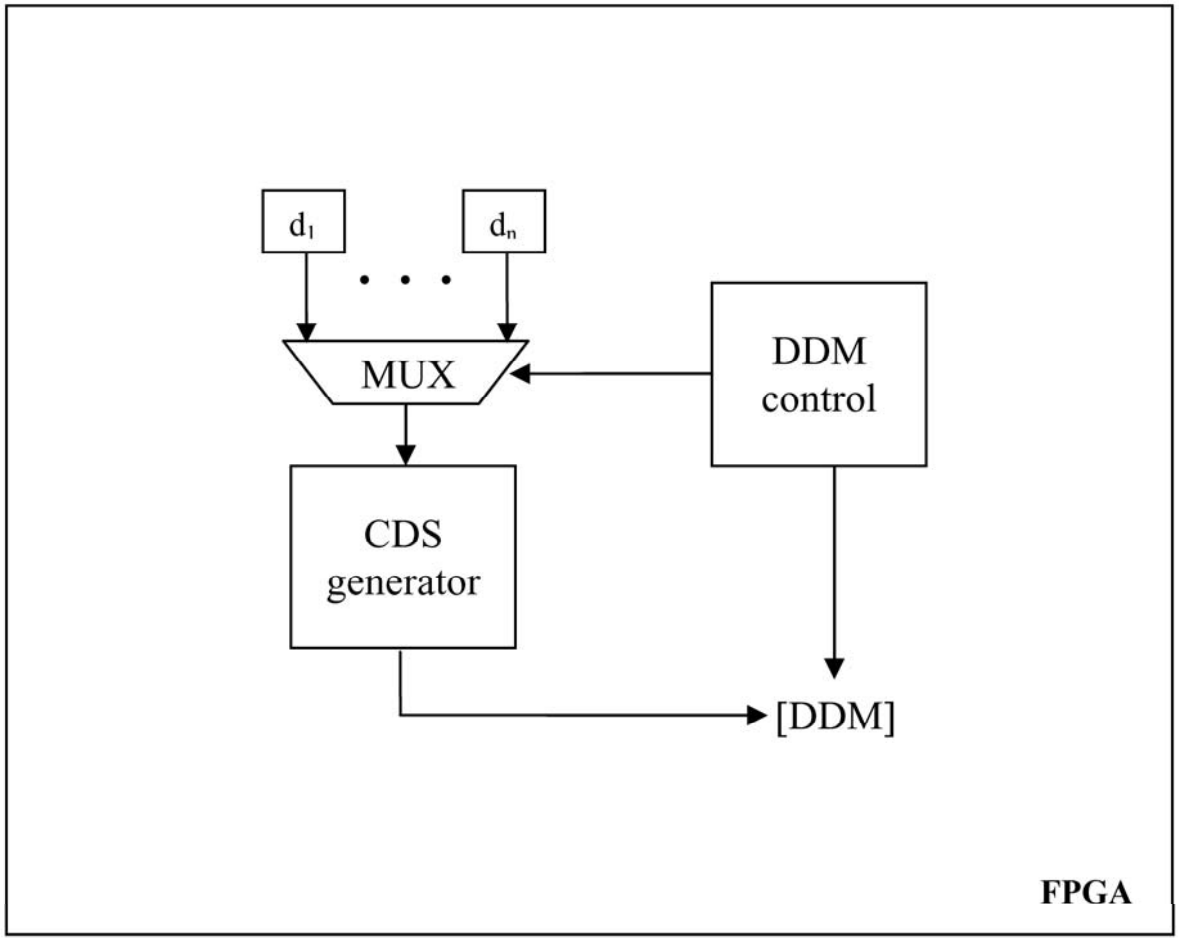
Basic functionality description



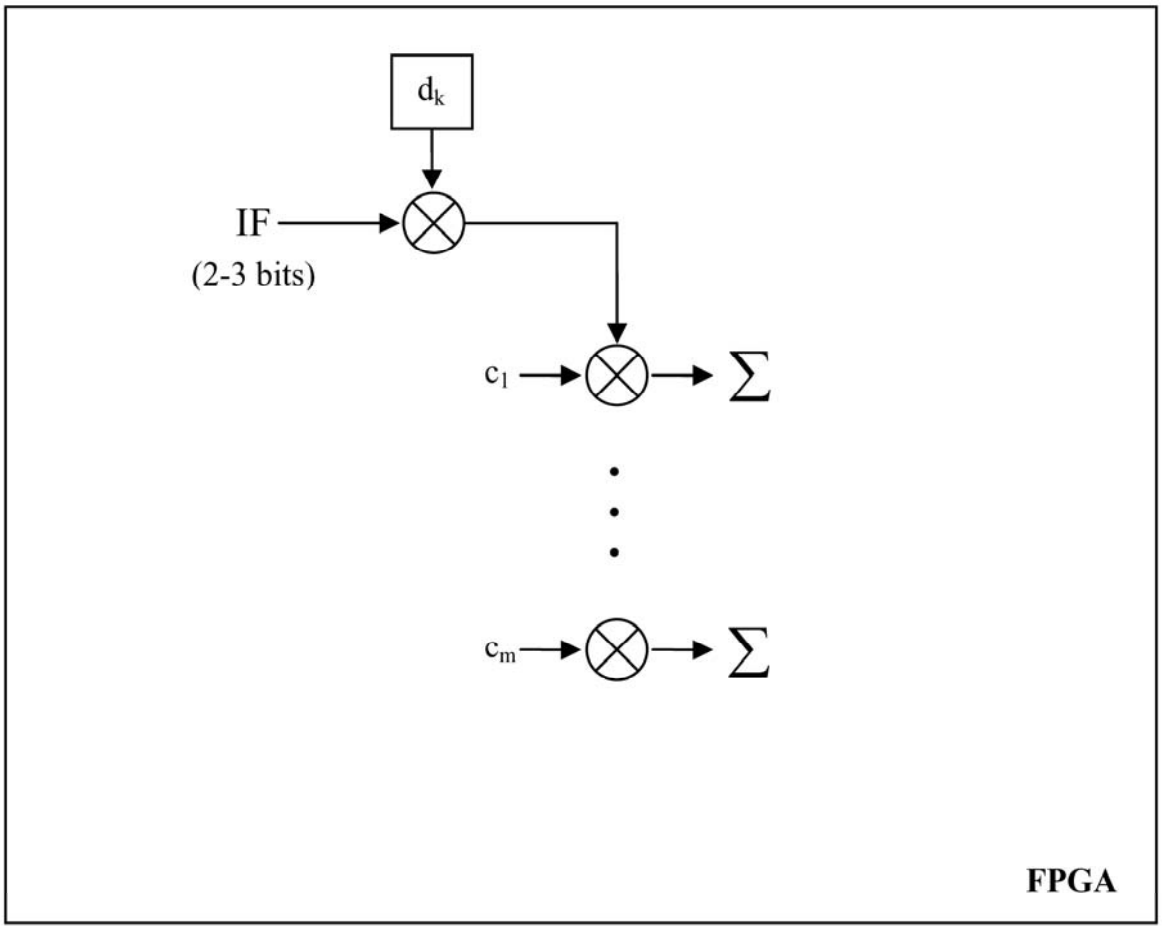
Basic functionality description(2)



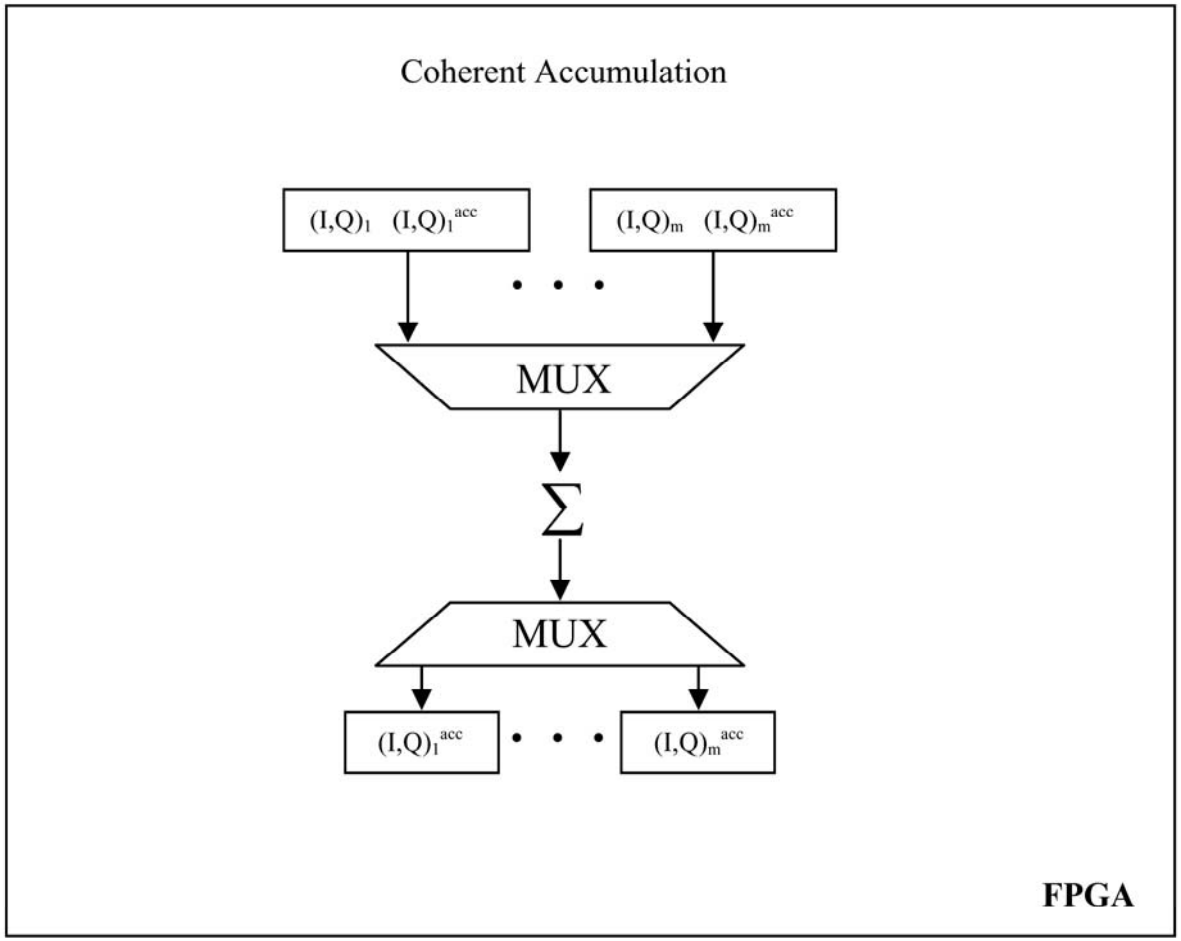
Basic functionality description(3)



Basic functionality description(4)



Basic functionality description(5)

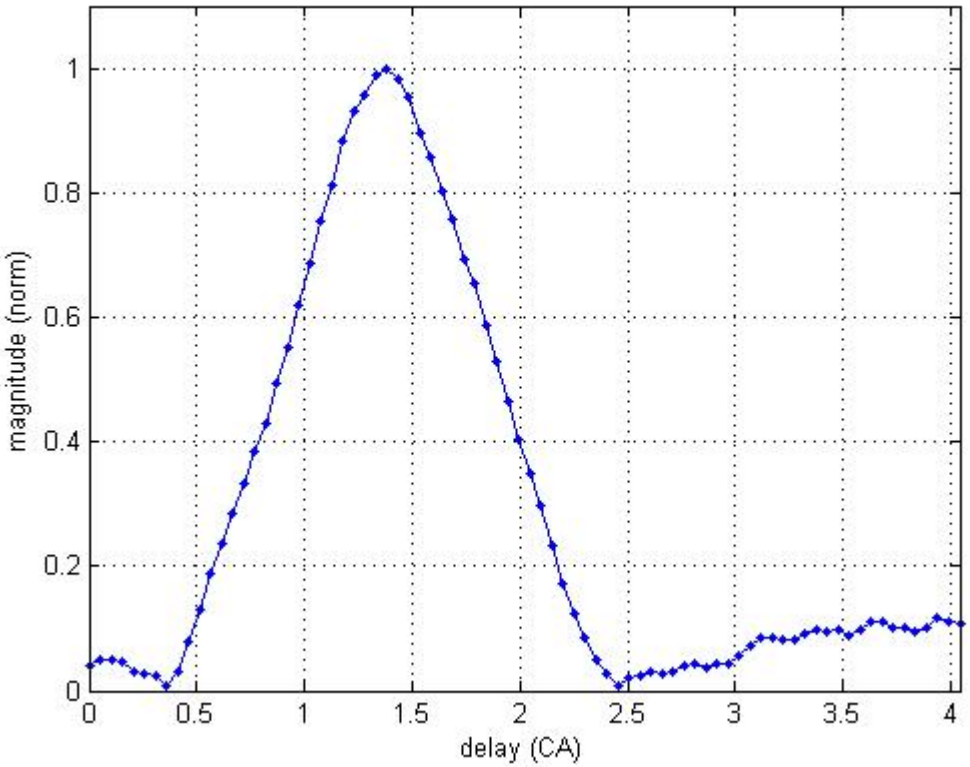


Basic functionality description(6)

- Output data:
  - FPGA Slave Channel parameters.
  - Global variables(CPU).
  - Tx id., Tx elv. and az.
  - Tx vel., Tx pos., Rx vel., Rx pos. (ECEF), Rx hdg.
  - Time tag, GPS time, carrier phase, pseudo range, etc.
  - All tracked Tx elv., az.
  - IQ Prompt master channel.
  - IQ slave channel.
  - other ...

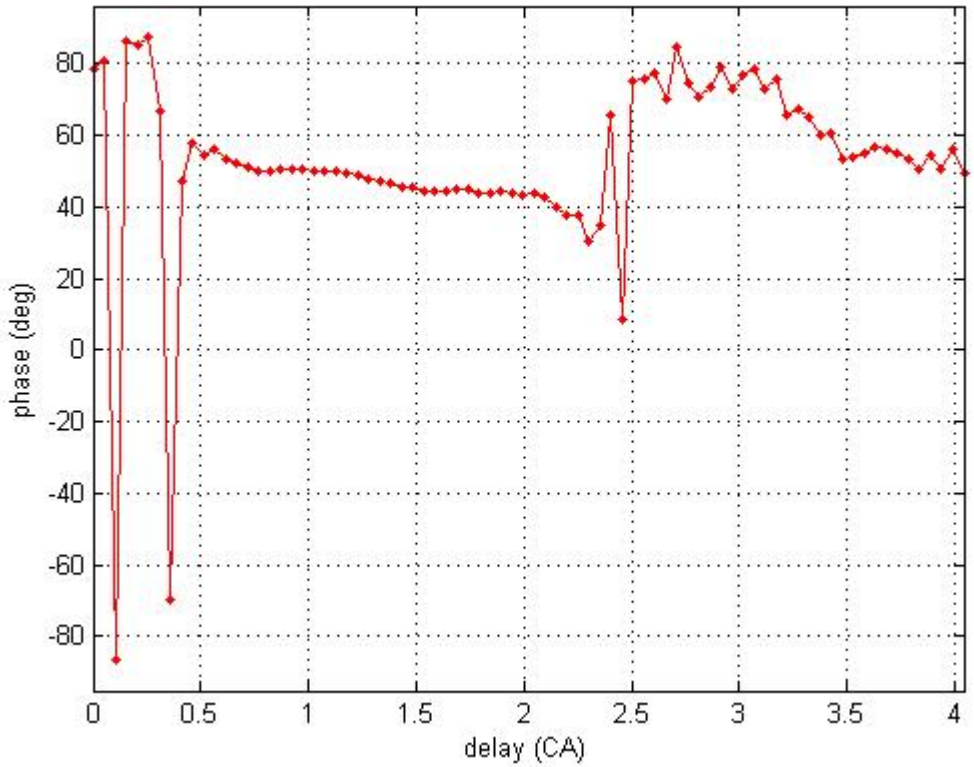
Campaign data

Campaign data(2)



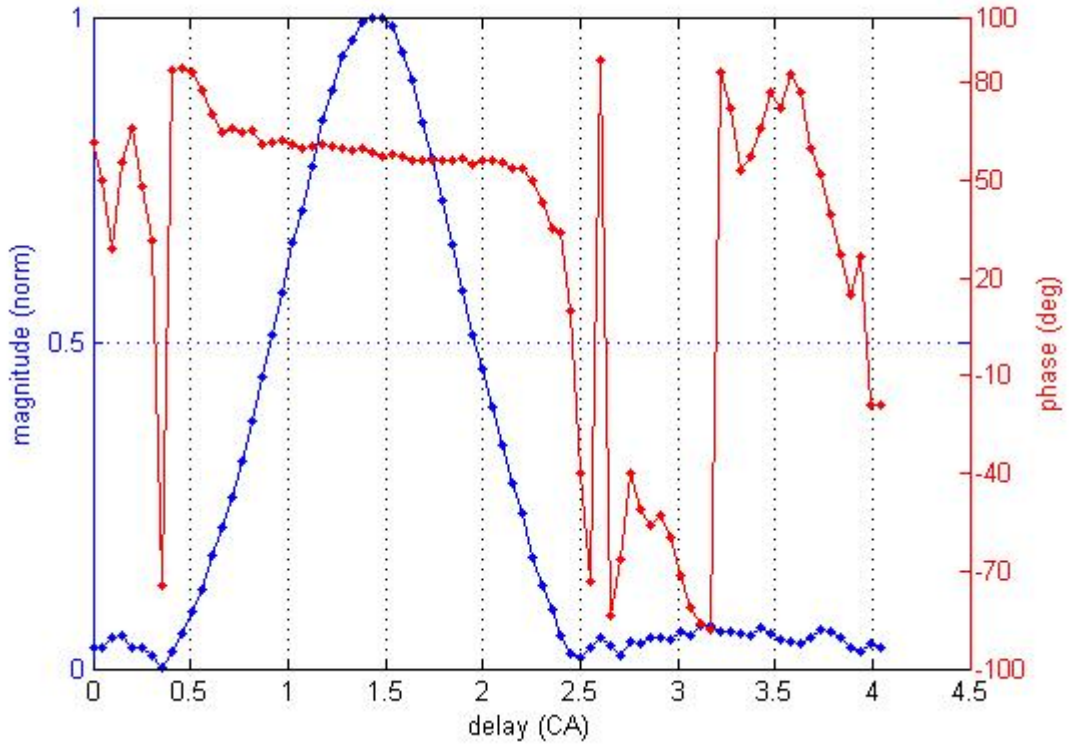
- coh. acc. = 6 ms.
- delay peak = 757 m.
- Tx id. = 6
- Tx elv = 84.2°
- Tx az. = 310.2°

Campaign data(3)



- coh. acc. = 6 ms.
- delay peak = 757 m.
- Tx id. = 6
- Tx elv = 84.2°
- Tx az. = 310.2°

Campaign data(4)



- coh. acc. = 9 ms.
- delay peak = 672 m.
- Tx id. = 16
- Tx elv. = 62.6°
- Tx az. = 204.9°

Planned upgrade

- GEOHALO certification process.
  - Calibration signal + network.
  - MAX2769 frontend matrix.
  - New interface board.
  - New clock conditioning(active) board.
  - Ethernet(USB) datalogger.
- Software
  - Autonomous GNSS-R Rx operation.
  - ...

Future Campaigns

- Fahrenberg (2011).
- Reflected signals from sea (2011).
- ZOIS 2011?.
- GEOHALO 2011-2012.