RELIABLE ASIC (RELIASIC)
2014 - 2018

Problem: Fault tolerant computation for low power processing in signal processing application..

Application: The tracking process of the GPS receiver.

Objectives:
1) Produce an ASIC with a standard GPS receiver and a hardened GPS receiver (28 nm FDSOI)
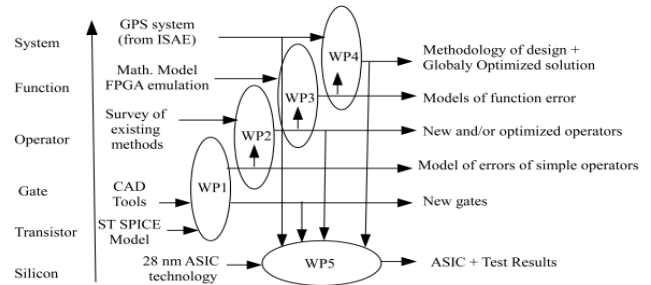2) Feedbacks from model to reality with measurements with the ASIC.

Figure 1.4: Structure of the project

Time schedule

T$_0$ → State of the art / Proposition of new solutions → VHDL Design → Layout Design → Foundry → T$_{end}$ / Chip Test
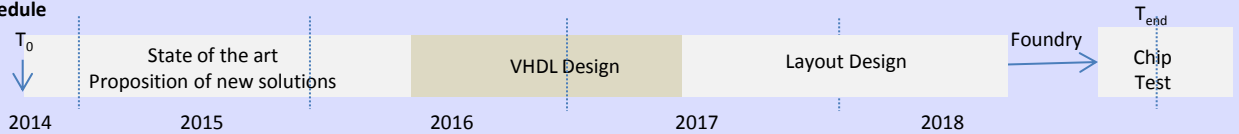
2014   2015   2016   2017   2018

Photo by Catherine Dezan (Lab-STICC/UBO, Le Croisic, nov. 2016)
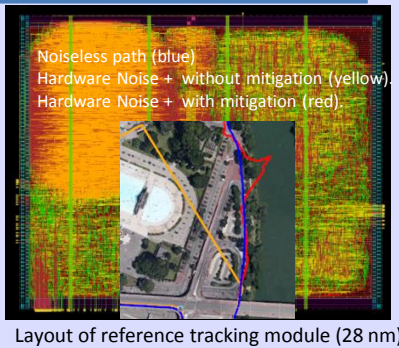
Summary per WP

WP1: Modeling Random Telegraph Noise, statistical study of impact of low supply voltage on elementary gate behavior.

WP2: New mechanisms of detection/correction of fault in tracking loop.

WP3: Reduced-Precision Redundancy

Noiseless path (blue)
Hardware Noise + without mitigation (yellow).
Hardware Noise + with mitigation (red).

Layout of reference tracking module (28 nm)

WP4: Integration of « reliability » in MCSE tools (IETR) ; Dynamic evaluation of GPS position quality based on sensor and Bayesian Network (publication with award).

WP5: Only active task at the moment. Tape out two times delayed due to unexpected Design Route Checker problems.

Publications related to RELIASIC:

[1] Mohamed Hafidhi, Emmanuel Boutillon, "Hardware Error Correction using Local Syndromes", IEEE SIPS 2017), Oct 2017, Lorient, France.

[2] I. Wali, E. Casseau, A. Tisserand: An Efficient Framework for Design and Assessment of Arithmetic Operators with Reduced-Precision Redundancy Conference on Design and Architectures for Signal and Image Processing (DASIP) : 2017

[3] Mohamed Mourad Hafidhi and Emmanuel Boutillon, '' Improving the performance of the carrier tracking loop for GPS receivers in presence of transient errors due to PVT variations''. In: The International Workshop on Signal Processing Systems (SIPS 2016).

[4] Sara Zermani, Catherine Dezan, Chabha Hireche, Reinhardt Euler, Jean-Philippe Diguet: ''Embedded and Probabilistic Health Management for the GPS of Autonomous Vehicles''. In: the 5th Mediterranean Conference on Embedded Computing 2016.

[5] Mohamed Mourad Hafidhi, Emmanuel Boutillon and Chris Winstead, "Reliable Gold Code Generators for GPS Receivers". In: the 2015 IEEE 58th International Midwest Symposium on Circuits and Systems (MWSCAS), Aug 2015.

[6] Mourad Dridi, Mohamed Hafidhi, Chris Winstead, Emmanuel Boutillon, ''Reliable NCO carrier Generators for GPS Receivers''. In: Design and Architectures for Signal and Image Processing (DASIP 2015) .

[7] Mohamed Mourad Hafidhi, Emmanuel Boutillon and Chris Winstead,''Reducing the impact of internal upsets inside the correlation process in GPS Receivers''. In: Design & Architectures for Signal & Image Processing conference (Dasip 2015).

Focus on WP2 results

Corellation function (4 MHz)

$s(n)$

Tracking Loop (100 Hz)
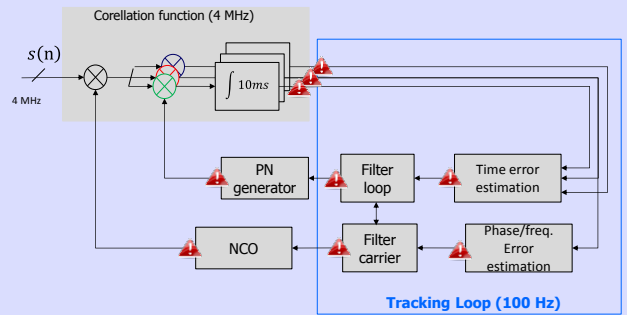
Error tolerance has been studied in all components of the tracking loop. Innovative idea has been proposed to mitigate the effect of noise. Example: syndrome correction when F is a morphism (90 % of signal processing function) with hardware redundancy. [1]

$X \Rightarrow C = G \cdot X \Rightarrow Z = F(C) \Rightarrow R = H.Z \Rightarrow$ Synd. $\Rightarrow$ Select $\Rightarrow Y$
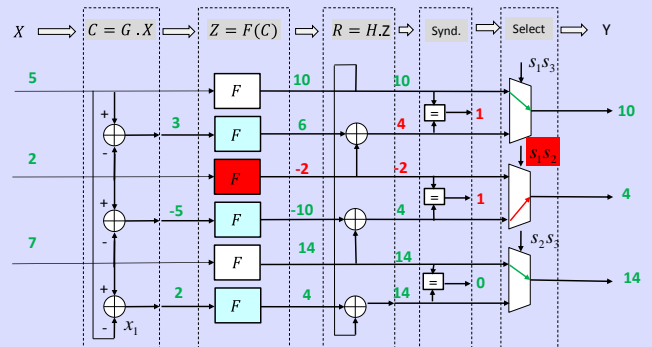
Follow up of RELIASIC:

CNRS PEPS GLORIA-IoT that use knowledge on GPS syncronisation and tracking for IoT geo-localization.

Switzerland-French project deposal between UBS and ETH Zurich (2018 ANR-SNF call, answer 10/2018) using geo-localization services for IoT.