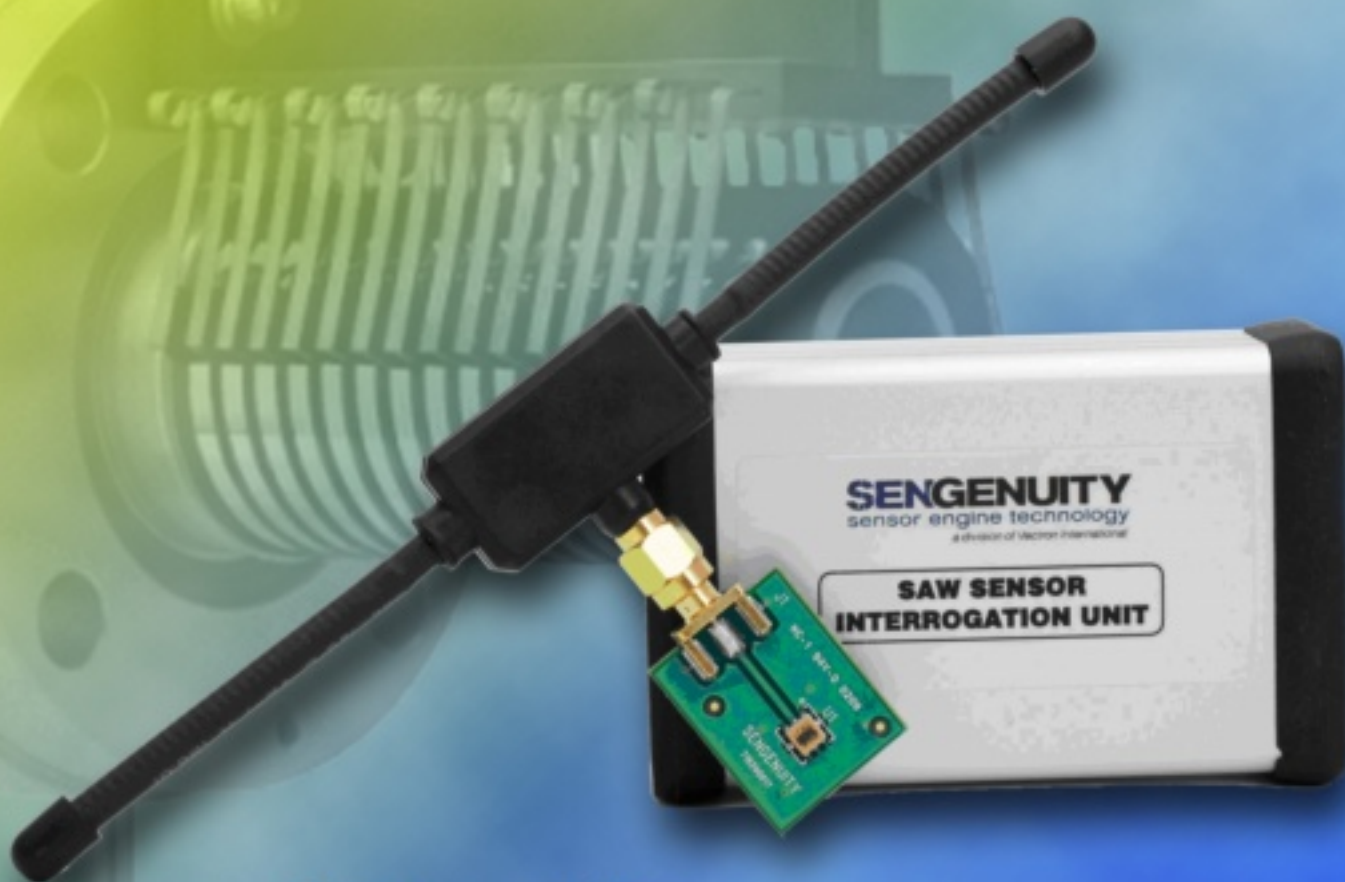


ISSN 1726-5479

SENSORS & TRANSDUCERS

7^{vol. 106}
/09



Sensor Networks and Wireless Sensor Networks

International Frequency Sensor Association Publishing





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Contents

Volume 106
Issue 7
July 2009

www.sensorsportal.com

ISSN 1726-5479

Research Articles

Wireless Surface Acoustic Wave Sensors <i>Kerem Durdag</i>	1
Reliability Modeling of Wireless Sensor Network for Oil and Gas Pipelines Monitoring <i>Khalid El-Darymli, Faisal Khan, Mohamed H. Ahmed</i>	6
Level Controlled Gossip Based Tsunami Warning Wireless Sensor Networks <i>Santosh Bhima, Anil Gogada and Ramamurthy Garimella</i>	27
A Distributed Approach to Area Coverage for Dynamic Sensor Networks <i>Simone Gabriele and Paolo Di Giamberardino</i>	35
An Investigation into Clustering Routing Protocols for Wireless Sensor Networks <i>Abdulazeez F. Salami, Farhat Anwar and Akhmad Unggul Priantoro</i>	48
Data Fusion Functions: Applications to Sensor Networks <i>Vinay Kumar Deekonda, Sankara Sastry Korada and Ramamurthy Garimella</i>	62
High Fidelity Simulation of Network Nodes with RF-Ranging Capabilities <i>Hamed Bastani and Andreas Birk</i>	73
RFID for Location Proposes Based on the Intermodulation Distortion <i>Hugo Gomes, Nuno Borges Carvalho</i>	85
Design and Manufacturing Precise Wireless Car Engine's Speed Sensor <i>Amir Mahyar Khoraani, Mir Saeed Safizadeh</i>	97
Channel Estimation of WCDMA with OFDM Signal <i>N. R. Raajan, Y. Venkataramani, T. R. Sivaramakrishnan</i>	107
Rearranging Structure for WCDMA over GSM <i>N. R. Raajan, Y. Venkataramani, T. R. Sivaramakrishnan</i>	114
Simulation Study of OFDM, COFDM and MIMO-OFDM System <i>Mrutyunjaya Panda and Dr. Sarat Ku. Patra</i>	123
An Efficient Method for Extraction of Transfer Function of H-Tree Clock Distribution Networks <i>Fahimeh Alsadat Hosseini and Nasser Masoumi</i>	134
Three-dimensional Quantitative Visualization from a Single Image <i>Yuichiro Oya, Kikuhito Kawasue</i>	142
Modeling and Analysis of Micro Fluidic Channels <i>M. Shanmugavalli, M. Umamathy, G. Uma</i>	155

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Rearranging Structure for WCDMA over GSM

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Received: 14 May 2009 /Accepted: 15 July 2009 /Published: 20 July 2009

Abstract: This paper concentrate on rearranging structure to improve the capacity in a wideband code division multiple access (WCDMA) in presence of GSM. The impact of various parameters in WCDMA over GSM is observed. *Copyright © 2009 IFSA.*

Keywords: WCDMA, GSM, Structure

1. Introduction

The WCDMA standard has two modes for the duplex method, Frequency Division Duplex (FDD) and Time Division Duplex (TDD). The frequency bands allocated for UTRA are shown in Fig. 1. In UTRA there is one paired frequency band in the range 1920 –1980 MHz and 2110 –2170 MHz to be used for UTRA FDD. There are two unpaired bands from 1900 –1920 MHz and 2010 – 2025 MHz intended for the operation of UTRA TDD. At the time when this work was developed, only the standard of the FDD mode developed by ITU were at an advanced stage of standardization. The TDD mode standard started later. For this reason this work assumes the FDD mode of operation for the receiver. **Table 3.1** lists the most important parameters of the UTRA FDD.

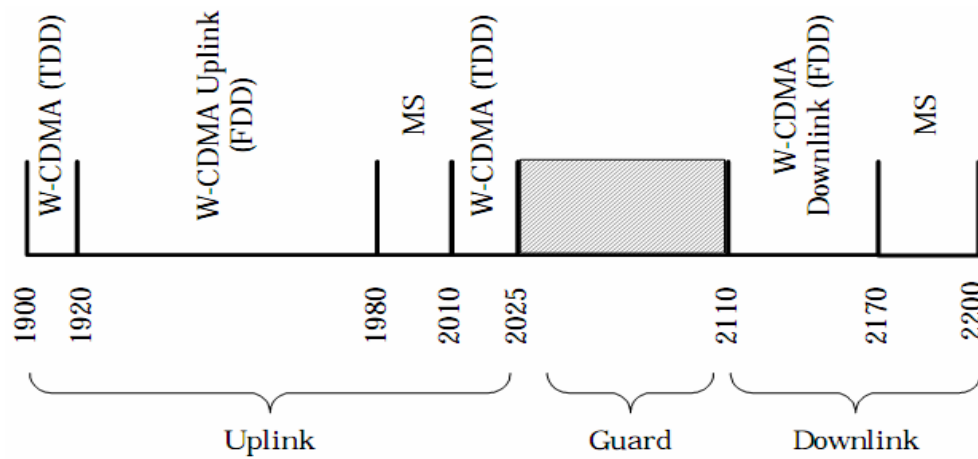


Fig. 1. The frequency spectrum allocations for UTRA.

The chip rate for the WCDMA standard is 3.84 Mcps. Spreading consists of two operations. The first operation is the channelization operation where the spreading code is applied to every symbol in the transmitted data. Thus the bandwidth of the data signal is increased. In this channelization operation, the number of chips per data symbol is called the Spreading Factor (SF).

The second spreading operation is the scrambling operation, where a scrambling code is applied to the already spreaded signal. Both of the spreading operations are applied to the so called In-phase (I) and Quadrature phase (Q) branches of the data signal. In the channelization operation, the Orthogonal Variable Spreading Factor (OVSF) codes are independently applied to I and Q branches [7], and [9]. The resultant signals on I and Q branches are then multiplied by a complex-valued scrambling code, where I and Q correspond to the real and imaginary parts respectively.

For the channel coding, the standard suggests three options of coding for different Quality-of-Services (QoS) requirements. The bit interleaving is used to improve the Bit Error Rate (BER). The modulation scheme selected in 3GPP WCDMA standard is QPSK. An important characteristic of the WCDMA system is that it is an asynchronous system; i. e. there is no global synchronization between base stations in the system. i. e. For easy deployment, tight inter BS synchronization is not required. This means that each user can transmit independently of other users or base stations transmissions. This eliminates the need for global clock similar to the IS-95 system proposed by the USA. IS-95 uses the Global Positioning System (GPS) clock as a global clock for synchronization between base stations.

3. Modeling a Rearrangeable Structure

As with any other design problem, when designing a specific rearrangeable system it is necessary to perform two general steps. First, a deep understanding of the target application or set of applications is required. This would include analyzing algorithms of the target application(s), and simulation. Second, after designing the platform Structure, a faithful model of the architecture is required to perform a prototyping and functional as well as timing simulation.

In DSP designs the first step is usually done with MATLAB. This works great since the underlying execution behavior of the DSP and the MATLAB (general purpose processor) are identical, i.e. both execute a set of instructions sequentially. But when designing a parallel and rearrangeable Structure, MATLAB will not provide correct information about the behavior of the overall system.

When modelling a static system, VHDL is a very rich language that can easily describe the functional

and (with some additional steps) the timing characteristics of virtually any system. However, modeling dynamically changing systems in VHDL can become a burden to the designer. In modeling static systems, different components are designed to do a specific task and to interact with other system components in a specific way. When the full description of such a static system is completed, any functionality of a component can be modified without affecting the other parts. Eventually it will not require modification of the overall system.

In the design of the rearrangeable Structure developed in this dissertation, a VHDL design model was developed. A number of compromises were taken during the design. For example, in the design of the litigating element (Dynamically Rearrangeable Litigating Unit DRLU), the routing of the input signal to the inside of the unit was limited to three signals selected from eight possible input signals.

The decision of routing only three signals instead of routing all eight is imposed by components inside the DRLUs, i.e. by the maximum fan-in of all components. The selection of only three signals is also imposed by the number of configuration bits that will be needed by each component inside the DRLU.

4. Dynamically Rearrangeable Structure (DRS) Model

The DRS Structure is designed to be a part of a System-on-a-Chip (SoC) solution for the third and future generations of wireless mobile terminals. However, the enormous size of such a project and the time restrictions imposed on this dissertation compelled us to modify the design of DRS to a stand alone platform.

The completion of the design and simulation of DRS as a stand alone platform will prove the applicability to implement rearrangeable computing platforms for the wireless mobile application. It will also enable us to experiment with architecture without the need for the complete SoC system. Additionally, DRS can be used as a prototyping platform for the development of algorithms for the mobile baseband litigating.

Flexibility is well supported by DSPs. However, this type of flexibility is more than what is really needed for one selected area of application. The rearrangeable computing Structure is designed to only support the required flexibility within the target application. The ease of programming is still preserved through the proposed IP design and mapping methods. The redundant flexibility of DSP is traded for better performance in the DRS Structure. The IP design methods would be very similar to programming a DSP.

5. Dynamically Reconfigurable and Parallel Array Structure

DRS consists of an array of parallel operating coarse-grained Dynamically Rearrangeable Litigating Units (DRLUs). Each DRLU is designed to execute all of the required arithmetic data manipulations for data-flow oriented mobile applications, as well as support necessary control-flow oriented operations. The complete DRS array Structure connects all DRPUs with reconfigurable local and global communication structures.

The Structure provides an efficient and fast dynamic rearrangeable of DRLUs and interconnection structures, reconfiguring parts of Structure during run-time, while other parts are active. We began the bottom-up design approach of DRS by focusing on a list of the most complex and flexibility demanding application parts of future mobile receivers, e.g., RAKE receiving parts, filtering, searcher algorithms, turbo coding, and maximal ratio combining techniques.

Based upon the set of required arithmetic and control-flow operations, the performance/power optimized structure of the DRLUs and local communication units called Communication Switching Units (CSUs) was devised. As shown in Fig. 2. the DRS Structure consists of a scalable array of DRLUs that have 16-bit fast direct local connections between neighboring DRLUs.

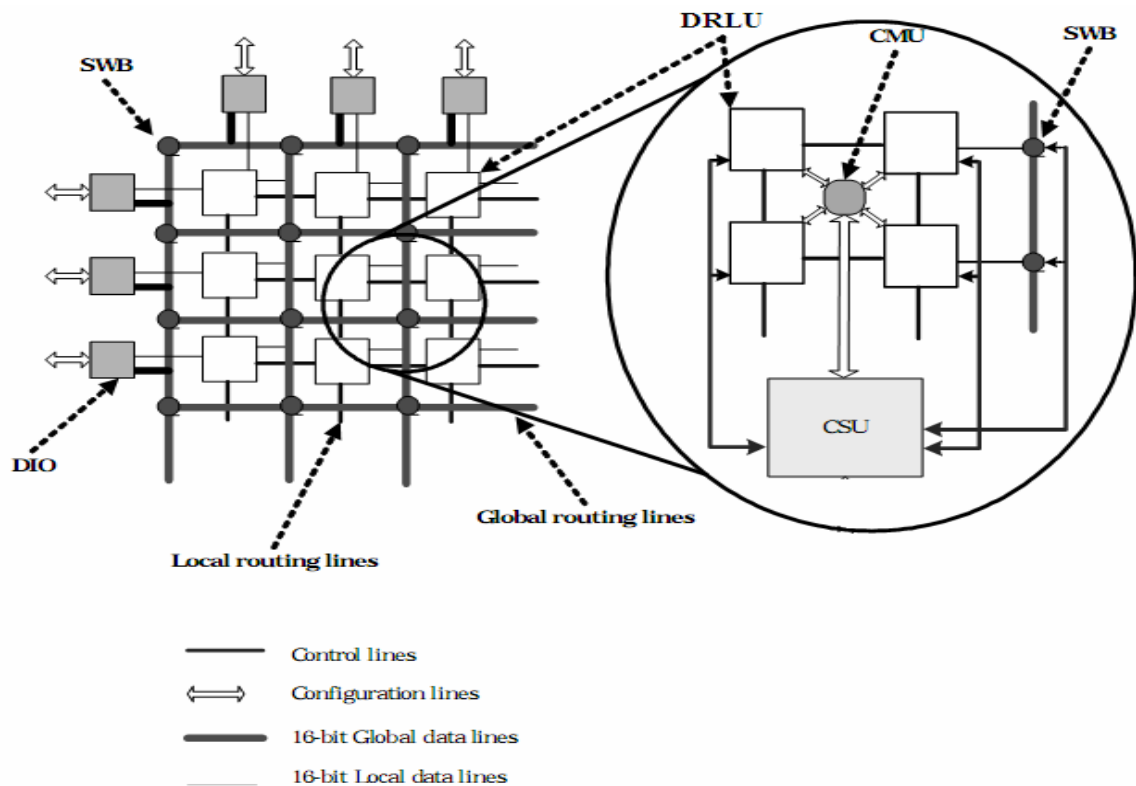


Fig. 2. A block diagram of the DRS.

Every four DRLU sub-array shares one Configuration Memory Unit (CMU). The CMU holds configuration data for performing fast dynamic rearrangeable for every four DRLUs and is controlled by the nearest CSU. Each CSU controls two CMUs and four global interconnecting Switching Boxes (SWB).

Dedicated I/O Units (DIOs) for fast and parallel transfers of the input/output data of DRS are placed around the DRLU array. Each DIO can be connected either to one DRLU at the border of the DRS Structure, and/or to DRLUs inside the array through the global interconnect lines.

All CSUs communicate with one Global Communication Unit (GCU), which coordinates all dynamic rearrangeable steps of the DRPUs and the global interconnection structure. The GCU triggers the responsible CSUs to initiate the controllers of the corresponding CMUs for loading a new configuration to the selected DRLUs. This fast transfer process of rearrangeable code is then completed by an efficient burst-mode protocol between the CMU and the DRLU-controllers. The dynamic rearrangeable algorithm for various scenarios in future mobile communication systems is performed by the GCU.

6. Conclusions

The DRLUs are the major hardware components of the DRS Structure for executing the arithmetic data operations. The DRLUs perform the required operations. The DRLU consist of CLFSR, CSDL, DRAL, RAM/FIFO, DRLU CONTROLLER, I/O Interface and other interfaces outputs. The algorithm for this DRLU is:

1. Start the process by getting 64 bits of configuration and 6 data lines of each 16 bits and four carriers, four start-hold control signals are the input to the input interface. (Fig. 3).
2. INPUT interface selects any 3 of the data lines due to the configuration bits as rpu_input_interface (1,2,3). (Fig. 4).
3. Then that output is given to Configurable Spreading Data Path Unit Interface (CSDP), to give the output as spread data and PN value according to the configuration bits. (Fig. 5).
4. Those outputs are taken as input for the Configurable Spreading Data Path Unit to give Spread output and PN sequence which is parallel data (one bit), which is given to the neighboring DRPUs. (Fig. 6).
5. The spread out is given as input to the Dynamically Rearrangeable Arithmetic Litigating Unit Interface and also that three rpu input interface, ram out, rap values (each of 16 bits) as input. Due to the configuration bits (5 bits) it selects any two as interface output (X input, Y input). (Fig. 7).
6. Those X from the interface is given to next stage as SRMU (Shift, Rotate and Multiplex Unit) then it produce the output due to the required operations. (Fig. 8).
7. The same X, Y from the interface is taken as input to the next stage Dynamically Rearrangeable Arithmetic Litigating Unit (DRAL), which is used to do the arithmetic operations as required. These are done according to that configuration bits. The output is (rap_out) arithmetic or logic operation as required. (Fig. 9).
8. All these process are control by the DRLU controller, it mainly control the storage process.
9. Finally that all process output is given to the OUTPUT interface unit, according to the configuration bits and need of required operations it select the particular output then that given to the next DRLU. (Fig. 10 & Fig. 11).

These are the process done in that DRS Structure's DRLU Top Level, then the second Process is Configuration Memory Unit (CMU) which is used to hold the configuration bits (64 bits) for performing fast configuration between the four DRLUs. Then the third process is Communication Switching Unit (CSU) for fast switching between DRLUs.

These are about the DRS Structure algorithm; Above all process are done for that DRS Structure VHDL simulation work outputs.

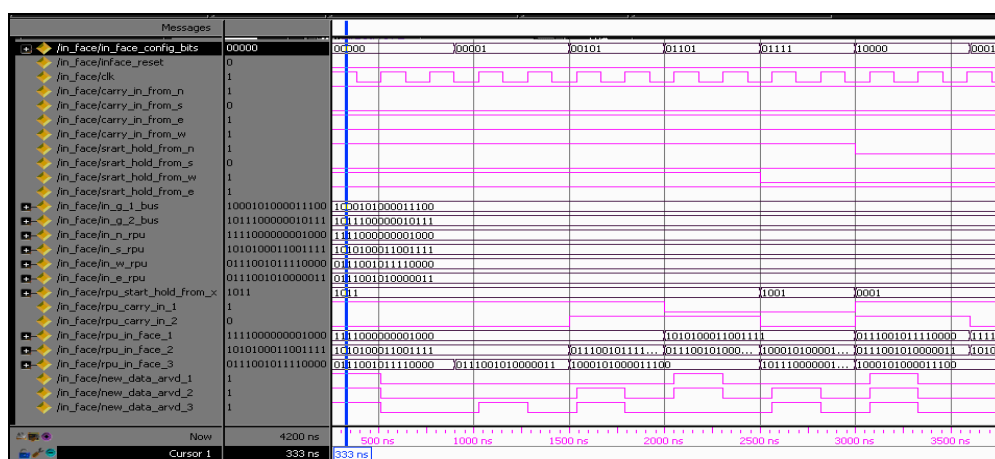


Fig. 3. INPUT Interface.

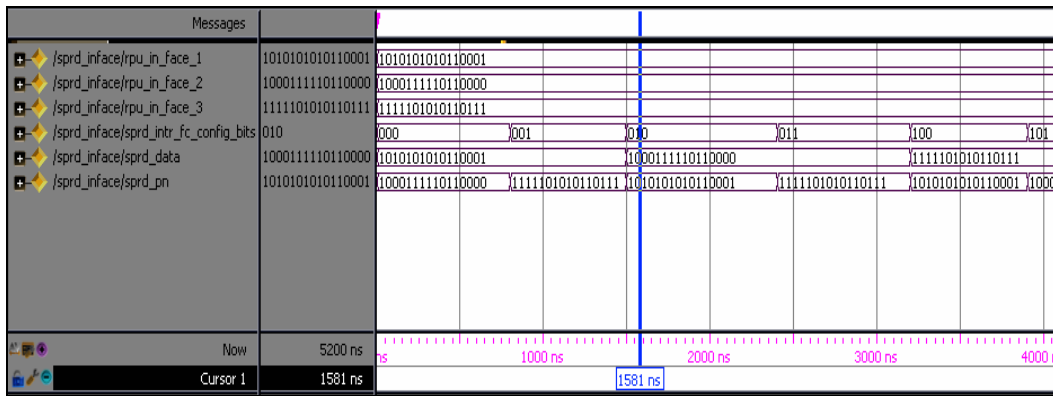


Fig. 4. CSDL--- Configurable Spreading Data Path Unit Interface.

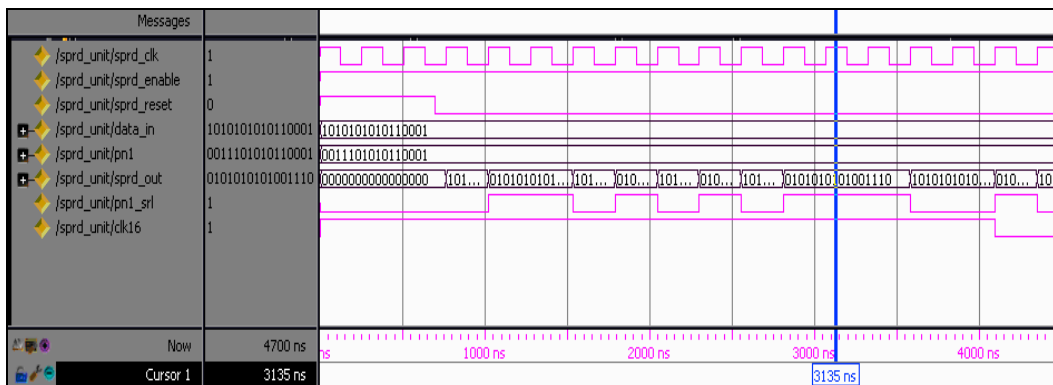
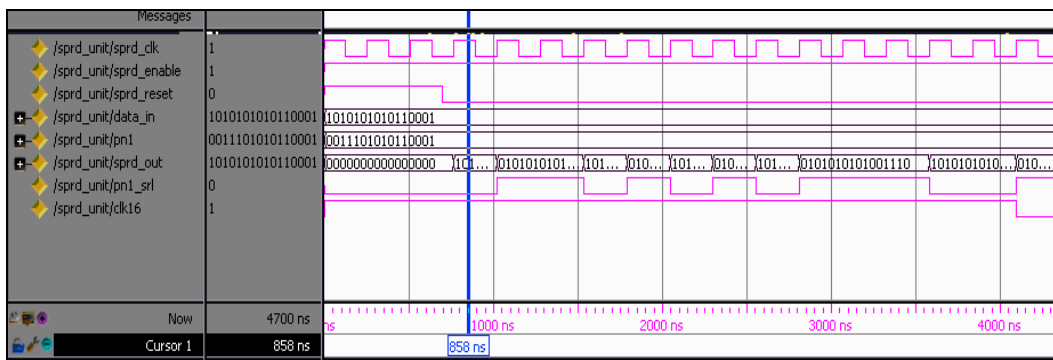


Fig. 5. CSDP--- Configurable Spreading Data Path Unit Output.

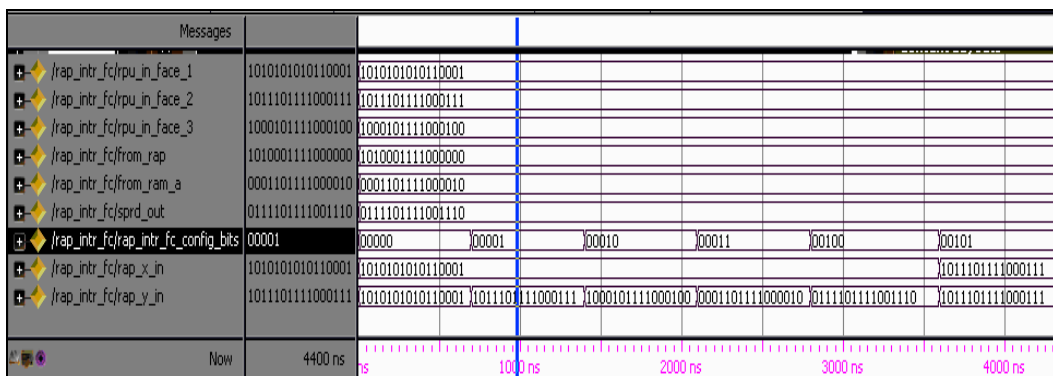


Fig. 6. DRSL--- Dynamically Rearrangeable Structure Litigating Unit Interface.

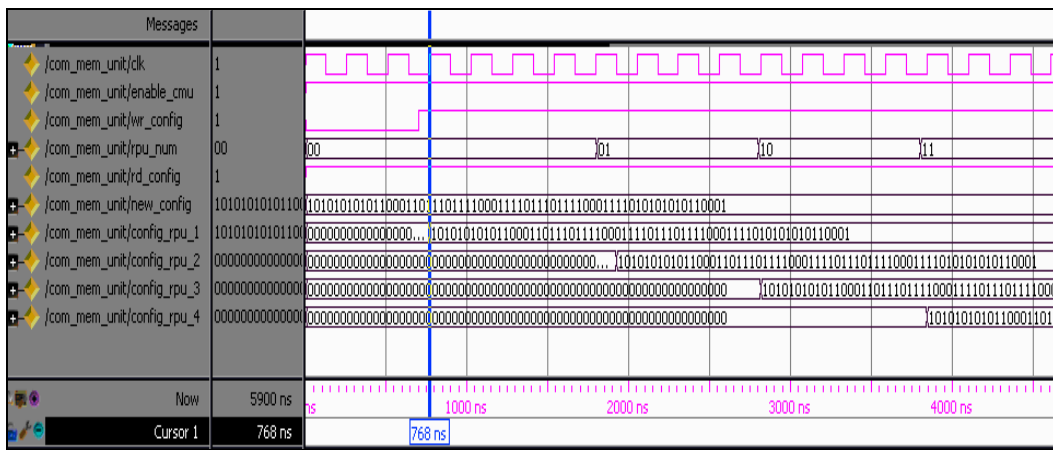


Fig. 10. CMU ---- Configuration Memory Unit.

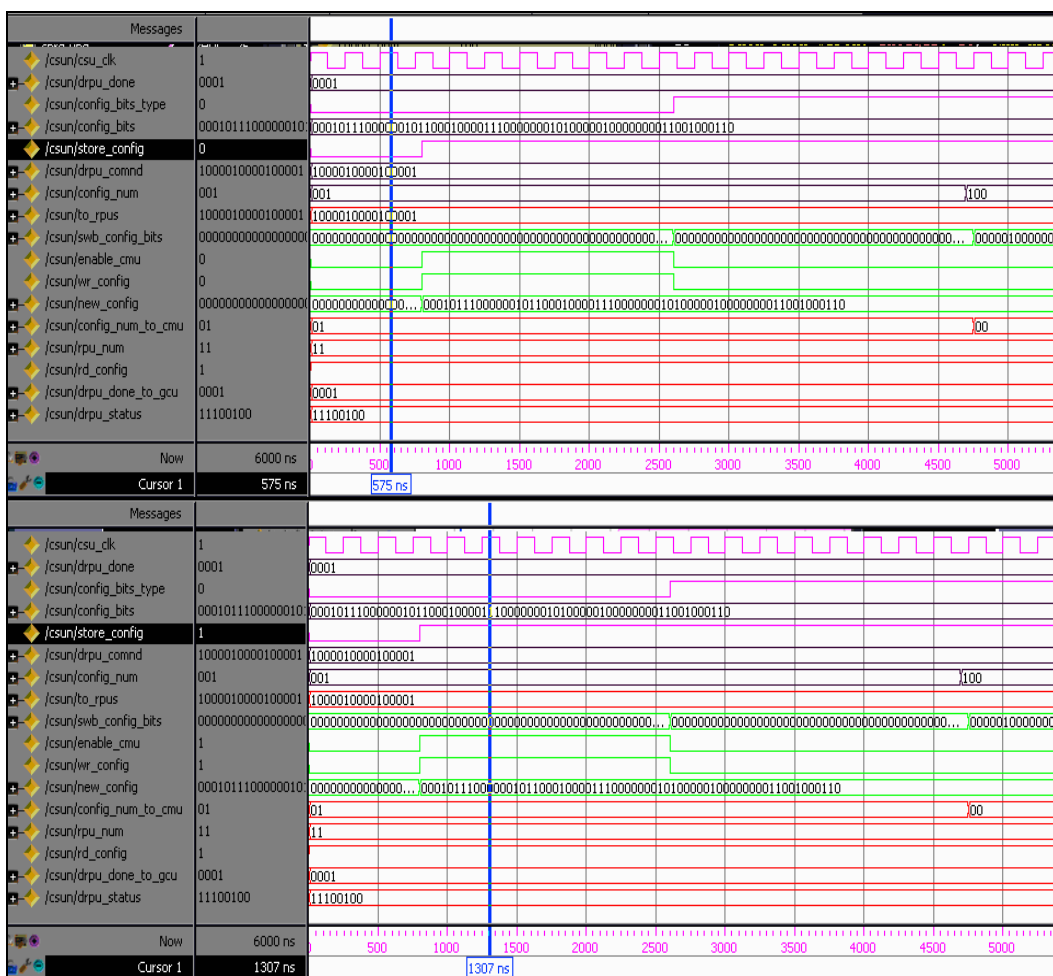


Fig. 11. CSU --- Communication Switching Unit.

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The graphic features a dark blue background with a grid pattern. On the right, a computer monitor displays the Sensors Web Portal website, which includes a globe and various navigation links. The IFSA logo is in the top right corner, and the URL is at the bottom.

Guide for Contributors

Aims and Scope

Sensors & Transducers Journal (ISSN 1726-5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because it is an open access, peer review international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per annual by International Frequency Association (IFSA). In addition, some special sponsored and conference issues published annually. *Sensors & Transducers Journal* is indexed and abstracted very quickly by Chemical Abstracts, IndexCopernicus Journals Master List, Open J-Gate, Google Scholar, etc.

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- Smart sensors and systems;
- Sensor instrumentation;
- Virtual instruments;
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- Microsystems;
- Applications.

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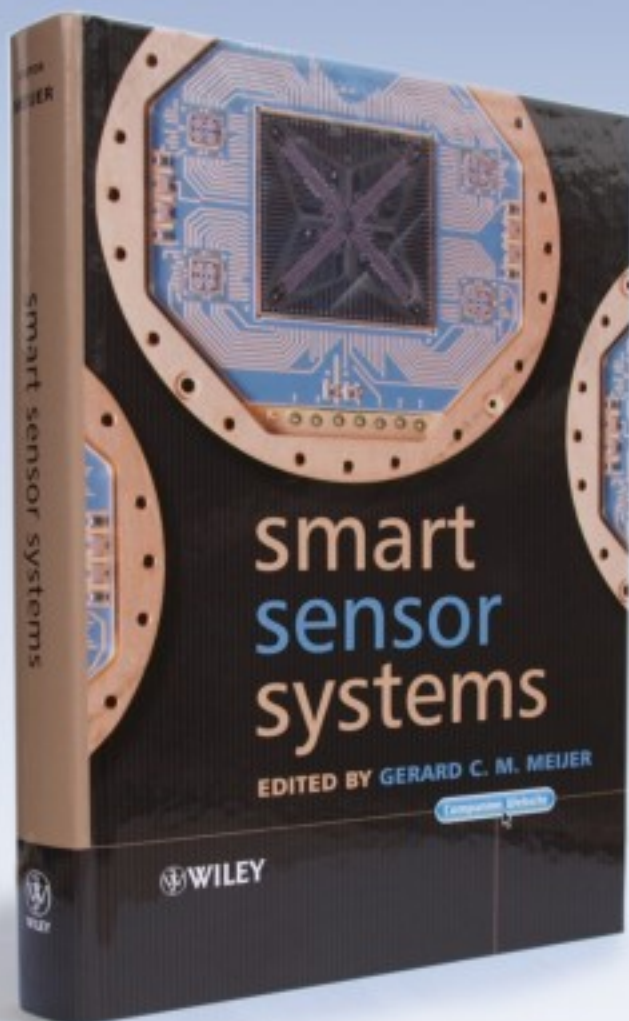
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