Adaptative integration systems using FPGA COTS devices.

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Abstract

This work proposes a conceptual structure of systems integration using Field Programmable Gate Array (FPGA) and lookup tables to define an adaptive integration structure in order to provide communication link between systems that don't work with the same protocol. An implementation using Commercial of The Shelf (COTS) transceivers as front-end in addition with FPGA devices to processing the message code, where VHSIC Hardware Description Language (VHDL) routines can be organized in blocks of encoders/decoders, in this way providing logical resources to translate protocols. Additionally, using lookup tables with these FPGA, are achieved capabilities in adaptive configurations to more complex algorithms. The aim of this paper is to model an adaptive structure of integration systems, using FPGA devices and lookup tables. Experiments with applications for UAVs and cubesats were developed in the Integration Systems Laboratory from the Instituto Tecnológico de Aeronáutica (ITA), using COTS transceivers, COTS FPGAs and software implementation tools from XILINX.

Introduction

Traditionally the patterns bus can be found in communication and control systems are RS-232, RS-422, RS-485, USB or Ethernet with protocols such as DeviceNet, CANopen, Profibus, TCP-IP, SDLC, HDLC, etc. This variety is increasing requiring interfaces to cross a wide range of applications, such as Communication Systems, Programmable Logic Controllers (PLCs), I/O modules, motors, sensors, etc. Military, Industrial and Medical networking protocols needs to provide communication between modules, allowing components from different manufacturers to provided they use the same protocols. The process of communications can be classified into three levels: the device, process, and network levels. In order to provide a ready-to-use development platform for system designers to quickly and easily implement programmable system integration for applications where the main system needs to control different data streams, such as logical or physical protocols (for example RS-232C, RS-422, RS-485, ETHERNET, TCP-IP, SDLC, CANBUS, ARINC429, MIL-STD-1553, etc), it's useful work with some resources as FPGA devices that can offer the flexibility to support changing standards, parallel processing and customizable interfaces with integrated functions like high performance DSP, memory, analog and I/O interfaces, making it easier for designers to embed soft processors to control dataflow and manage a number of interfaces in the system. The concepts achieved in message management and data frame interface used in Radio Defined by Software (RDS)

systems where applied in this work to define a basic algorithm structure.

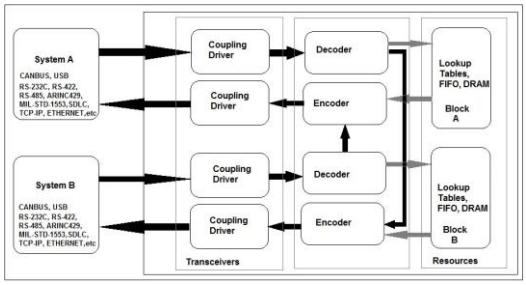

Figure 1 – Basic structure of systems integration.

This capability in integrate systems with low mass and electrical power it's too much useful in UAVs and cubesats, were devices from several suppliers need be used in a fusion data system for the mission. In this research are used only COTS devices in order to allow the use in academic projects and the analysis of flight performance of these devices in embedded Real Time Systems architectures.

Glossary

FPGA – Field Programmable Gate Array

VHSIC - Very High Speed Integrated Circuits

VHDL – VHSIC Hardware Description Language

XILINX – Commercial FPGA Manufactory

COTS – Commercial Of the Shelf

RDS – Radio Defined by Software

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