

# Re-engineering, System Design, & Code Generation for Legacy Avionics Systems

**VP Technologies, Inc.**

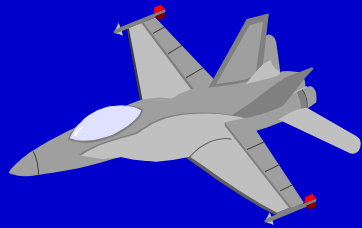
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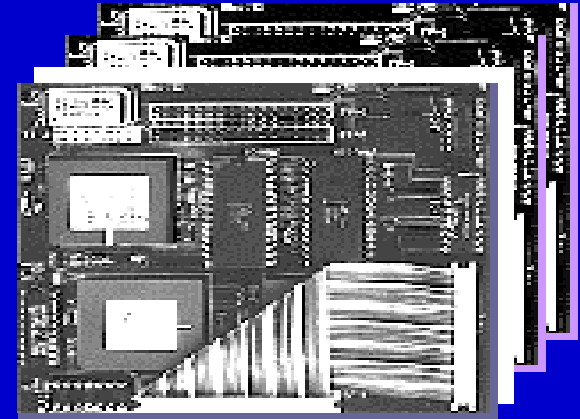
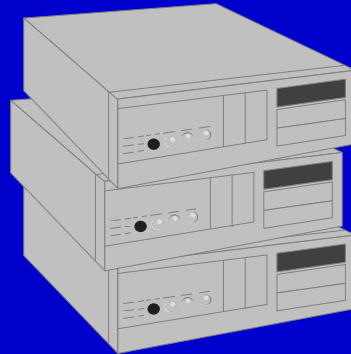
October 1998

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# Typical Avionics Systems Architecture

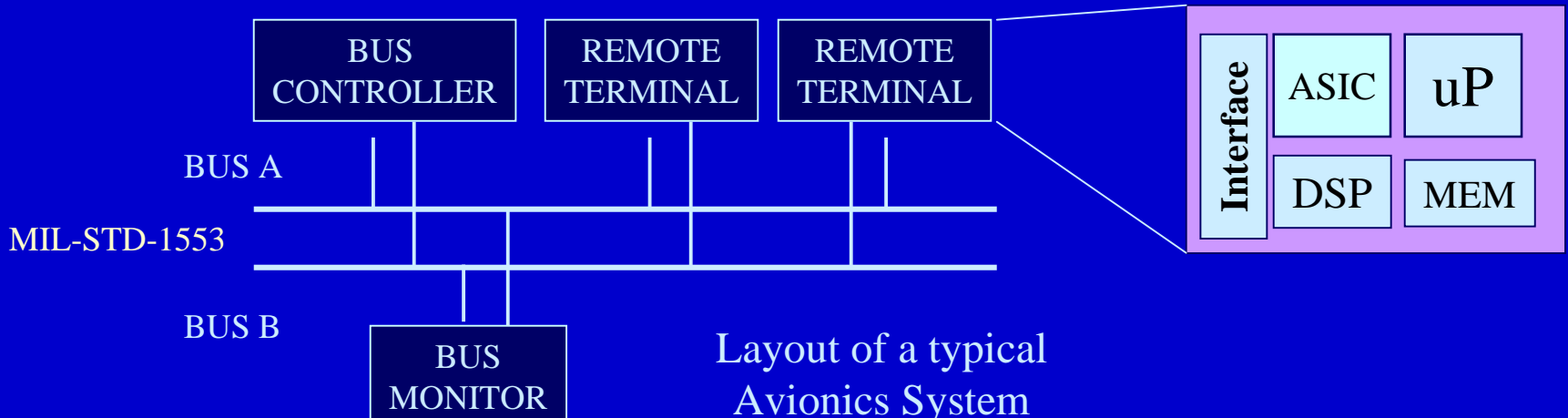


Avionics Systems



Avionics Subsystems

We use the example of a MIL-STD-1553 based system for this presentation



Layout of a typical Avionics System

# Challenges in Design and Re-Engineering of Avionics Systems

## *How does one re-engineer legacy systems subject to:*

- Critical real time constraints on computation and communication.
- Crucial reliability and error handling requirements.
- Resource usage is constrained by the power and forms.
- New application requirements.

## *The current approach/status is:*

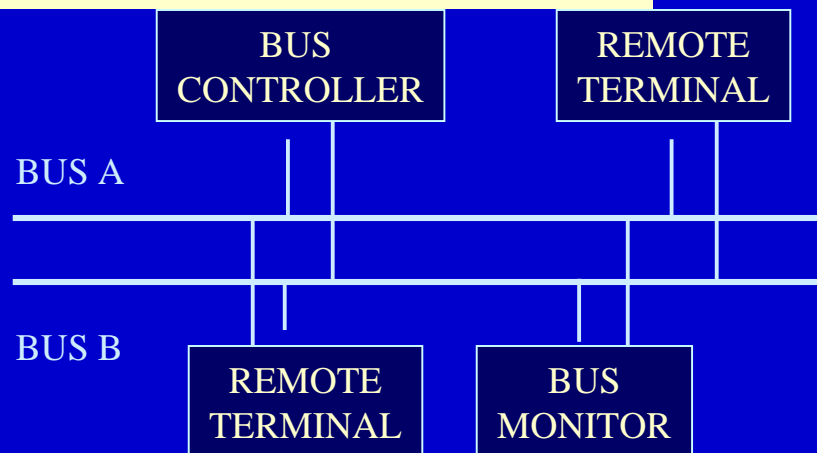
- Ad-hoc methodology towards design and re-engineering.
- Control and application code development is very complex, time consuming and hand crafted.
- System integration and testing is time demanding, error-prone and complex.
- Non-upgradeable solutions that cannot benefit from COTS advances.

*We will illustrate a new approach using the a MIL-STD-1553 case study.....*

# MIL-STD-1553 Overview

- Throughput : **1 Mbps.**
- Command/ Response Communication Mode

*The MIL-STD-1553  
implements a time-share bus...*

## Legend

### Bus Controller :

- The task of initiating information transfer on the data bus

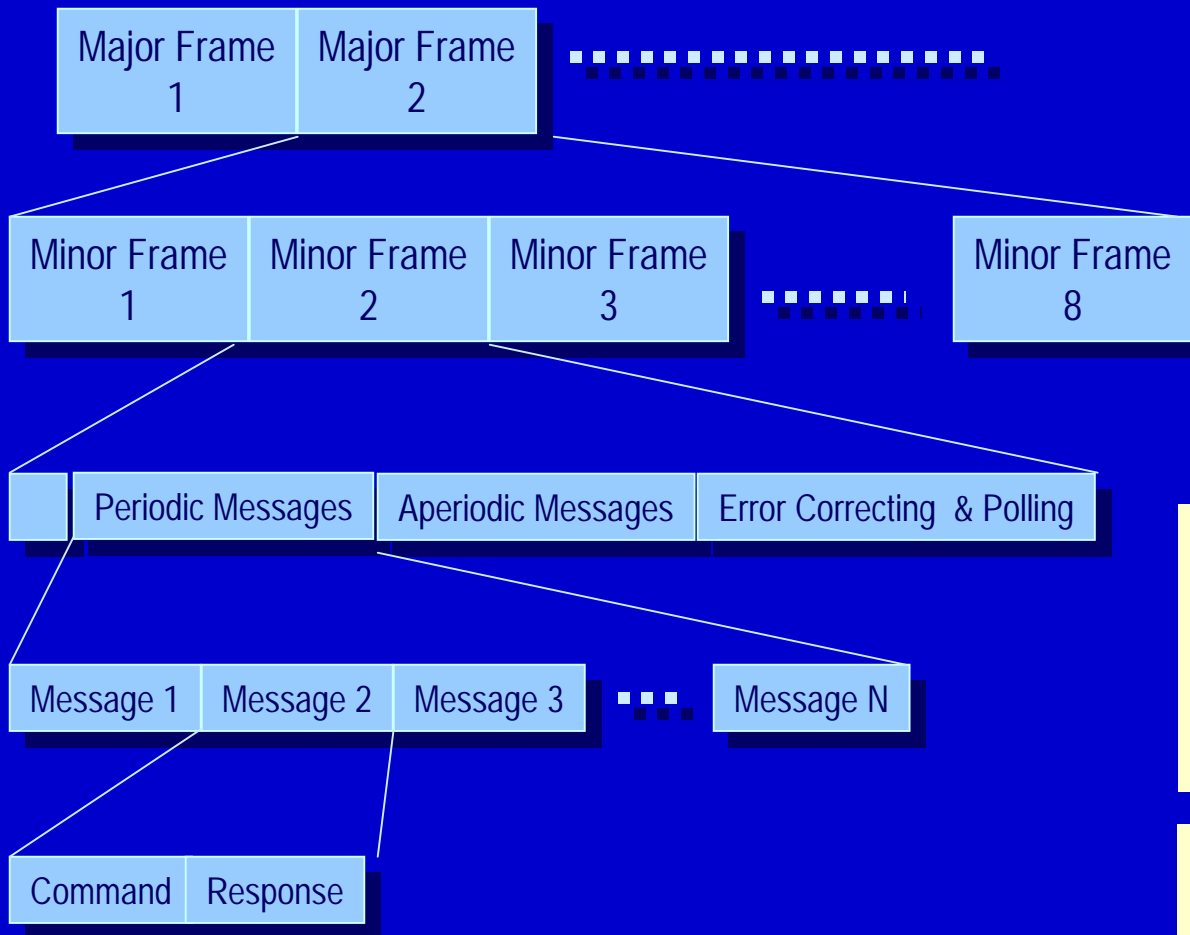
### Bus Monitor :

- Monitors bus activities for maintenance, mission analysis.

### Remote Terminal :

- Operates in response to the valid commands of the bus controller.

# 1553 Overview: Frame Composition



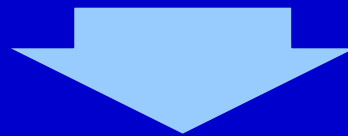
- Message Transactions modes
- BC to RT Transmit
  - BC to RT Receive
  - RT to RT
  - BC to RT Command Mode with Data
  - BC to RT Command Mode w/o Data

- The words are of three types
- Command Word
  - Data Word
  - Status Word

## Known Facts About MIL-STD-1553

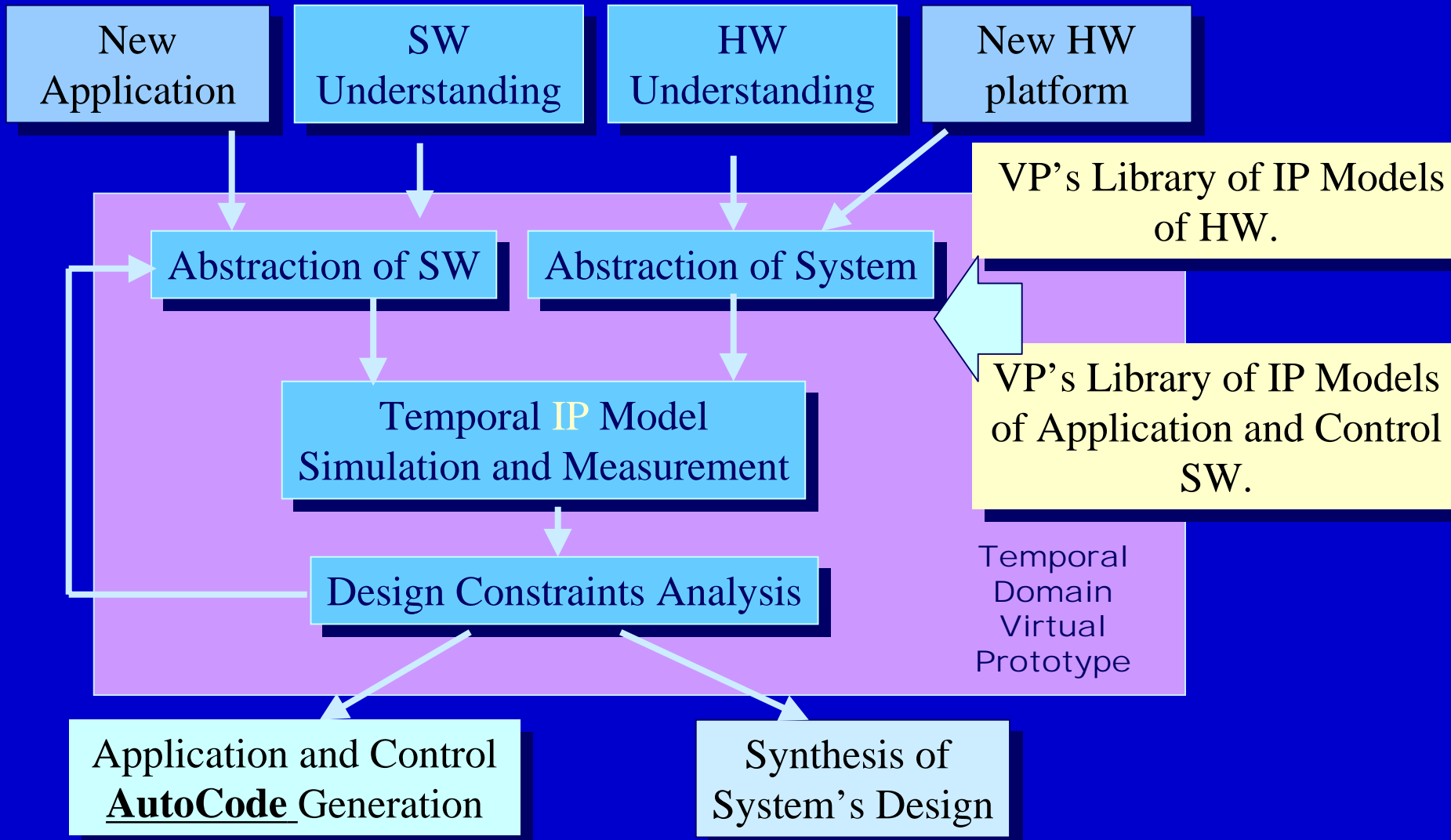
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- MIL-STD-1553 is a standard, not a specification - Its implementation results in non-standard systems.
- The requirements of MIL-STD-1553 are subject to interpretation.
- Integration of 1553 is a complex software intensive method.
- Not all MIL-STD-1553 hardware are created same.
- Testing MIL-STD-1553 system is a non trivial task.

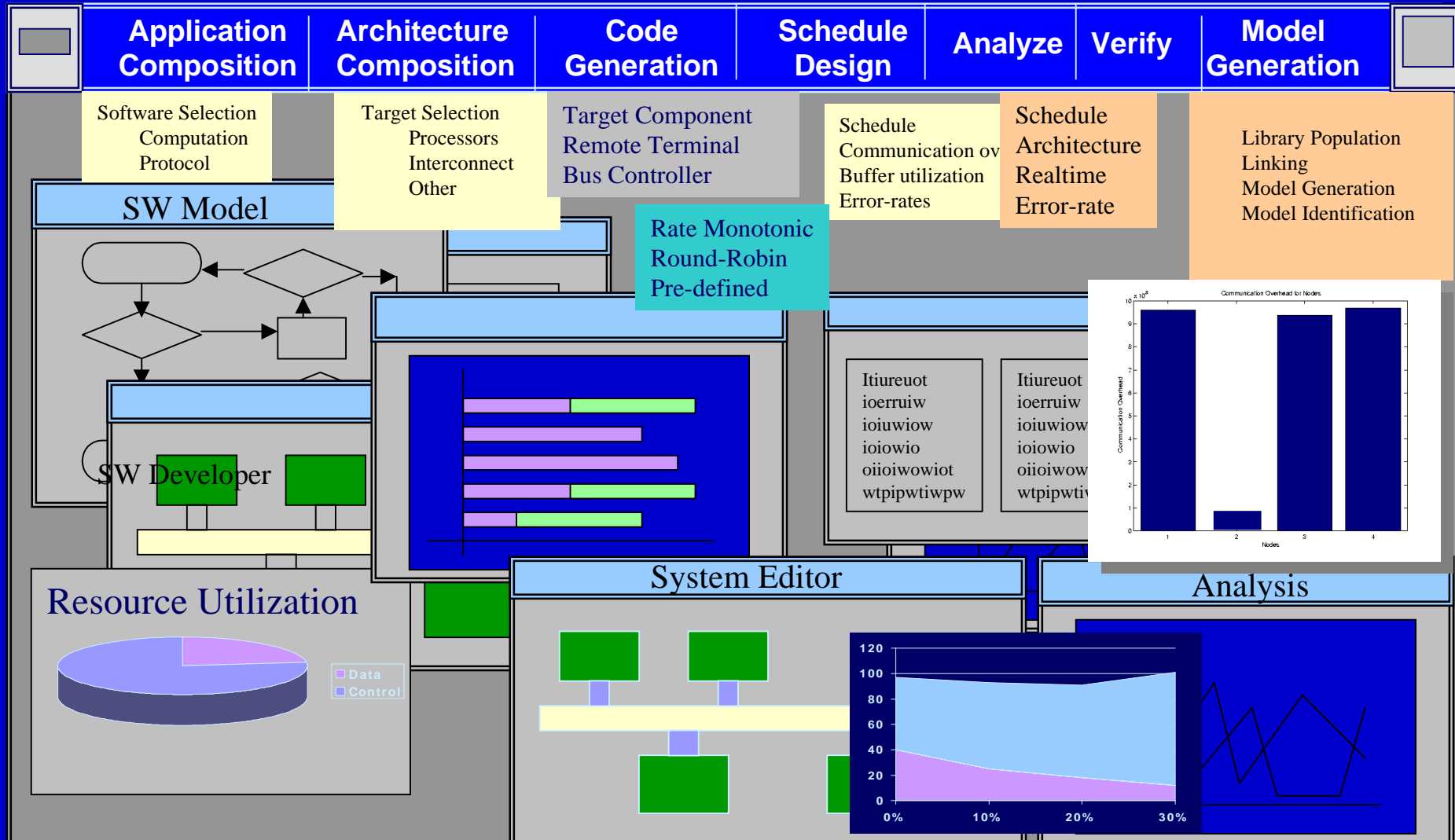


Difficult to upgrade 1553 based legacy system

# VP Technologies' Re-Engineering and Design Methodology



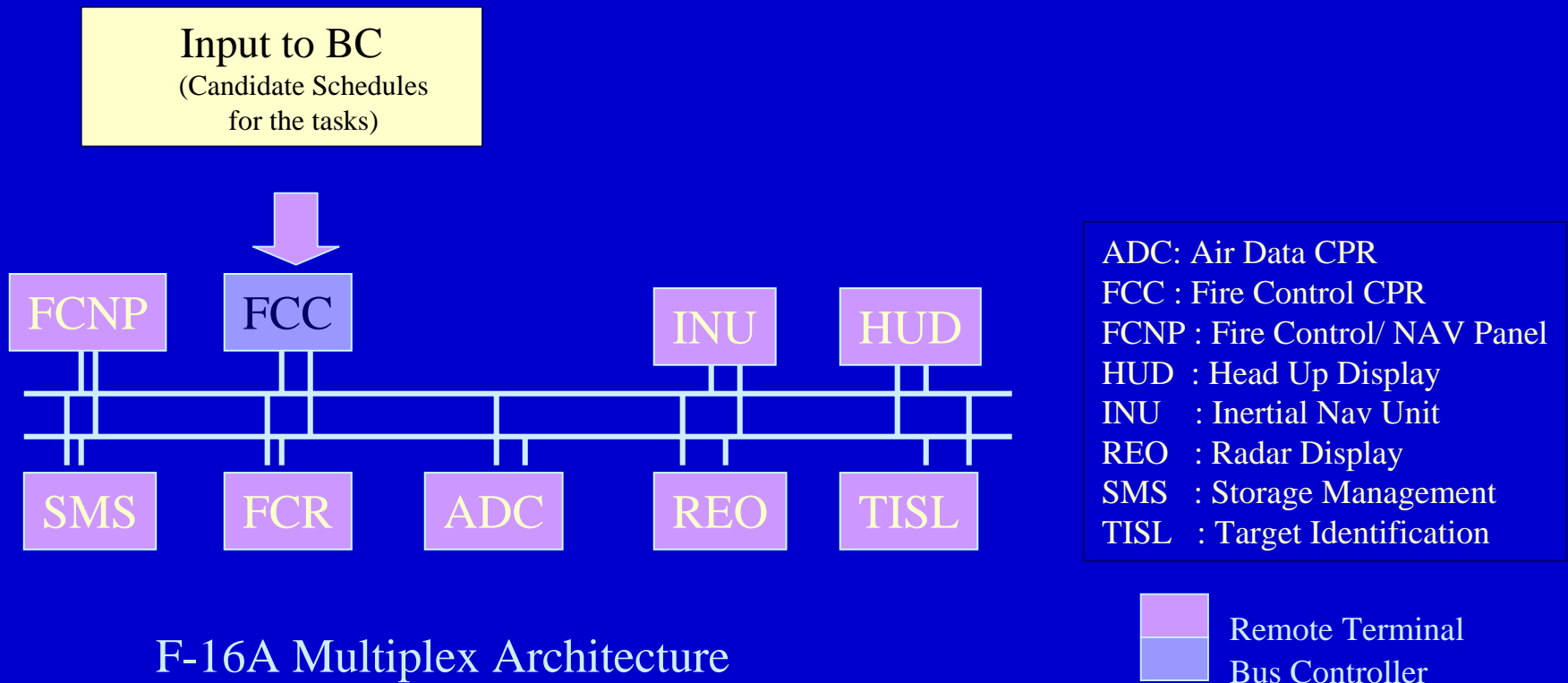
# Overview of the VP's Architectural Re-Engineering Environment



# Case Study I :

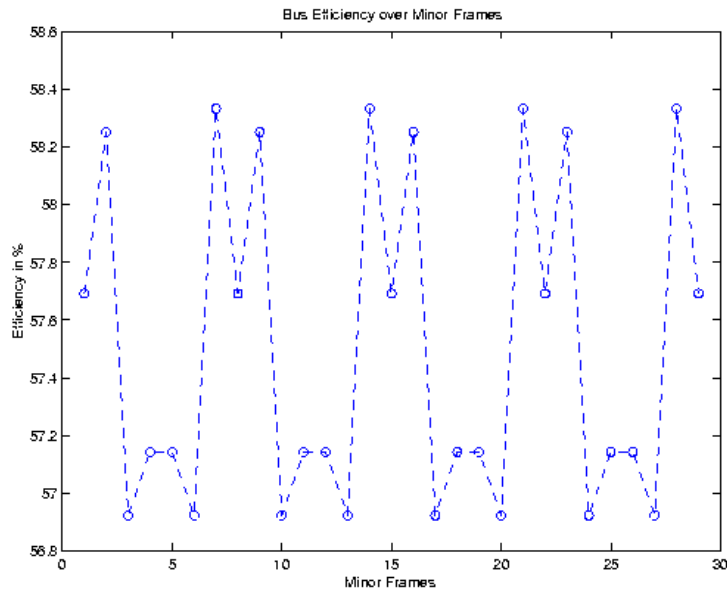
## Communication Schedule Design for MIL-STD-1553 and Bus Control Code Synthesis

Objective : Real Time Scheduling design for 1553 based systems.

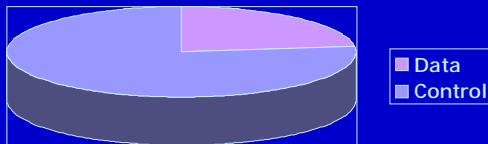


# Analysis of Communication Schedule

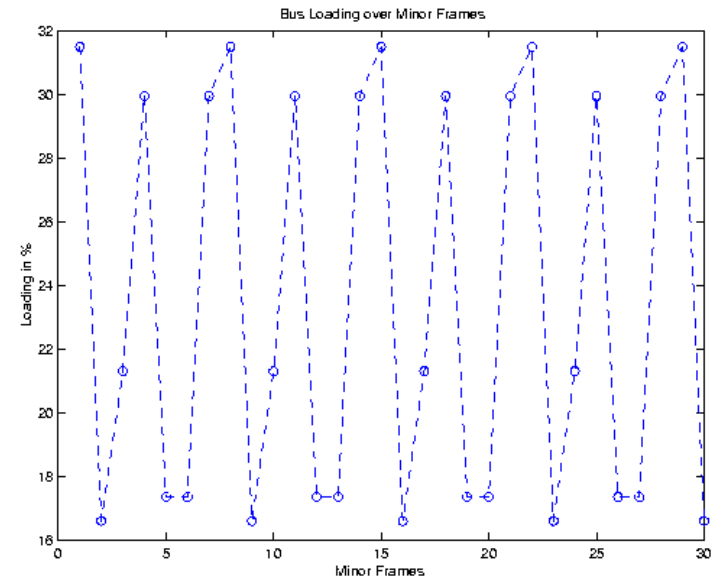
## Bus Efficiency % vs. Minor Frames



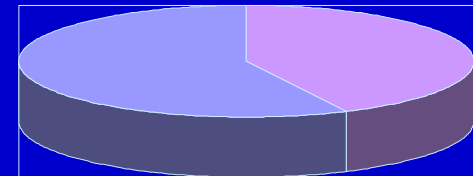
Mean : 23.12 %



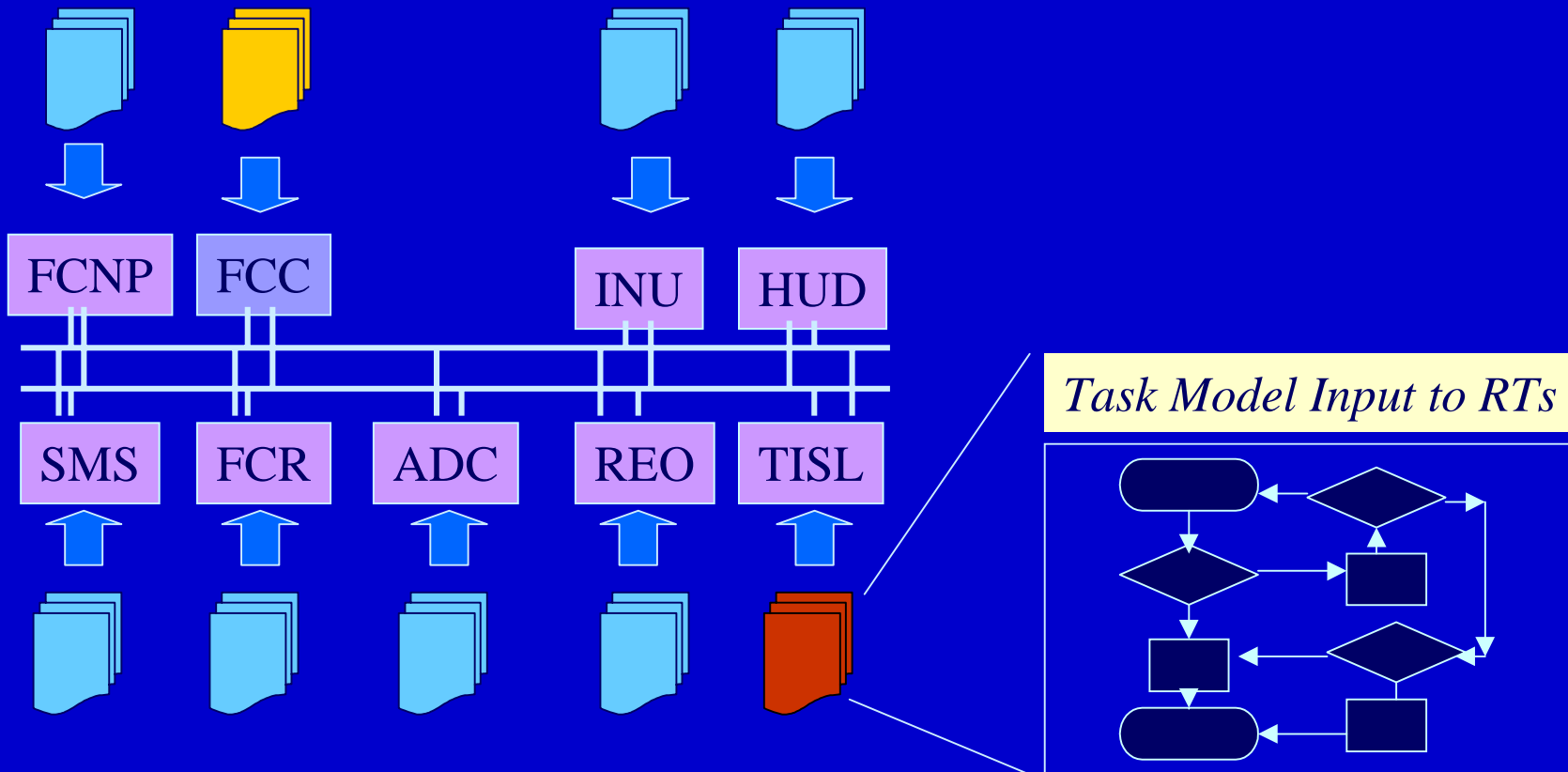
## Bus Load % vs. Minor Frames



Mean : 57.17 %



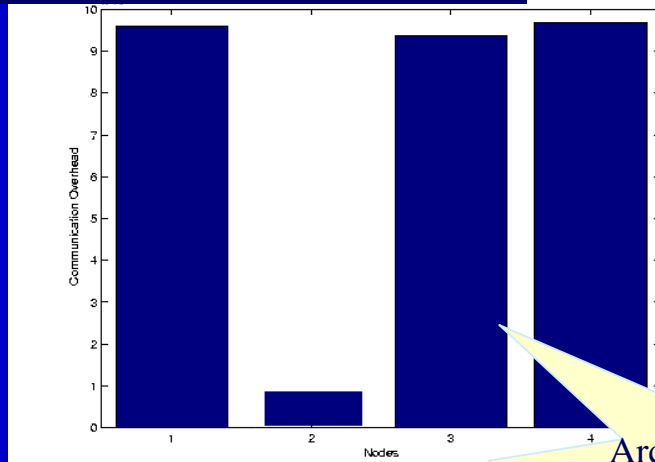
# Case Study II : Application Design for Remote Subsystems



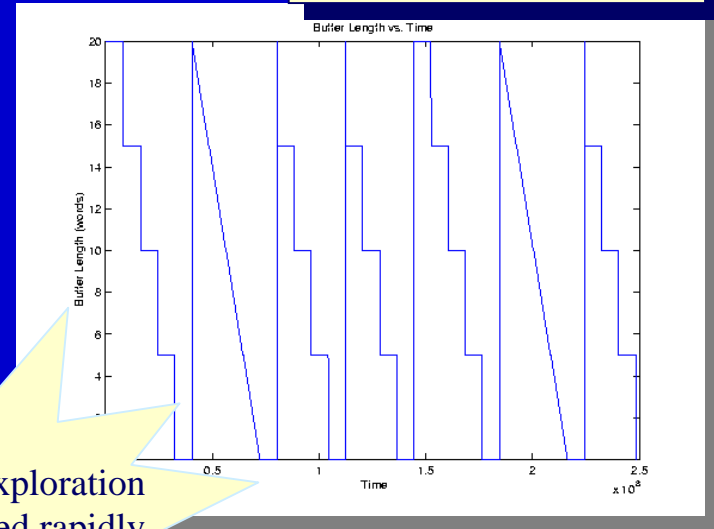
- Task Models for RTs
- Bus Controller Schedule
- Additional Functionality/Component

# Execution Characteristics Analysis

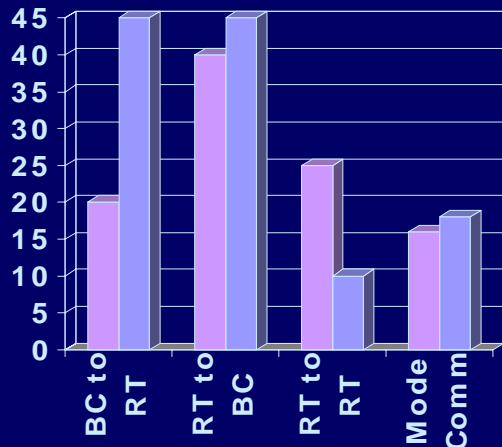
## Communication Overhead



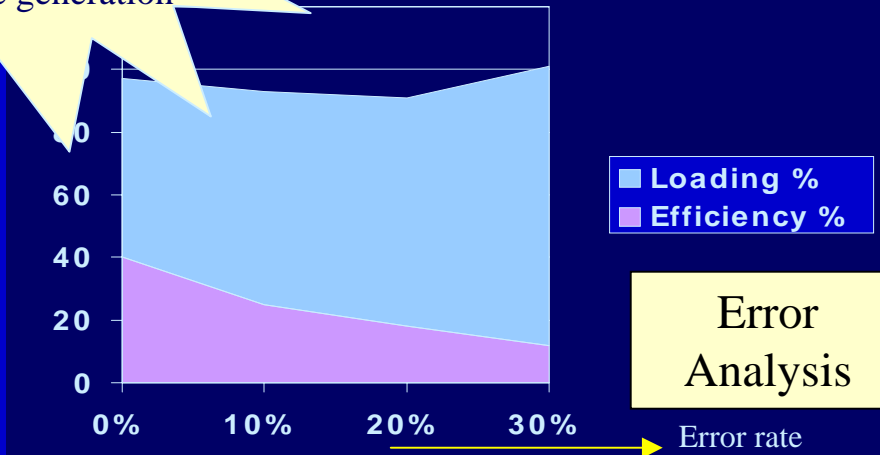
## Buffer usage



Architectural exploration can be completed rapidly prior to code generation



## Instruction Density



## Error Analysis

# Summary

VP Technologies' design services and libraries facilitate:

- Architectural exploration during re-engineering through evaluation of performance using *HW/SW IP model* libraries.
- *Design in & verification* of real-time application guarantees.
- Reduction of re-engineering time through *autocode generation* for commonly used avionics architectures (e.g., MIL-STD-1553, MIL-STD-1773, VME64, SCI, FibreChannel,...)



Cost Effective, Accurate, and  
Quicker Re-designs