**CHAPTER 1**

**INTRODUCTION**

* 1. **ABOUT ANANTH TECHNOLOGIES**

Ananth, founded in 1992 and servicing Fortune 1000 clientele since, is a global broad-based Software and Hardware, Services and Solutions provider. On the IT services front they support enterprises business processes and systems, with innovative services, solutions and products. On the hardware front they specialize in the design and development of highly sophisticated aerospace subsystems and other embedded systems. Ananth Technologies has been, AS 9100C and ISO 9001:2008 certified and is actively working towards CMMI Level 5 assessment.  
  
 Ananth's strength is its 750+ seasoned engineering professionals, working from R&D centers across India and design centers across the globe. Ananth's varied clientele include leaders in the areas of Aerospace, Mining, Pharma, Higher Education, Public Sector, Manufacturing and Health care. Ananth is the technology partner with a single passion: dedicating its systems expertise, and global resources to transform businesses.

Experience the Ananth way of business; mutually striving to provide great value to their customers through innovative services and products and growing together in that process.

* 1. **UNITS IN ATL**

**1.2.1 SATELLITE SYSTEMS**

**Experience: ATL actively participates in the development of Satellite Systems for ISRO**

* More than 20 years, in India6
* 6n Aerospace industries
* Professionals with extensive background and expertise in the area related to the Development / Operationalization / Product Quality Assurance for the Communication & Remote Sensing Satellites and Network Operations
* The cumulative experience around 1000 years

**Sub-systems**

* Telemetry-Telecommand Systems,
* Attitude and Orbit Control Electronics,
* Core Power Packages
* TWTA
* Digital Sun Sensors
* Power Distribution Packages
* Electronic Power Conditioners,
* EED subsystems,
* DC-DC Converters
* Analog Sensors
* Steradian Sensors
* EMI filters,
* Satellite Integration and I/F
* Launch vehicle Avionics subsystems,
* Mini PCM Telemetry systems,
* Decoding Electronics for Sequencing,
* Mini Dual Power Modules,
* Advanced Signal Processing Units
* Advanced Mission Computers
* Mini Remote Telemetry Units,
* HF-DC/DC Converters,
* Image Data Processing Units
* Associated Checkout units.

**Facilities**

* ISRO certified / qualified work centers
* Clean rooms
* Thermal Chambers
* Vibration& Shock Tables
* Radiation Shielding, Conformal Coating & Potting Facility,
* Wide Range of Test and Measuring Equipment (Digital & Microwave)

**R&D UNIT**

* A strong R&D base in the multi-disciplinary areas of its involvement to ensure a continuous improvement end product realization.

**Satellite Systems - Consultancy Services**

The ATL has expertise in providing services for satellite/operators covering all the phases of communication satellites.  Consultancy services focus on both the space and ground segments of the communications satellite and include the definition of requirements up to and including orbital acceptance testing of the satellites.

**Conceptual Design Studies**

* Orbital slot selection
* Associated rules and regulation procedures to be followed-like for ITU
* Basic satellite definition,
* Satellite bus selection,
* Frequency bands of operation,
* No of transponders
* EIRP optimization
* Antenna pattern coverage.,
* Optimum footprints coverage interference mitigation methodology etc.

**Market Studies**

* Business Plan Development
* Technical Support for
  + Products and Services
  + Applications

**Assistance with proposal preparation:**

* Can assist a customer in soliciting proposals from the major reputed satellite manufacturers
* Can contribute to the development of the Request for Proposal

**Proposal evaluation**

* This includes comparative assessment of the proposals received from the prime contractors   from needed coordination, technical, implementable, customer needs, financial implications etc., point of view.

**Assistance with contract negotiations**:

* Can assist a client in negotiating the various aspects of a contract.

**Spacecraft contract monitoring**:

* During the design, fabrication, and testing of a satellite, through appropriate progress monitoring methodology the technical issues are properly addressed.

**Launch vehicle interface assistance**

* Assistance to launch vehicle interface activities, including technical interface meeting during satellite development, satellite integration at the launch site, and launch day monitoring and support.

**Satellite interface assistance**

* Assistance related to satellite IF with LV and pre, LEOP, IO operations etc., during the designated service lifetime.

ATL has a high level of knowledge in the engineering of satellites and their operations, and as such offer’s consultancy and technical advisory services for the management of support projects for other satellite companies, organizations.

**Clients**

* Satellite Operators
* Satellite Manufacturers & Content providers
* Satellite Service Providers & Satellite subsystem suppliers

**Current Plans**

With a view to harness its vast experience in the satellite technology and associated disciplines,  and for meeting the growing demands of the communications transponders worldwide, ATL is presently working- on an ambitious space program to launch  communication satellites of its own- in close collaboration with reputed international global space partners to provide Broadcast, Telecommunication and value added services to the global community.

Ananth Technologies offers its customers access to world-class IC design expertise. We have expertise in the quick and accurate FPGA design, or the complex task of building multi-million gate SOC designs. Our depth and breadth of design expertise in FPGA, SOC (System on Chip), and the investments in our design infrastructure, enable the customers to reduce R&D cost and time to market.  
  
 Our engineers have wide technology domain expertise and vast experience in FPGA, IP Block, Embedded system S/W Designs to provide effective solutions to your problems. We follow standardized design and quality process flow and we have a good track record in projects completed, and expertise in a wide area of design. In addition, Ananth also provides full turnkey embedded software development services. Comprehensive embedded software development includes firmware, device drives and kernel level development.

**1.2.2 BOARD DESIGN**

Ananth team has a rich experience in designing high-speed, high-density multi-layer boards and systems, coupled with a proven design practice that helps us deliver complex boards on time.  
  
Ananth offers complete board design capability - from requirements to design, layout, prototyping, testing and transfer to production. Our team has rich experience in designing high-speed, high-density multi-layer boards and systems. This coupled with proven design processes & methodologies help us meet the challenge of delivering complex boards on time to meet the reduced time-to-market requirements of our customers.

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| --- |
| **Solutions** |
| |  |  | | --- | --- | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | High Speed Digital, Analog, Mixed signal and RF design | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | SBCs & Motherboard design | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | ASIC evaluation boards, Probe cards | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Mechanically constrained PCB's | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Microcontroller based boards and Industrial controllers | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Peripheral adapters: PCI, PCMCIA and Compact FLASH | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Silicon validation and reference boards | |
| **Ananth Advantage** |
| |  |  | | --- | --- | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Architecture design | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Schematics capture | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Board layout | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | DFM/DFT | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Signal integrity & Cross talk analysis | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | EMI/EMC analysis | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Thermal analysis | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Prototyping | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Bring-up testing & Design validation | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Transfer to production | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Design validation tests | |

They ensure that all PCB designs are analyzed thoroughly for timing, signal integrity, power, heat dissipation (thermal compliance), and EMC/EMI compliance. Ananth has a state-of-the-art Hardware Development Laboratory with various tools like EDA tools from Mentor Graphics and Cadence, analyzers, in-circuit simulators, ESD protected workbenches, oscilloscopes etc., which bolster our hardware design expertise.

**1.2.3. EMBEDDED SYSTEMS**

**FPGA DESIGN**

Expertise ranges from design of companion FPGA with a few hundred gates to SoC designs with multi-million gates FPGA.  
  
Ananth FPGA development team is capable of delivering fully validated ready to deploy FPGA solutions based on a set of requirements from the customer. Our expertise ranges from design of companion FPGAs with a few hundred gates to SoC (System on Chip) designs with multi-million gates FPGAs.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | **Expertise** | | |  |  | | --- | --- | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Architecture design | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | HDL coding | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Building test benches and test automation scripts for FPGA verification | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Functional and Timing Verification | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Device fitting: Pin out and place & route | | https://ci3.googleusercontent.com/proxy/R6BbXwRYoH4QcuuP8wMB5sk_TgumlilEvhY8XKOuO6POsOoy99U-C4oSAK80OYzNCATparK0jSyBN1IG=s0-d-e1-ft#https://ananthtech.com/images/bullet3.jpg | Validation on hardware platform | | |
|  |
| **1.2.4. ELECTRONIC MANUFACTURING SERVICES (EMS):**    **Manufacturing Capabilities:**   * SMT Line including both Single and Double Sided. * Fine Pitch BGA’s * Through Hole & SMT Mixed * Multi-Chip Modules * Potting & Conformal Coating Facility * Rapid Prototyping * HMLV (high-mix low-medium-volume) * Reflow Assembly * Box Build / Final Assembly * In-Circuit & Functional Testing * Placement of loose components * ROHS Compliance process capability     A picture containing floor, indoor, building  Description automatically generated A person standing in a kitchen  Description automatically generated  A person standing in a kitchen  Description automatically generated |
|  |

**1.2.5. THE PROCESS OF TAKING UP A PROJECT**

They have a very specific way of taking up on a project. The project will be taken in the following steps:

1. Tender

2. Project specifications

3. Components selection (MIL-GRADE)

4. PCB layout & Schematic development

5. Verification of schematics

6. Assembly of the components and PCB integration

7. Creating a test module.

8. Environmental and tensile tests

9. Delivering the project.

#### 1. Tender: The company first gets the tender by bidding at a lower rate and then gets the project.

#### 

**2. Project specifications:** After getting the project, they look for the specifications, budget.

**3. Components selection:** After knowing the specifications, this department selects the components according to the specifications.

**4. PCB layout & Schematic Development:** After selection of the components, the plan/schematic is doneaccordingly.

**5. Verification of Schematics:** After the schematic plan, the verification is done by checking the netlist, input and output ports.

**6. Assembly of the components and PCB integration:** This department assembles all the components on the PCB board and integrates all the modules.

**7. Creating a test module:** A model test design is created in order to perform all kinds of tests.

**8. Environmental and tensile tests:** Environmental tests such as pressure test, temperature tests are performed. Also, tests like accelerometertests are performed.

**9. Delivery of the project:** The product is finally delivered after verification of and testing all the aspects.

#### CHAPTER 2

#### MISSILE TELEMETRY

#### 2.0. Definition

Telemetry is used for monitoring the guided missile for its performance during flight trials and ground tests. Precisely it is an automated communications process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring. So in guided missile systems by means of telemetry we observe whether missile is going in predetermined path or not. If missile has gone rogue then a self destruction signal is transmitted to missile. Thus Telemetry is vital in the development of missiles because the system might be destroyed during or after the test. Engineers need critical system parameters to analyze (and improve) the performance of the system. In the absence of telemetry, this data would often be unavailable. A popular form telemetry in missile systems is PCM telemetry.

### 2.1 Need for TELEMETRY

The primary benefit of telemetry is the ability of an end user to monitor the state of an object or environment while physically far removed from it. Once you’ve shipped a product, you can’t be physically present, peering over the shoulders of thousands (or millions) of users as they engage with your product to find out what works, what’s easy, and what’s cumbersome. Thanks to telemetry, those insights can be delivered directly into a dashboard for you to analyze and act on.

Because telemetry provides insights into how well your product is working for your end users – as they use it – it’s an incredibly valuable tool for ongoing [performance monitoring and management](https://stackify.com/retrace-application-performance-management/). Plus, you can use the data you’ve gathered from version 1.0 to drive improvements and prioritize updates for your release of version 2.0.

Telemetry enables you to [answer questions](https://blogs.windows.com/buildingapps/2014/03/20/instrumenting-your-app-for-telemetry-and-analytics/#pELH6DO38eShIkOd.97) such as:

* Are your customers using the features you expect? How are they engaging with your product?
* How frequently are users engaging with your app, and for what duration?
* What settings options to users select most? Do they prefer certain display types, input modalities, screen orientation, or other device configurations?
* What happens when crashes occur? Are crashes happening more frequently when certain features or functions are used? What’s the context surrounding a crash?

Obviously, the answers to these and the many other questions that can be answered with telemetry are invaluable to the development process, enabling us to make continuous improvements and introduce new features that, to your end users, may seem as though we’ve been reading their minds – which we have been, thanks to telemetry.

**2.2. Principle Involved in this project:**

**2.3. How can we Achieve:**

In a general sense, telemetry works through sensors at the remote source which measures physical (such as precipitation, pressure or temperature) or electrical (such as current or voltage) data. This is converted to electrical voltages that are combined with timing data. They form a data stream that is transmitted over a wireless medium, wired or a combination of both.

At the remote receiver, the stream is disaggregated and the original data displayed or processed based on the user’s specifications.

In the context of software development, the concept of telemetry is often confused with logging. But [logging](https://stackify.com/retrace-log-management/) is a tool used in the development process to diagnose errors and code flows, and it’s focused on the internal structure of a website, app, or another development project. Once a project is released, however, telemetry is what you’re looking for to enable automatic collection of data from real-world use. Telemetry is what makes it possible to collect all that raw data that becomes valuable, actionable analytics.

**CHAPTER 3**

**SELECTION OF COMPONENTS AND THEIR POPULATION**

**CHAPTER 4**

**SOFTWARES USED**

1. **Keil**
2. **MATLAB**
3. **mmwave demo visualizer**

**DESCRIPTION ABOUT SOFTWARES:**

**4.1 Keil:**

**4.1.1 Concept of compiler:**

Compilers are programs used to convert a High Level Language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors. I.E the programs written in one of the HLL like ‘C’ will compile the code to run on the system for a particular processor like x86 (underlying microprocessor in the computer). For example compilers for Dos platform is different from the Compilers for Unix platform

So if one wants to define a compiler then compiler is a program that translates source code into object code. The compiler derives its name from the way it works, looking at the entire piece of source code and collecting and reorganizing the instruction. A little bit difference between compiler and an interpreter. Interpreter just interprets the whole program at a time while compiler analyzes and executes each line of source code in succession, without looking at the entire program.

The advantage of interpreters is that they can execute a program immediately. Secondly programs produced by compilers run much faster than the same programs executed by an interpreter. However compilers require some time before an executable program emerges. Now as compilers translate source code into object code, which is unique for each type of computer, many compilers are available for the same language.

**4.1.2 Concept & Need of Cross Compiler**

**Concept of cross compiler:**

A cross compiler is similar to the compilers but we write a program for the target processor (like 8051 and its derivatives) on the host processors (like computer of x86)

It means being in one environment you are writing a code for another environment is called cross development. And the compiler used for cross development is called cross compiler.

So the definition of cross compiler is a compiler that runs on one computer but produces object code for a different type of computer. Cross compilers are used to generate software that can run on computers with a new architecture or on special-purpose devices that cannot host their own compilers. Cross compilers are very popular for embedded development, where the target probably couldn't run a compiler. Typically an embedded platform has restricted RAM, no hard disk, and limited I/O capability. Code can be edited and compiled on a fast host machine (such as a PC or Unix workstation) and the resulting executable code can then be downloaded to the target to be tested. Cross compilers are beneficial whenever the host machine has more resources (memory, disk, I/O etc) than the target. Keil C Compiler is one such compiler that supports a huge number of host and target combinations. It supports as a target to 8 bit microcontrollers like Atmel and Motorola etc.

**4.1.3 Why do we need cross compiler?**

There are several advantages of using cross compiler. Some of them are described as follows

• By using this compilers not only can development of complex embedded systems be completed in a fraction of the time, but reliability is improved, and maintenance is easy.

• Knowledge of the processor instruction set is not required.

• A rudimentary knowledge of the 8051’s memory architecture is desirable but not necessary.

• Register allocation and addressing mode details are managed by the compiler.

• The ability to combine variable selection with specific operations improves program readability.

• Keywords and operational functions that more nearly resemble the human thought process can be used.

• Program development and debugging times are dramatically reduced when compared to assembly language programming.

• The library files that are supplied provide many standard routines (such as formatted output, data conversions, and floating-point arithmetic) that may be incorporated into your application.

• Existing routine can be reused in new programs by utilizing the modular programming techniques available with C.

• The C language is very portable and very popular. C compilers are available for almost all target systems. Existing software investments can be quickly and easily converted from or adapted to other processors or environments.

4.1.4 **Keil C cross compiler:**

Keil is a German based Software development company. It provides several development tools like

• IDE (Integrated Development Environment)

• Project Manager

• Simulator

• Debugger

• C Cross Compiler , Cross Assembler, Locator/Linker

Keil Software provides you with software development tools for the 8051 family of microcontrollers. With these tools, you can generate embedded applications for the multitude of 8051 derivatives. Keil provides the following tools for 8051 development

1. C51 Optimizing C Cross Compiler,

2. A51 Macro Assembler,

3. 8051 Utilities (linker, object file converter, library manager),

4. Source-Level Debugger/Simulator,

5. µVision for Windows Integrated Development Environment.

The keil 8051 tool kit includes three main tools, assembler, compiler and linker.

An assembler is used to assemble your 8051 assembly program

A compiler is used to compile your C source code into an object file

A linker is used to create an absolute object module suitable for your in-circuit emulator.

**4.1.5 8051 project development cycle:** these are the steps to develop 8051 project using keil

1. Create source files in C or assembly.
2. Compile or assemble source files.
3. Correct errors in source files.
4. Link object files from compiler and assembler.
5. Test linked application.

**4.1.6 Working with keil:**

To open keil software click on the start menu then program and then select keil2 (or any other version keil3 etc. here the discussion is on keil2 only). Following window will appear on your screen

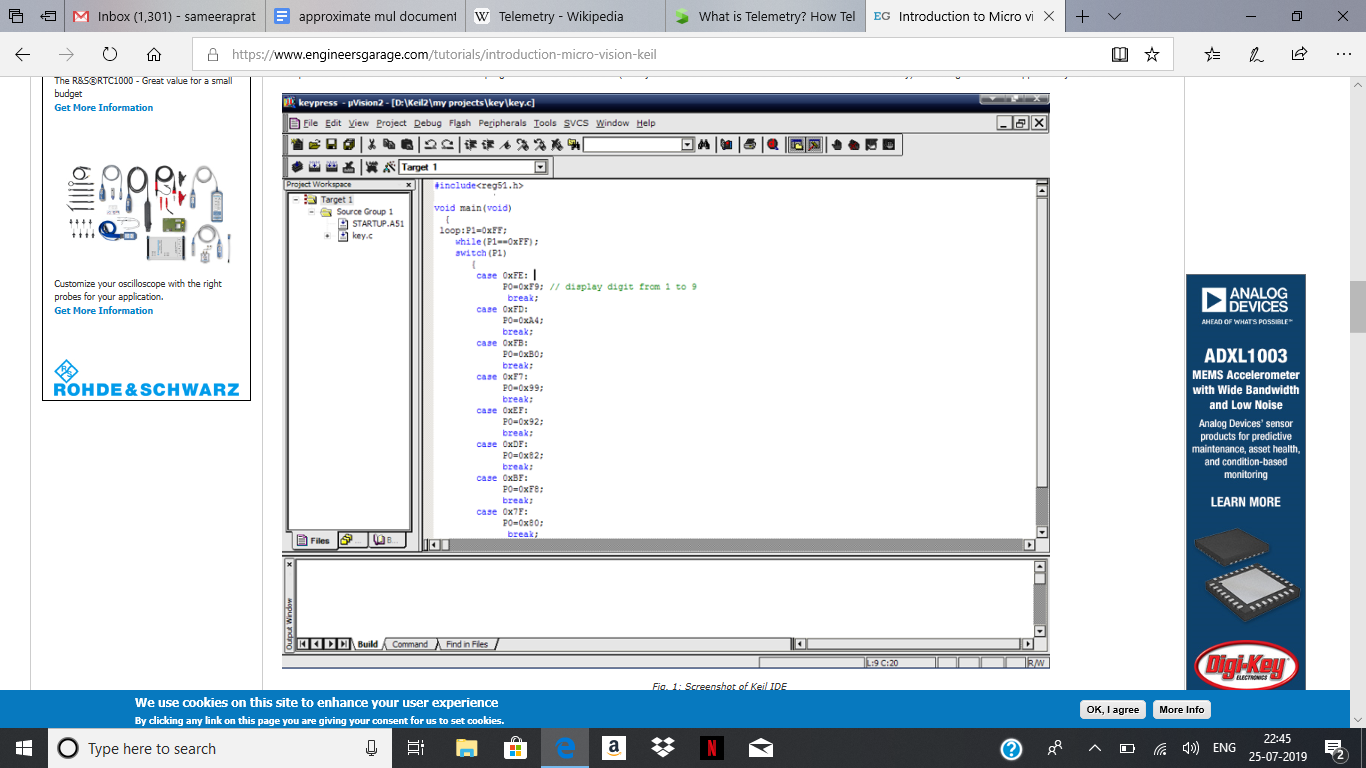


Fig. Working with Keil

You can see three different windows in this screen.

* project work space window
* editing window
* output window.

Project workspace window is for showing all the related files connected with your project.

Editing window is the place where you will edit the code

Output window will show the output when you compile or build or run your project.

**4.2 MATLAB**

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

* Math and computation
* Algorithm development
* Modeling, simulation, and prototyping
* Data analysis, exploration, and visualization
* Scientific and engineering graphics
* Application development, including Graphical User Interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar noninteractive language such as C or Fortran.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation.

MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to *learn* and *apply* specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

The MATLAB System

The MATLAB system consists of five main parts:

#### The MATLAB language.

This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

#### The MATLAB working environment.

This is the set of tools and facilities that you work with as the MATLAB user or programmer. It includes facilities for managing the variables in your workspace and importing and exporting data. It also includes tools for developing, managing, debugging, and profiling M-files, MATLAB's applications.

#### Handle Graphics.

This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

#### The MATLAB mathematical function library.

This is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix eigenvalues, Bessel functions, and fast Fourier transforms.

#### The MATLAB Application Program Interface (API).

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It includes facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.

**4.3 mmWave Demo Visualizer**

**CHAPTER 5**

**ADVANTAGES USING RADAR FOR MILITARY**

Radar has been a significant RF/microwave technology since the days of World War II. During that time, radar (a shortening of “radio detection and ranging”) proved an invaluable military tool for locating threats and targets and providing advanced warnings of an adversary’s position and direction. The basic operation of a radar system involves transmitting a high-frequency signal (usually a pulsed signal) towards the location of an expected target and receiving signals reflected from said target. By performing signal processing on these radar returns, information can be extracted regarding the target, its position, and its speed.

Military uses were once the only applications for radar technology, but times have changed. Radar technology is now finding uses in many commercial, industrial, medical, weather, and especially automotive systems. These new and growing application areas are keeping radar designers—from integrated-circuit (IC) to system-level engineers—busy in search of high-performance, cost-effective solutions from RF through millimeter-wave frequencies.

Military systems still represent the most plentiful source of radar applications, with military radar systems found on land, at sea, and in the air (and in lesser numbers, in space-borne systems). Radar systems have been used in military applications for ground surveillance, missile control, fire control, air traffic control (ATC), moving target indication (MTI), weapons location, and vehicle search.

As land-based radar systems were being developed in support of American troops during World War II, the U.S. Naval Research Labs (NRL) developed radar systems for maritime applications, including onboard submarines. For such uses, a submarine would draw close to the water surface level, enabling a radar antenna to rise above the surface of the sea water to transmit signals in search of enemy aircraft.

Modern ground-based radar systems are transportable by personnel as well as by vehicles, with some systems—such as the AN/PPS-5A/B ground surveillance radar system—in service for a number of decades. Older military radar systems, whether of the ground-, maritime-, or avionic-based variety, are continuously upgraded as newer technologies become available.

With the AN/PPS-5A/B system, for example, systems based on magnetron tube power sources and weighing 125 lb. have largely been replaced by systems using solid-state transmit amplifiers and weighing only 70 lb., with a slight tradeoff in transmit power. This is considered a man-portable radar system that has been packed in waterproof enclosures for dropping into locations with infantry via parachute.

The AN/PPS-5A/B is fairly representative of a ground-based surveillance radar, operating over a fairly narrow bandwidth in the frequency range from 8.8 to 9.0 GHz with a pulse repetition frequency (PRF) of 4 kpulses/s. The system transmits pulses with 1 kW peak power and achieves ranges of about 6 km for detecting personnel and 10 km for detecting vehicles. The system is built for U.S. military customers by a number of different suppliers, including [Eaton Corp.](http://www.eaton.com/), [Telephonics Corp.](http://www.telephonics.com/), and the [Thales Group](http://www.thalesgroup.com/).

In the air, [Lockheed Martin](http://www.lockheedmartin.com/) has long been an innovative developer of reliable military radar systems for surveillance. The company’s Tactical Reconnaissance and Counter-Concealment (TRACER) radar system *(Fig. 1)* provides effective long-term surveillance of suspect operations by means of synthetic-aperture-radar (SAR) technology. The basic principle of SAR is to use data from multiple radar returns to form the equivalent image that would be produced by a single large aperture antenna. The time delay information from returned radar signals is also converted to spatial dimensional information to produce additional details about a target.



Fig. The TRACER radar system operates with lower UHF and VHF frequency bands to effectively detect targets through foliage.

Military radar systems also are increasingly integrated into other weapons systems for guidance. One of the long-time suppliers of defense-based radar systems, [Raytheon Co. has](http://www.raytheon.com/) developed its Small Diameter Bomb II (SDB II) system for the Air Force and Navy to improve missile efficiency under all weather conditions, even when visibility is limited. The firm is currently involved in integrating the radar system onto F-35 Joint Strike Fighter aircraft, F/A-18E/F Super Hornet, and F-15E Strike Eagle aircraft.

The SDB II missile seeker system actually combines several different technologies, with a millimeter-wave radar to detect and track targets through adverse weather, an infrared (IR) imaging system to provide enhanced target discrimination, and a semi-active laser system that allows the SDB II system to track an airborne or ground-based laser designator for identification by allied troops. The radar/IR/laser weapons system can fly more than 45 miles to find a fixed or moving target, providing a great deal of flexibility to an airborne military team.

**CHAPTER 6**

**PROPOSED SYSTEM**

**CHAPTER 7**

**SIMULATION & SYNTHESIS RESULTS**

**CHAPTER 8**

**CONCLUSION**

In many countries, the government and army units define the requirements for missile projects and in order to ensure that these criteria are met, telemetry tests are performed. However, the amount of data transmitted are in most cases very high and compression methods are not used in those tests. Thus, in long-range missiles and space vehicles, the telemetry data size is bigger, and it is difficult to receive all of this high bandwidth data. This study proposes the compression of telemetry data to obtain more data in the tests and observes effects of data reduction on communication range and link margin using link budget calculations. For this purpose, synthetic data was fabricated in the commonly used telemetry data format; then this data was compressed using lossless compression techniques of Huffman and LZW. Link budget analysis made after compression showed that for a control group using the same equipment and systems, data compression resulted in higher communication range and higher link margin; indicating a good communication quality between the missile and telemetry ground station. It is also projected that this decrease in data bandwidth can decrease the cost and increases the efficiency for a telemetry test. During the literature search made for this study, it was seen that telemetry data compression was mostly researched for archiving purposes as the telemetry data reaching the ground station needs to be kept for a long time. Besides these studies, works of the Consultative Committee for Space Data Systems (CCDS) which involves foundations such as European Space Agency (ESA) and National Aeronautics and Space Administration (NASA) were researched. In its publications, this board recommends the usage of Golomb-Rice algorithm for the lossless compression of telemetry data. However, this technique does not only compress regular telemetry data, but also compresses image and video data collected from space vehicles. Thus, it is not specialized for telemetry test characteristics like those performed for missiles. Within Turkey, where the space agency was recently founded, there are no studies published on compression of missile/rocket telemetry data. Within the future work planned, it is planned to design the hardware components according to this study so the real-life costs (financially, size-related, delay-related, etc.) can be observed for inserting compression algorithms to actual missile subsystems.

**REFERENCES**

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