ARKETEL
ARKE TELEKOM

CREATIVE SOLUTIONS
FOR YOUR DESIGN NEEDS

ARKETEL.COM

ABOUT US

Arke Telekom started operations in 2014 with TÜBİTAK-funded R&D projects in the civilian sector together with consulting projects in the defence sector. Starting in 2020, we have expanded our team and moved to our new office in Hacettepe Teknokent Campus. In the same year, we received MSB Facility Security Clearance Certification and were listed as an Approved ASELSAN Sub-Contractor.

Our philosophy is to provide expertise in highly focused areas to add value to our customers' products with traceable outputs at every stage of system analysis, design, implementation and testing.

In 2022, we started to diversify our projects to non-defence industries as well and made our first cooperation in the automotive sector.

OUR SERVICES

- Military Waveform Development
- Simulators and Tools
- Software Testing and Verification
- Automotive
- Consultancy
- Cloud Service Based applications

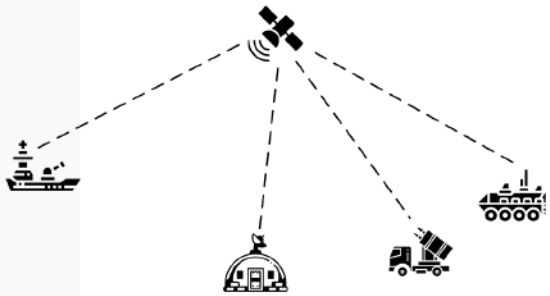
Military Waveform Development

UHF SATCOM Military Waveform

We implemented NATO STANAG UHF SATCOM waveform on ASELSAN 9661-AG2 software defined radio under a contact signed with ASELSAN in year 2020. This project enabled 9661-AG2 radio to communicate over satellite simply by installing a new software and connecting a satellite antenna. The main purpose of this project is to meet long-distance communication needs of military units spread far away from each other over a large geographical area where non-satellite communications are either not possible or not feasible. STANAG 4681 compatibility also enables the system to work over NATO satellites with other NATO units ensuring coordination in joint operations. The project was completed by the start of 2022. It is also provisioned to port UHF SATCOM Waveform to other ASELSAN software defined radios.

UHF SATCOM Satellite System

Geostationary SATCOM communication satellites are located in orbit at an approximate distance of 36.000 km from the earth above the Equatorial Line. Due to its long distance from Earth, a UHF SATCOM satellite covers almost a hemisphere as its broadcast area, thus the communicating units can be spread over a very wide area. Due to the same fact, the round-trip delay is quite high varying between 239-279 ms. depending on the location of the unit in the coverage area. In a UHF SATCOM network, no control information is kept on the satellite; the satellite only performs channel separation, amplification and signal relaying. As the satellite bandwidth is limited, effective use of resources is required.



Tactical Field Satellite Communication Network

STANAG aims to perform the resource management dynamically by means of a central control unit on earth, which keeps track of connection requests and allocates resources accordingly. Each unit connected to the network listens to and participates in the control communication on a pregiven frequency and time slot on the satellite. The control communication takes place over the so-called order-wire (OW) service.

Dynamic Resource Management

Dynamic resource management is addressed by two different methods. The first is the use of pre-planned services. In this method, continuous services can be planned by assigning resources before deployment of the system. The resource assignment can also be changed and distributed during the operation phase. It is possible to end unused services, add/remove new services, or add/remove new members to existing services; but in this method terminals cannot request a service that is not predefined. Whenever an unplanned communication service is needed, the ad hoc services and DAMA protocol come into play.

Whereas an SFOW service is used for scheduled pre-assigned services, DFOW and DROW services are used for DAMA protocol. The SFOW service is located in the Master Channel, the DFOW service is located in the DAMA Control Channel. DROW, UCOM (user communication) and Ranging services can take place on all channels.

Sharing of a satellite channel by multiple communicating units is accomplished by employing a TDMA protocol. A single access communication mode is also supported in which some satellite channels are dedicated for exclusive use of certain units.

OUR SERVICES

Channel Controller (CC) and Alternate Channel Controller (CC)

The Channel Controller (CC) is the central unit that manages satellite resources. The terminals join the network and request resources from the CC while the Alternate Channel Controller (ACC) stands by and watches the control communication in order to replace CC and take control of the network when necessary. Apart from performing resource assignments, CC also monitors if the allocated resources are used adequately and takes necessary steps to reassign unused resources to new services. ACC, on the other hand, listens to all control transmissions in the air in order to form its own database of ongoing services as accurately as possible so that it can replace the CC when required.

Timing Requirements and Ranging

All terminals are time synchronized to the transmissions of the CC. The clocks of different units may however differ due to synchronization errors, doppler shift or phase noise. Terminals also need to correct for this variation and provide synchronization to other units' data rates. Transmissions of all units, including the CC, must fit into their assigned time slots with reference to the satellite's time frame. The operations carried out to achieve time synchronization are called Ranging. The range, which is the terminal's distance to the satellite, can be calculated passively using GPS location and time information, or be measured actively by transmitting a dummy signal in a preassigned time slot, receiving back the same signal and calculating the time difference.

User Services

Three types of user services are defined by the STANAG. The Circuit Service provides fixed-rate voice and data transfer, while the ADT Service is designed to provide fixed or variable rate data transfer. The Block Assignment Service, on the other hand, permits sub-division of an assigned time slot by higher layer protocols for further multi-access purposes. This is an optional feature.

The satellite network provides many modern communication services such as point-to-point calls, conference calls, joining an existing call, leaving a call, pausing a call, queuing service requests, waiting on a busy terminal and prioritizing services. As a military system, features such as encryption or joining a network as listener-only (silent mode) are also supported.

Variable Data Rates and Error Detection/Correction

The physical layer is designed to accommodate various terminals with different modulation capabilities under varying link quality conditions. A wide range of data rates is supported through various modulation types. The signaling protocol provides means to the target and source units to agree on mutually supported transmission parameters suitable for the actual channel quality. Control data fields are protected with CRC or RS codes.

Simulators and Tools

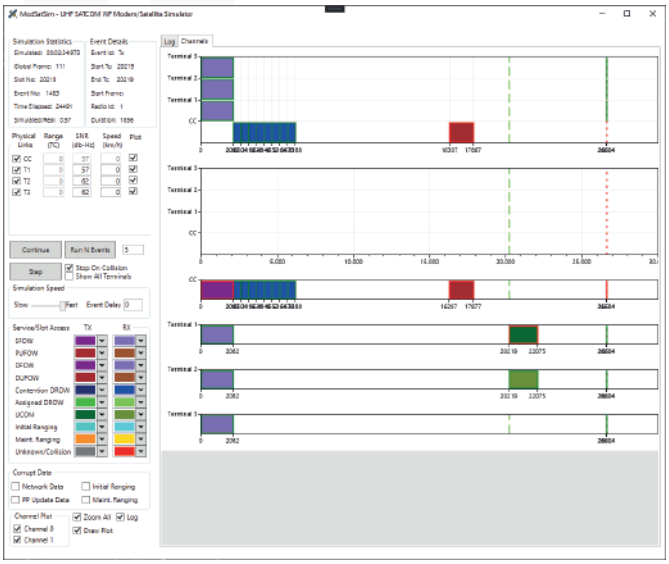
Modem and Satellite Channel Simulator (ModSatSim)

ModSatSim is developed as a «Soft» Channel and Modem Simulator application specific to the UHF SATCOM Waveform. The packets generated by the radios are sent over TCP/IP connections to ModSatSim instead of being delivered to the modem or air. Embedded in ModSatSim are separate modem simulators connected to different radios and a satellite/channel simulator that connects these modem simulators. ModSatSim routes packets from source terminals while taking into account delays, conflicts, frequencies and other physical layer parameters. Errors can intentionally be inserted. Units that do not meet reception requirements do not receive packages or receive them as corrupted. In this way:

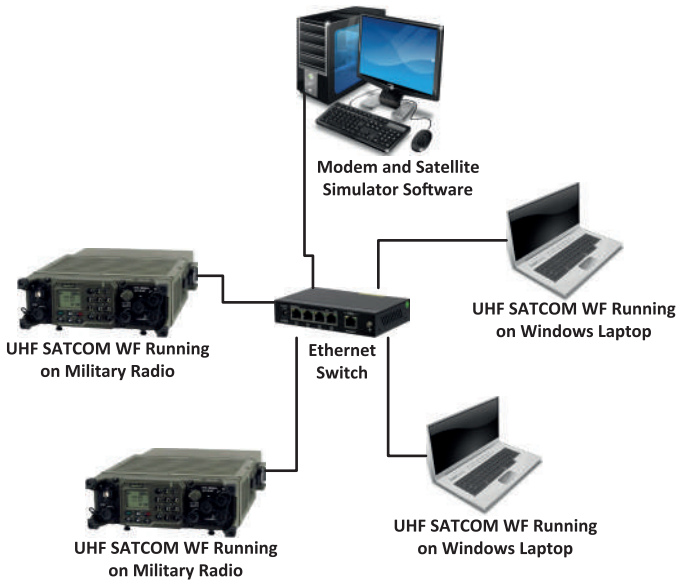
- We achieve fast, easy and low-cost testing and verification
- We can create and validate complex scenarios that are very difficult to create in real life.

ModSatSim can simulate/modify the followings:

- Satellite and terminal timing
- Channel access
- Packet conflicts
- Link Quality/SNR values
- Radio mobility
- Bit- and packet-level error insertion
- Pause, resume, step or fast-forward operations



ModSatSim – User Interface



Hybrid Setup with 9661-AG2 Radios and Windows PC's

Emulation Setup

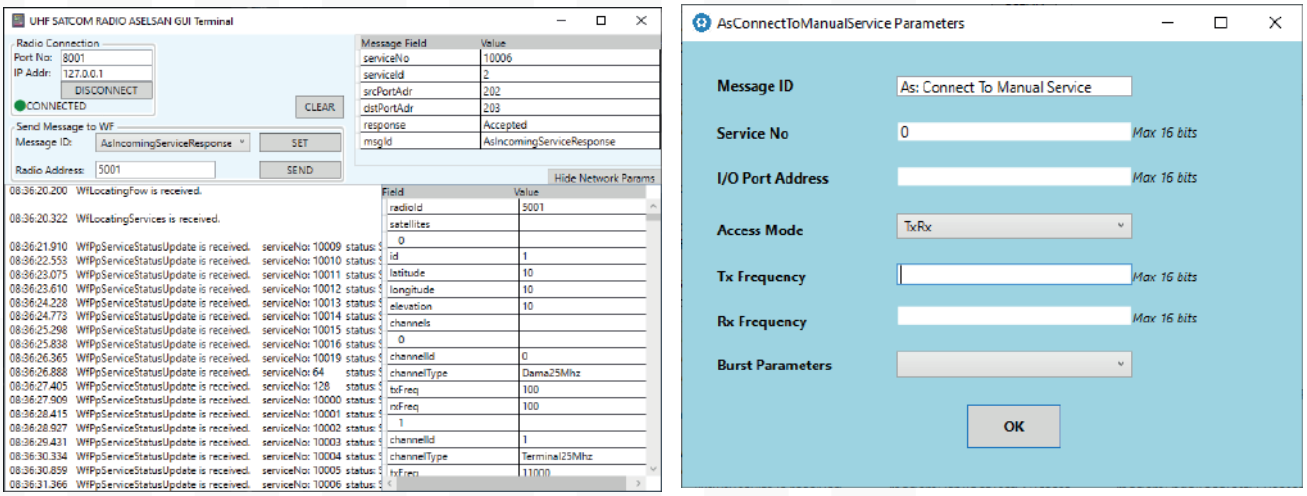
The embedded code to be run on the radios are first developed and debugged on PCs in a so-called "emulation environment" which eliminates dependency on hardware and facilitates generation of complex network configurations in a desktop environment.

The code running on real radios and the emulation environment are exactly the same except for being compiled by different compilers and having different compiler switches. All communication is routed through ModSatim. PC's can establish voice or data calls among each other and transfer data.

OUR SERVICES

Radio Interface Simulator

Radio Interface Simulator has been developed to simulate actions of the radio user and certain messages from other software modules surrounding the waveform software. It facilitates testing and verification stages of the development process.

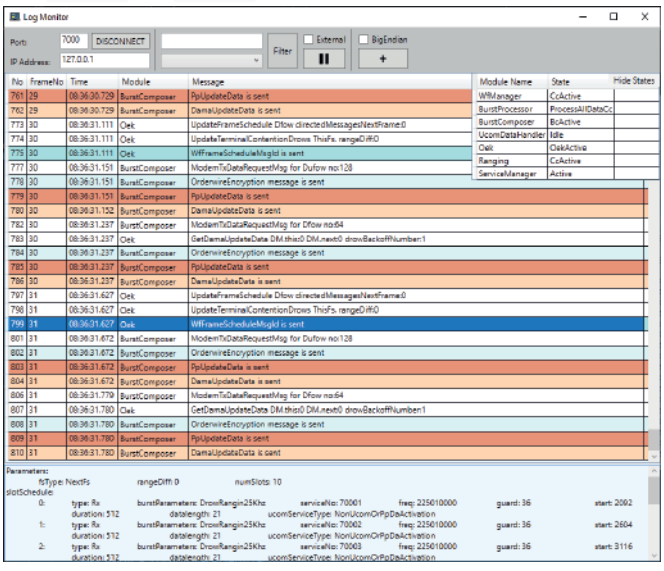


User Interface | Message Parameters Interface

Radio Interface Simulator can send selected messages both to the embedded software running on radios or to the emulated radios running on computers. The parameters of each message can be set by the user.

Log Monitor

Using standard logging libraries with embedded software may interfere with the real-time operation of the software thus may have unpredictable consequences. Commonly preferred methods such as printing the logs to the command window or to a file can make it difficult to follow the logs or filter out the information of interest due to poor user interfaces. The Log Monitoring Software Framework we have developed incorporates many capabilities that facilitate log monitoring and provides means to customize these capabilities depending on the needs of the project. With the Log Monitoring Software Framework, the log stream can be viewed live or the recorded logs can be viewed later. Examined logs can be filtered by the sending unit, a keyword, priority or timestamp. Data that is relevant but is too long to fit in a line can be viewed in a separate data window associated with the log line.

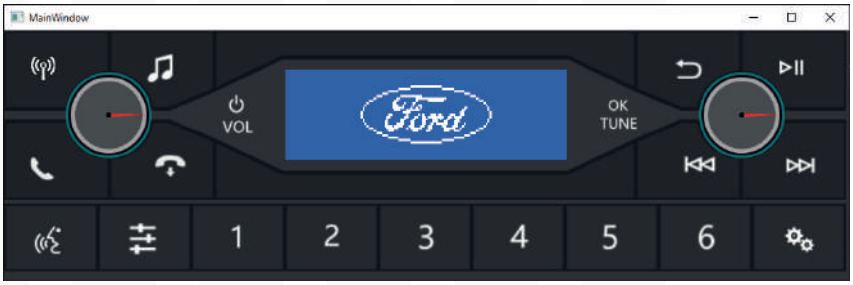


Thanks to many configuration options such as different endianness types, connection types (TCP/IP, Serial Port), the Log Monitoring Software Framework is easily reconfigurable and can work with a variety of embedded hardware and software.

OUR SERVICES

Infotainment Interface Simulator

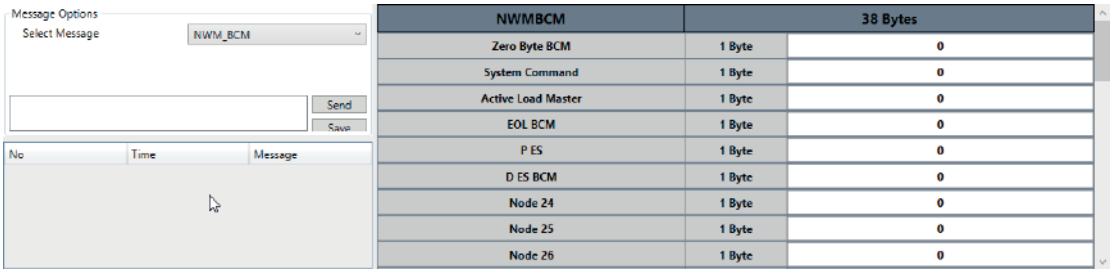
In-vehicle infotainment systems become more complex with each new model as computer-assisted driving becomes more ubiquitous. A system's ability to offer high connectivity, multimedia access and ease of use in driving influence customer decisions in choosing vehicle models. Assessing the impact of software changes made to HMI on user experience is one of the repetitive tasks that slow down the development lifecycle. Integrating the HMI Simulator we have designed into our development environment provides a means to quickly observe the changes made to the HMI in effect. The HMI Simulator also provides the possibility for pixel-wise comparison of screen images or against various rules, thus detecting differences or errors that can escape the human eye.



Infotainment Interface Simulator – User Interface

CAN Bus Simulator

An average vehicle produced today contains tens of microcontrollers and hundreds of software modules working together to control the vehicle's functions including driving safety. The cooperation of different microcontrollers fulfilling different functions is made possible via CAN Bus communications. In the development of such a high complexity system, it is essential to divide development tasks and distribute them to different developers working in parallel. The CAN Bus Simulator we have developed simulates the communication of a given software module with other modules and facilitates independent development of modules. It also provides a means to observe and debug software behavior before integration.



CAN Bus Simulator – User Interface

Software Testing and Verification

Simulators and Automated Tests

With software products becoming increasingly complex and development processes increasingly flexible, new requirements on the design and execution of tests are imposed. Products that are configurable in numerous ways or agile processes that involve ongoing changes to the software design need to be addressed in order to ensure the repeatability and durability of tests. These needs are addressed by our testing infrastructure in two ways:

- Abstraction and Simulation
- Automatic Regression Tests

Abstraction and Simulation

Abstraction refers to determining the sub-system to be tested and defining its interactions with the outer world at its interfaces. In this way, the rest of the system is "abstracted" from the point of view of the system to be tested as "possible sequences of messages". This partitioning also determines which units in the system will be simulated or mocked. In ARKE Telekom we use various simulators developed for different software units and these tools are an integral part of our development workflow.

Automatic Regression Tests

Agile is a software development method based on adding new capabilities to the software in small steps. Unlike traditional software development processes, system-level validation and regression tests are needed after each development cycle to verify that existing capabilities are not lost. Performing these tests repetitively and automatically ensures the health and speed of the development process. The automated testing infrastructure we have developed executes predetermined scenarios by booting the tested (embedded) software and simulation software in various configurations. In case of an unexpected output, the test framework marks the test as failed and saves the logs for later review. The ability of each developer in the team to run tests with one click in their own development environment ensures that errors and regressions that may occur during development are noticed early and resolved before spreading to the product.

OUR SERVICES

Automotive

HMI Display Library

An EmWin based Infotainment HMI Display Library has been developed for the commercial vehicle line of a global automotive manufacturer. This software conforms to the industry standards for embedded software.

Central Vision Processing

The Central Vision Processing Module (CVPM), a sub-module of a brand's passenger car Surround View System, is still under development.

Consultancy

Novel Military Waveforms Design Consultancy

- System design and review
- Analysis of layered architecture and providing cross-layer improvements
- Protocol optimizations and alternative solutions

Consultancy on Enhancement of Existing Military Waveforms

- Analyzing and adding new features
- Making improvements according to the feedback from the field

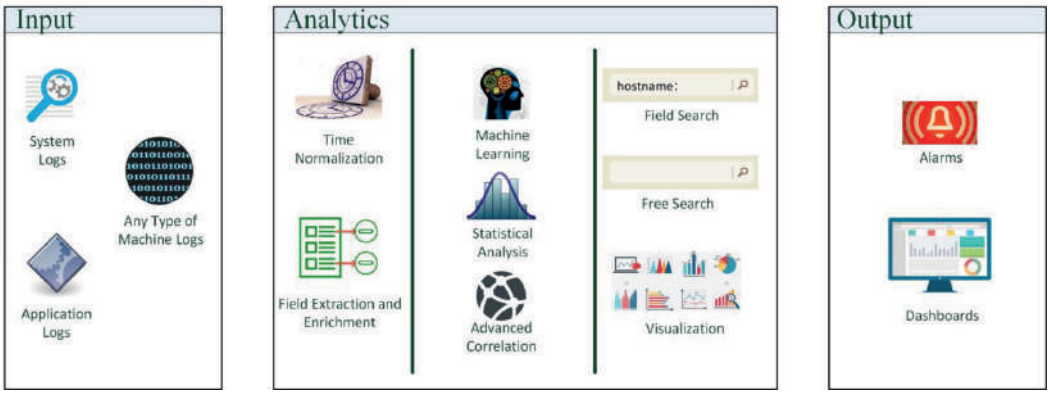
Digital Design and Hardware Design Consultancy

DO-254 FPGA Functional Verification

Cloud Service Based Applications

ZettaLogs – Online Log Management and Analytics System

Today's online applications consist of middleware units (such as databases, web servers, etc.) working together with application software. These units as well as the operating system they run on continuously generate records to mirror their statuses. Collecting and aggregating these records at a central point for real-time examination, analysis and rule-based alert generation is a crucial task in monitoring the health of such component-based systems. Receiving instant notifications in error conditions, and examining the sequence of events at varying levels of detail in order to determine the root cause is necessary to assure the smooth operation of the system and for resolution of errors in a way that has the least impact on customers. The ZettaLogs system is designed as a cloud-based log management service to achieve the above objectives. Users register to use the service from the web interface and request the logs they are interested in from the ZettaLogs service. The system maintains records for a retrospective period and provides users with the necessary infrastructure and interfaces to analyze their records in real time.



- Analysis, archiving and aggregation of application logs in a central place,
- Supervising the health of applications through inspection of application logs,
- Decomposition of text logs into fields and indexing for real-time search,
- Visualization of metrics extracted from logs,
- Defining alerts on data extracted from logs and sending real-time notifications to team members when a problem occurs,

- Analysis:
  - Users can define thresholds for alert creation,
  - Correlative analysis using multi-search feature,
  - Aggregation analysis on log fields,
  - Near real-time processing of streaming logs,
  - Multi-tenant, scalable and fault-tolerant design
- Correlation between logs: Complex Event Processing (CEP)
  - Knowledge Representation and Reasoning (KRR): Rule based knowledge representation
  - Production Rule System: Rule engine
  - Easy DSL for rule entry: User / system rules
  - Facts: received logs, user / system definitions, user can define on the go (2., 3. level facts)
- Automatic anomaly detection
  - Feature extraction (feature vectors from system/user facts)
  - Automatic and unsupervised learning
  - Rule extraction from learned models
  - Effective detection using rule engine
  - User guidance:
    - Interactive feature definition
    - Capability to modify automatically extracted rules

OUR CAPABILITIES

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Our philosophy is to provide expertise in highly specialized areas to add value to our customers' products with traceable outputs at every stage of system analysis, design, implementation and testing.

- **Military and Civil Communications**
- **System Design, Development and Validation**
- **Application Software Development**
- **Digital Design**

OUR CAPABILITIES

Capabilities

Military/Civil Communications

- Networking Waveform Design and Development
- MANET (Mobile Ad-hoc Networks)
- Multi-Hop and Automatic Relay
- Self-healing Networks
- Packet-Switched and Circuit-Switched Communications
- Data Services (IP, Synchronous/Asynchronous)
- Voice Services (Point-to-Point, Push-to-Talk, VoIP)
- Data Link Waveform Design and Development
- Narrowband/Broadband
- Frequency Hopping, DSSS, OFDM, TDMA, Half-Duplex
- Design for crypto requirements
- Physical layer communication algorithms design, FPGA and DSP implementations
- Participated actively in the development of HF/VHF/UHF/EHF communication systems currently in use by Turkish Armed Forces

Application Software Development

- File Transfer and Messaging Applications for military waveforms
- Monitoring and Debugging Applications
- Virtualization Framework and Simulation/Emulation Applications

Digital Design

- FPGA digital design and implementation
- PCB design
- Digital communication algorithms design
- Digital communication algorithms FPGA and software implementations
- Digital board design
- Modem board Design
- BSP modules

System Design, Development and Validation

- Requirements Analysis
- System Architecture Design
- Software Architecture Design
- Development
- Module Testing
- Lab/Field Testing
- User/Acceptance Testing
- Comprehensive and Up-to-Date Documentation

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