Crevavi

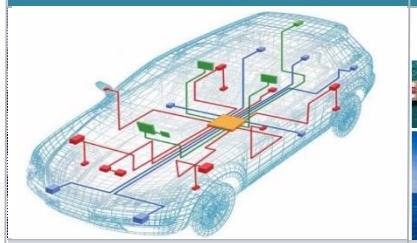
Create, Embed, Empower

Crevavi Technologies

Company profile

Introduction

An Indian MNC, founded in 2011

Automotive	IoT/M2M	Building Automation
		
Automotive ECU Software	Edge, end nodes, gateways	Energy management

Global footprint

Automotive software competencies



ICE Powertrain, Body & Chassis ECU
- IC Engine Management ECU
- Immobilizers
- Instrument Clusters
- Active Anti-roll ECU
- CAN, FlexRay, Ethernet

E-Mobility ECU
- HV Inverter for e-motor
- DC-DC converter
- On-board-Charger

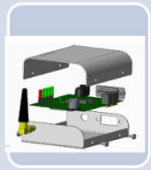
AUTOSAR BSW
- Custom MCAL
- Multicore OS
- Bootloaders
- Complex Drivers

Cyber-security
- Immobilizer
- Secure boot
- Secure programming
- OEM specific security algorithms

Company strengths

- Product Innovation
- One-stop shop for end-to-end R&D solutions
- Diverse industry experience
- Focused on IP creation
- Systems and domain consultancy
- Global vendor network for HW
- Manufacturing for series production

Industry 4.0 and AI/ML competencies



IoT/M2M Edge
- Edge computing
- Condition monitoring and remote diagnosis
- Sensors and actuators

Robotics
- Robotic Arm
- Automated Guided Vehicle
- Shop Floor Automation

Cloud connectivity
- AWS
- SAP HANA
- On-premises servers

AI and ML
- -Data Augumentation
- Model Training using Convolutional Neural Networks
- Model deployment

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Crevavi in a nutshell….. Create, Embed & Empower

Who we are?

- 250 years of cumulative experience gained from working in fortune 500 companies like Siemens, Bosch, Intel, IBM, iRobot, Samsung

Global Reach

- World-wide presence
- Strategic partners with Top Tier1s
- Products & Solutions in series production in Europe & Indian Market

Client Base

- IoT / Industrie 4.0
- Automotive
- Energy and Power
- Clients in USA, Europe, Australia and India

What we do?

- Enable our clients in Digitization of factories
- Automotive ECU SW: Electric, Combustion, Hybrid
- Renovate legacy products to ‘Smart & Connected’
- IoT devices with Edge/Fog computing capability for industrial automation

Core Skills

- Domain & Systems consultancy for Automotive Software
- Product design house
- IoT/M2M edge / end nodes

Products, Solutions & IP

- Industrial IoT Products. From edge to cloud
- Automotive Immobilizer, UDS stack, Bootloaders
- Cyber Security for vehicle immobilizer
- IoT devices for asset tag/trace and Lat/Long

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Leadership Team of Crevavi Parent Organization

Ravikishore Attili

- Co-founder, Director
- 22 years of exp in technology
- IOT, AI /ML product architect

Sachin Shivapur

- Co-founder, CEO
- 21 years of exp. in automotive and mobile industry

Ayan Das

- Co-founder and advisory member
- 20 years of exp. in retail and robotics
- and mechatronics

Ganesh Kini

- Co-founder, Marketing Director
- 18 years of experience in Supply chain Management & Manufacturing
- International experience in Japan, Korea, Australia, Singapore, China

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Core Team of Automotive subsidiary

Sachin Shivapur
- Co-founder, CEO
- 20 years of exp. in automotive and mobile industry (Siemens, Bosch, Intel)
- International sales and marketing experience in USA, Germany and Australia

Sunil Joshi
- Co-founder, Director
- Exp of 18 years in Mobile SoC (Samsung)
- Multicore Mobile SoC
- Automotive domain controllers

Sudarshana Shivapura
- Co-founder, Director
- 20 years of exp. in automotive(Siemens, Bosch)
- Automotive SME for AUTOSAR, Diagnostics and Comm stacks

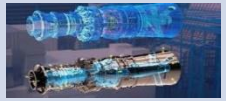
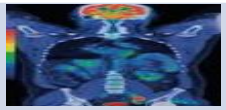
Shriram Kathavate
- Stakeholder
- 16 years in Industrial automation (Siemens)
- SME for SCADA
- SME for AUTOSAR BSW

Srikant Bhaskar
- Stakeholder
- Aerospace SME for GNSS based Navigation (Honeywell)
- SME for AUTOSAR BSW

Domain competencies and use cases

Automotive ECU Software	
	Engine Management System (EMS)
	E-Mobility : HV inverter ECU
	E-Mobility : DC-DC converter ECU
	Autonomous driving
	Gear-train ECU
	Instrument Cluster
	Body ECU
	Chassis ECU
	Telematics ECU

Industry 4.0	
	Factory automation
	Wind farm condition monitoring
	Solar farm monitoring
	Connected cars
	Oil & Gas for OE, Safety
	Digitization of Mining industry
	Smart Cities, Smart Buildings
	Marine Maintenance & Transoceanic IoT
	Drone based condition monitoring

Data Sciences, AI, ML	
	Autonomous driving
	Digital Twin
	Image Recognition/Machine Vision
	Medical Diagnosis
	Speech recognition
	Predictive Maintenance
	Reduce Supply chain forecasting errors and inventory optimization
	Automated Quality testing

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Customers

IoT / Telematics / Connected Car

Automotive

Energy, Retail & Consumer Electronics

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Crevavi's competencies

Data Sciences, AI ML	AWS IoT, AWS Lambda, Elastic Beanstalk, Amazon S3, Amazon DynamoDB, Keras, scikit learn, Apache Spark, TensorFlow, python, Scala
Connectivity	Wi Fi, 2G/ 3G/ 4G, Bluetooth, Modbus, CAN, GPS, MQTT.ORG
OS / Architectures	Linux, OSEK/VDX OS, Android, Classic AUTOSAR
IDE/EDA/CAD	VECTOR CANoe, DaVinci Configurator Pro, DaVinci Developer, eclipse, EB tresos Studio, IAR SYSTEMS
Platforms	Infineon, NVIDIA, ARM, Atmel, CYPRESS, Texas Instruments, intel, RENESAS, NXP, Microchip, NORDIC SEMICONDUCTOR, ST

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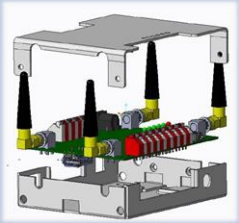
IPs Owned

UDS diagnostics stack for In-vehicle diagnosis and flashing

Microcontroller independent AUTOSAR like SW architecture



IoT Edge field tested use-cases with clients

WLAN SoC

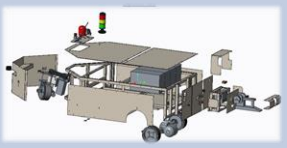
BLE and BLE Long Range SoC

GPS, GSM, GPRS , 2G, 3G Soc

Articulated Robotic Arm

6 Degrees of Freedom

Automate Anything for Industries



AGV for shop floor automation

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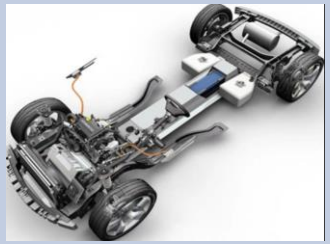
Automotive Core competencies



- Inverter for e-Motor
- On Board/Combined Chargers
- Battery Management System
- DC-DC Converter
- Super-Capacitor

- Immobilizer
- Secure boot
- Secure Programming
- Bootloaders
- Bootloader Updaters
- OEM specific flash loaders

- Drive Train ECU
- Instrument Cluster
- Telematics Solutions
- Domain / Gateway ECU
- Chassis and Body Control ECU

- IC Engine ECU
- Fuel Injection
- Fuel Ignition
- Engine Position
- Angle/Time Driver
- High-pressure pump control

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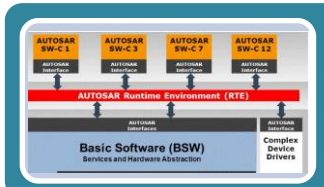
AUTOSAR Competencies

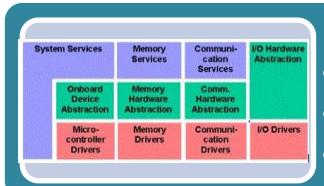
Application Software

- Software Component (SWC)
- Ports definition and configuration
- Runnables definition



Runtime Environment

- Interface configuration between ASW and BSW
- OS configuration: Tasks, interrupts, Events
- Runnables configuration



Basic Software

- Services and Operating system
- Communication, Memory, Diagnostics stack
- Bootloader and flash loaders

MCAL Software and Complex Drivers

- IO drivers
- Memory layout, Linkers, Compiler configuration
- Complex timing waveform generation and signal acquisition

Microcontrollers experience

Infineon RENESAS NXP arm

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List of core automotive services

- ECU System level Analysis and Requirements Engineering
- SW architecting for ECUs
- AUTOSAR stack configuration
- Optimization and fine tuning for performance and time critical applications
- Migration of legacy SW to AUTOSAR
- Hybrid implementation : Cohesion of legacy architecture with select AUTOSAR layers
- Manual coding of Complex Drivers and Device Drivers
- Flashloaders and bootloaders based on UDS ISO14229 standards
- Security algorithms, Secure boot and Secure programming
- Software Integration, Verification and Validation
- Functional safety (ISO26262) analysis and implementation, ASPICE Conformance

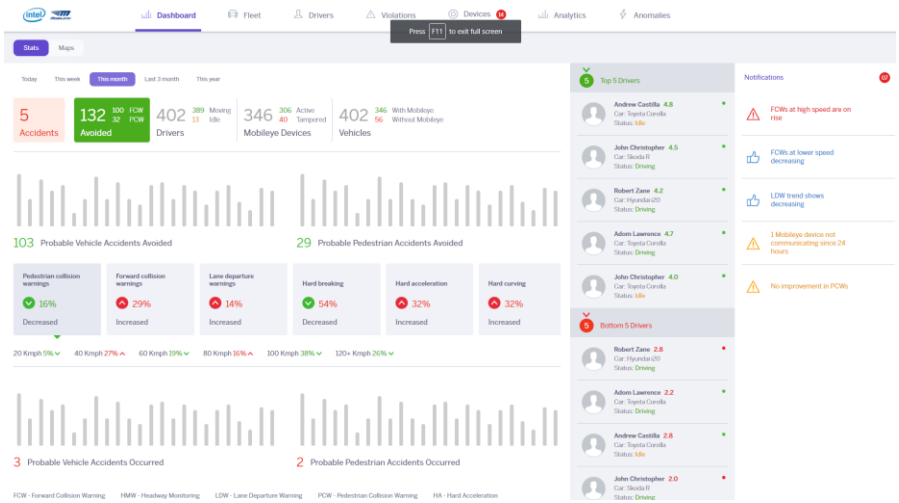
Success Stories

Telematics and ADAS platform with Intel

- Software platform co-developed with Intel
- Integrated OBDII, GSM and GPS communication on Linux based Intel Atom board
- Fleet Management System (FMS) on cloud
- Interface with ADAS processor for ADAS event recognition
- Connects to cloud via GPRS through a cellular modem
- Integrated GNSS for Navigation
- OBDII connection for vehicle FMS and Telematics

Benefits to customers:

- Ready platform for FMS, Telematics and ADAS
- Retrofit and factory fit option



Predictive Vehicle health

ADAS Events

Driver Authentication

Driver Monitoring

Driver monitoring & Authentication & Event recording

Mobileye CAS

Car Dashcam with event Recording

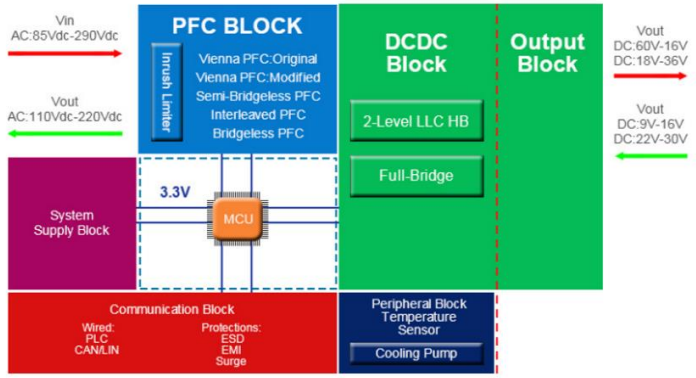
Rear Parking Camera

Centralized Processing Unit

1. Multiple Camera inputs
2. GPS & Accelerometer
3. 3G/4G/WIFI
4. CAS Events
5. Vehicle OBD

E-Mobility: Combined Charger Unit

- **Project:** CPU load reduction for AUTOSAR BSW stack on multicore and mixed ASIL ECU
- **Challenge:** Part of client task force team to meet project KPIs
- **Solution:** Deployed experienced team in AUTOSAR and reduced CPU load by 20%
- **Time and effort:** Sep 2019 ~ Feb 2020, 4 Engineers
- **Project Content:**
  - Entire Configuration analysis of AUTOSAR BSW and MCAL stack
  - Analysis of high frequency function calls and stacks
  - Profiling of start up, shutdown, communication (CAN-FD, LIN and Ethernet), OS Applications, spinlocks, memory and watchdog stacks
  - Validate and measurement of CPU loads for each of these ideas
- **Benefits to customer:**
  - Entire ECU SW architecting as a consultancy and reduction of CPU load
  - Effective CPU load improvements suggested for implementation



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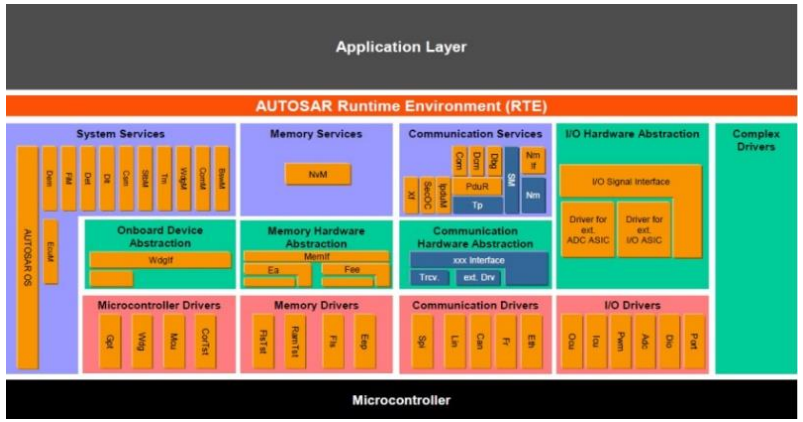
E-Mobility: DCDC and SCAP ECU

- **Project:** Implement and configure AUTOSAR BSW stack for Tier 1 Chassis supplier
- **Challenge:** Configure entire Vector BSW stack and develop complex drivers in 9 months
- **Time and effort:** May 2018 ~ Feb 2019, 6 Engineers
- **Project Content:**
  - Configuration and integration of Vector AUTOSAR BSW stack and Bootloader
  - Development of IoHwAbstraction and Complex Drivers
  - Functional validation
  - End-to-end system testing for series production
- **Benefits to customer:**
  - End-to-End System competency for E-Mobility ECU solutions
  - Entire ECU SW architecting as a consultancy
  - Effective and robust solutions in a short span of time.

Images for representation only



Credit: https://automotiveembeddedsite.wordpress.com/

E-Mobility: Function Safety Driver for CCU

- **Project:** Enhance Function Safety Driver conforming to ISO26262 standards for ST Chorus 6M controller
- **Challenge:** Provide implementation for upcoming features within short time.
- **Time and effort:** Mar 2020 ~ Ongoing, 2 Engineers
- **Project Content:**
  - Take the handover and quickly ramp up the knowledge on the implementation of FSD having 18 different modules such as
    - Flash and RAM memories
    - CRC for configured register contents at start up
    - Clock monitoring, Interrupt Source monitoring
    - Fault control and monitoring source of reset
  - Provide implementation of new features for the upcoming release
  - Write specifications for the new features and perform unit and integration tests
  - Update and maintain documentation as per ASPICE L2 conformance

ISO 26262
Road Vehicles - Fuctional Safety

ASIL Ready

SPC58 Chorus

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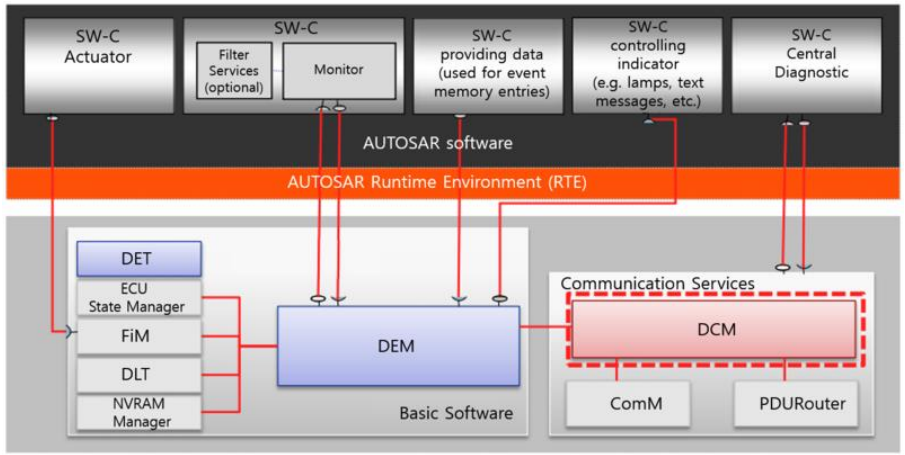
Transmission: DCM for Transfer case ECU

- **Project:** Implement OEM specific DCM module in AUTOSAR SW stack
- **Challenge:** Integrating custom diagnostic module in Vector AUTOSAR BSW stack
- **Time and effort**: Jan 2019 ~ Oct 2019, 3 Engineers
- **Project Content:**
  - Design, implementation and integration of diagnostic module in Vector AUTOSAR BSW stack
  - Configuration of Vector BSW stack
  - System testing, OEM acceptance testing (Elyzer, DST2005 and RTT testing)
- **Benefits to customer:**
  - Minimizing licensing cost
  - Adapting quickly to dynamic changes in customer requirements
  - On time delivery for series production
  - Collaborate and support end of line production



Credit: https://m.blog.naver.com/

ADAS: Tool Qualification for Front Looking Camera ECU

- **Project:** Perform safety requirements analysis for Tasking VX-toolset for AURIX TriCore Controller
- **Challenge:** Analysing all known bugs/issues in the Tasking toolset and its impact on product safety.
- **Time and effort:** Mar 2020 ~ July 2020, 3 Engineers
- **Project Content:**
  - Analysis of safety requirements and usage guidelines as specified in the Tasking toolset safety manual
  - Determining the adherence of guidelines and safety requirements from toolset perspective
  - Analysis of all known bugs/open issues (~280) in the toolset to determine if any of them could have a safety impact on the ECU software
  - Demonstration of compliance to ISO-26262 tool qualification requirements
  - Creation of tool qualification report
- **Benefits to customer:**
  - Compliance (w. r. t. to Tasking-VX toolset) to ISO-26262 tool qualification requirements
  - Critical analysis of toolset issues and clearly identified actions to prevent safety impact

TASKING

ISO 26262
Road Vehicles - Fuctional Safety

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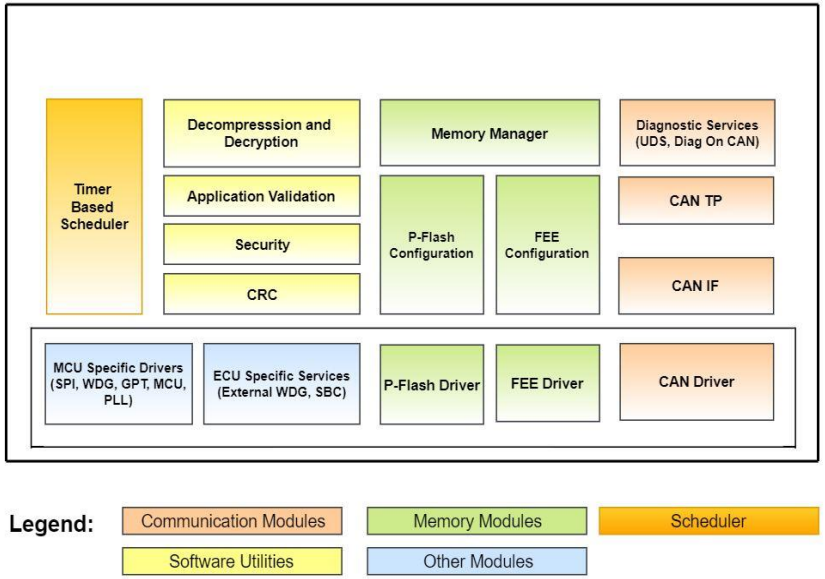
Flash Bootloaders (FBL) for Aurix TC2XX

- **Project: Develop Generic Bootloaders for Transmission control system**
  - End to End responsibility from concept to production
  - Integration and Configuration of MCAL stack using EB Tresos
  - Integration of Vector CAN Stack (CAN Driver, CANIF, CANSM)
  - Configuration of Vector CAN Stack using DAVINCI Configurator tool
  - Compliance to ISO 14229-1 and ISO 15765-2 (UDS on CAN)
  - Develop flashing using XCP protocol
  - Support for ODX flash specifications
- **Benefits to target customers:**
  - Generic, Scalable and modular SW
  - Jumpstart development with ready to use Bootloader Solution
  - Portable and Generic platform for different transmission applications using AURIX controllers
  - MISRA Compliant C Code
  - Leverage in more than 100 years of team combined expertise in Embedded systems

VECTOR

Elektrobit



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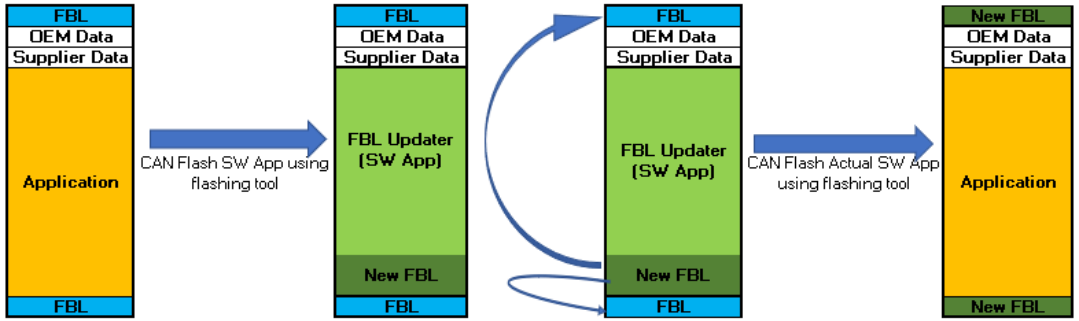
OEM Specific Aurix TC2XX FBL

- **Project:** Develop OEM specific Bootloaders for Transmission control system
  - Implementation and integration of external Watchdog driver (SBC.)
  - Implementation of OEM specific diagnostic requirements.
    - Diagnostic services, sub functions
    - Routine identifiers
    - Data identifiers & DTC's
    - Specific security algorithms (AES, RSA..)
  - Compression mechanism for flashing time reduction (25 sec flashing for 800MB of data)
  - Integration testing of bootloader in ECU with OEM specific flashing tool (DDT2000, vFlash, BW Gear, Corvus, AVD/MVD)
  - Integration and testing of bootloader in ECU with OEM specific protocol compliance tools (Elyzer, RTT)
- **Benefits to target customers:**
  - Jumpstart development with ready to use Bootloader Solution
  - Compliance to OEM specific tools and standards
  - Used across multiple variants
  - Strategies to meet demanding TTM targets

<table>
<tr><th>Applicability</th><th>OSI seven layer</th><th colspan="7">Enhanced diagnostics services</th><th>WWH-OBD</th></tr>
<tr><td rowspan="7">Seven layer according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td colspan="7">ISO 14229-1, ISO 14229-3 UDSonCAN, ISO 14229-4 UDSonFR, ISO 14229-5 UDSonIP, ISO 14229-6 UDSonK-Line, ISO 14229-7 UDSonLIN, further standards</td><td>ISO 27145-3</td></tr>
<tr><td>Presentation (layer 6)</td><td colspan="7">vehicle manufacturer specific</td><td>ISO 27145-2</td></tr>
<tr><td>Session (layer 5)</td><td colspan="8">ISO 14229-2</td></tr>
<tr><td>Transport (layer 4)</td><td rowspan="2">ISO 15765-2</td><td rowspan="2">ISO 10681-2</td><td rowspan="2">ISO 13400-2</td><td rowspan="2">Not applicable</td><td rowspan="2">ISO 17987-2</td><td>further standards</td><td rowspan="4">ISO 27145-4</td></tr>
<tr><td>Network (layer 3)</td><td>further standards</td></tr>
<tr><td>Data link (layer 2)</td><td rowspan="2">ISO 11898-1, ISO 11898-2</td><td>ISO 17458-2</td><td rowspan="2">ISO 13400-3, IEEE 802.3</td><td>ISO 14230-2</td><td>ISO 17987-3</td><td>further standards</td></tr>
<tr><td>Physical (layer 1)</td><td>ISO 17458-4</td><td>ISO 14230-1</td><td>ISO 17987-4</td><td>further standards</td></tr>
</table>

TC2XX Bootloader Updater

- **Project:** Develop Bootloader Updater for Transmission control ECU
- **Challenge :** Solve the problem of updating the FBL without removal of actuator
- **Time and effort :** 2 weeks, 3 Engineers from Sep'2020
- **Project content:**
  - Preparation of FlashBootloader (FBL) updater SW-app
  - Convert new FBL in to C binary array
  - Create P-flash driver APIs for erase and write FBLs
  - Adding UDS commands to erase, write, jump-down and version numbers
- **Benefits to target customers:**
  - OEM and tier-1 supplier could easily update their old version of FBL
  - Solved the problem for Tier-1 supplier while updating the FBL as it involves change of actuator
  - Save time and cost for OEMs and supplier



Immobilizer ECU

- **Project:** Develop Flash-loader and ECU SW
- **Challenge:** Competent team in ECU software, security and RF wireless domain.
- **Timeline :** 8 months
- **Project content:**
  - Develop diagnostics and flashing services of UDS conforming to ISO 14229
  - Develop CAN transport layer conforming to ISO 15765
  - Renesas RL78 based CAN driver, Flash-loader and other IO drivers
  - Key authentication with NXP transponder, Pairing with Immobilizer and Engine ECU
  - State of the art encryption and decryption Algorithms defined by Encrypt
- **Benefits to customers:**
  - Scalable, Configurable UDS SW stack for 2-wheeler, 4-wheelers & Commercial vehicles
  - Rugged, field proven SW tested with Industry standard 3rd party tools like Vector (ISO 14229, 15767 compliance)
  - Modular, portable, and generic immobilizer SW platform to meet any OEM need
  - Diverse in-house team from various industrial domains delivered in time with high quality

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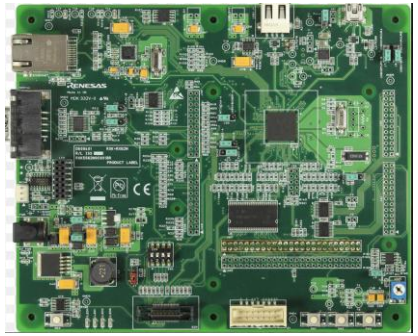
Instrument Cluster ECU

- **Project:** Develop IO drivers for Renesas RH850 controller
- **Challenge:** Deliver ECU software in 4 months
- **Project content:**
  - Develop AUTOSAR like ADC, PWM, I2C, RTC, WDT, SOUND, DMA drivers
  - Scalable, generic, modular and robust design
  - Compliance to SW layered architecture of AUTOSAR
  - Portable across Renesas RH850 family
  - MISRA compliant C code
- **Benefits to customers:**
  - RH850 controller know-how to meet demanding TTM targets
  - Instrument cluster domain know to scale to any OEM requirement
  - Modular, portable, and generic IO platform for all automotive ECUs



Cluster ECU

- **Project:** Development of Algorithms to display various parameters
- **Challenge:** Design and Development of algorithms to display these parameters in 2 months of time.
- **Time and effort:** Jan 2020 ~ Jul 2020, 3 Engineers
- **Project Content:**
  - Design and Development of Algorithms
  - Parameters : Pitch, Roll, TDMS, Altimeter, 4x4 Info, Power & Torque
  - MISRA compliant C code
  - Module, Integration and Vehicle testing
- **Benefits to customers:**
  - End-to-End SW development
  - Entire SW Algorithm consultancy
  - Able to demonstrate in AUTO expo

Pitch & Roll

Power & Torque

4x4 Info

TDMS

Powertrain ECU software

- **20 years of automotive powertrain ECU software development**
  - Application software, device drivers development for MPC5XX and TC17XX controllers
  - TPU and PCP co-processor programming for time and performance critical applications like injection and ignition
  - End power-stage control and diagnosis for injectors and ignition coils
  - CAN, UDS, KWP, LIN communication protocols development
  - Layered SW architecture development on the lines of AUTOSAR standards
  - International experience in Germany, France, Romania
- **Capability and Tools**
  - MISRA complaint software development
  - NI LabVIEW, Vector Canalyzer, Canoe, Lauterbach and UDE
- **Quality process\methodology**
  - ASPICE Level 3 compliance
  - V-cycle based software life-cycle development
  - FMEA, DRBFM (Design Review Based on Failure Modes)
  - 8D analysis for field errors and 3X5 why based root-cause analysis
  - ISO26262 compliant SW development

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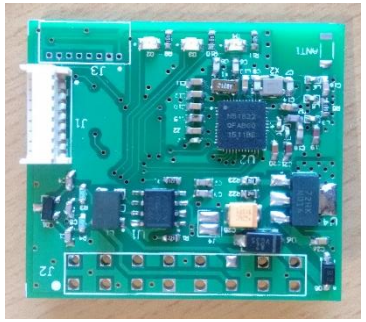
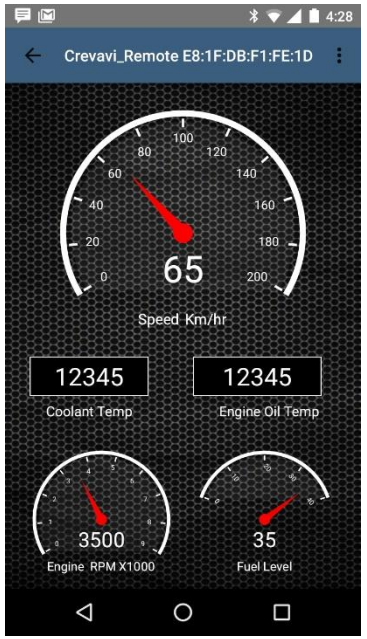
Automotive Products

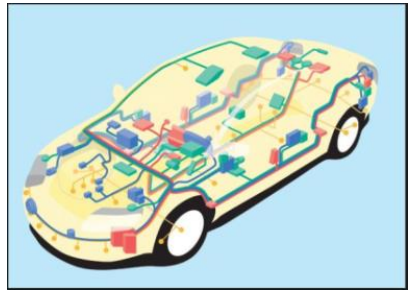




- **Project: Blue-Port**
  - CAN to Bluetooth adapter for OBD II diagnostics
  - Android application
  - Scalable HW and SW to support client specific configurations
  - Compact and sleek form-factor
- **Project: UDS-Immobilizer**
  - Immobilizer ECU SW (UDS stack, transport layer, CAN stack and Flash loader)
  - UDS ISO 14229 and CANTP 15765 SW IP owned by Crevavi
  - Pairing with ECU software
  - UDS configuration PC based tool
  - MISRA compliant C code
- **Benefits to target customers: OEMs**
  - Portable, configurable design compatible with various Automotive manufacturers
  - Custom UDS ISO 14229 and CANTP 15765 SW IP owned by Crevavi
  - State of the art product at economic cost, low form factor
  - Modular & flexible to add/modify features with minimum TTM

Water-in-Fuel Sensor HW development

- **Customer**
  - Sogefi-MNR – an Indian-Italian collaboration
  - For leading European and American Automotive Company
  - Product in series production
- **Overview**
  - Hardware development for Automotive sensor for Water in Fuel (WIF)
  - Product development, sourcing and supply
- **Benefits to target customer**
  - Aggressive TTM meeting required Automotive Standards



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IoT Success stories

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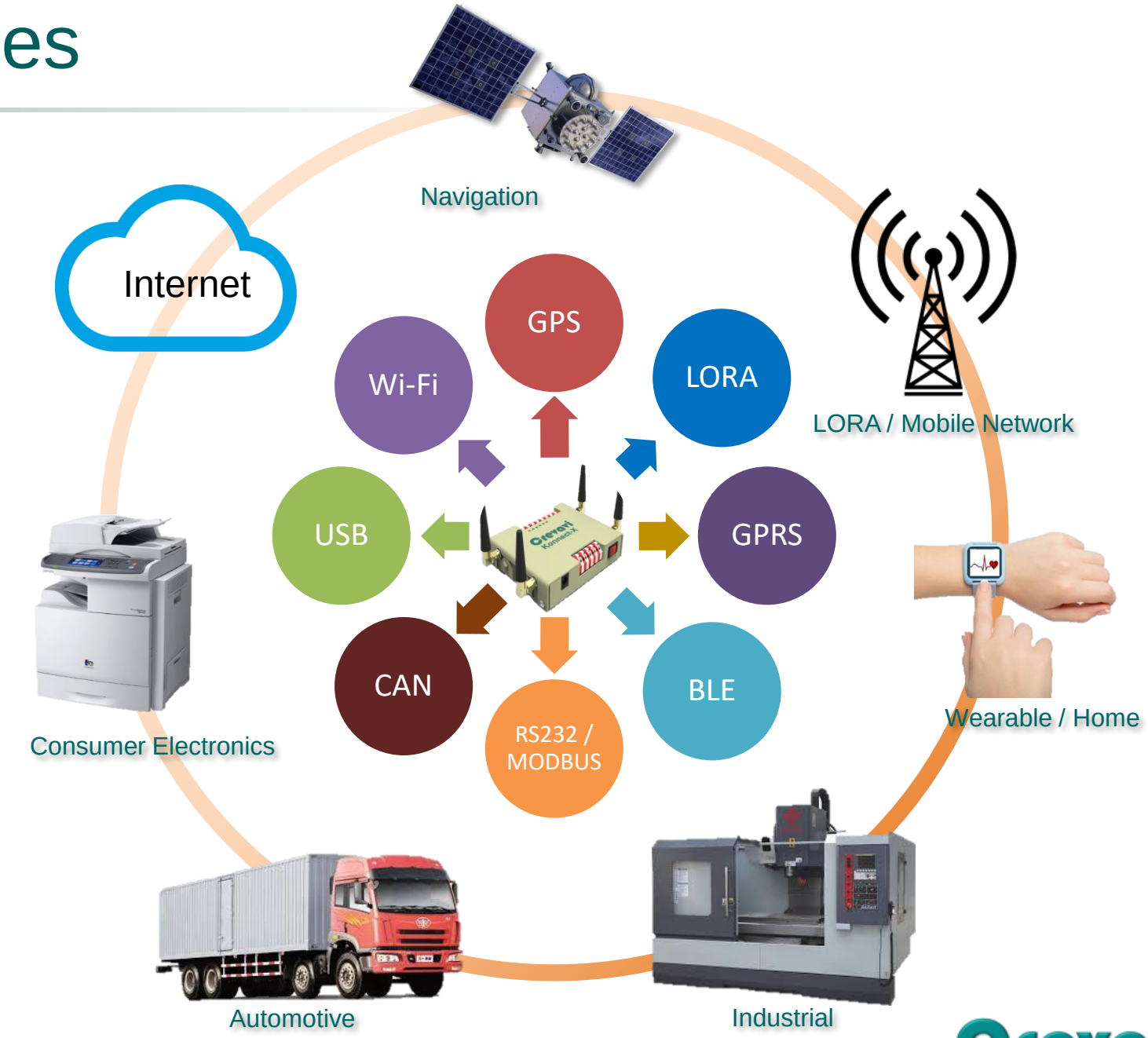
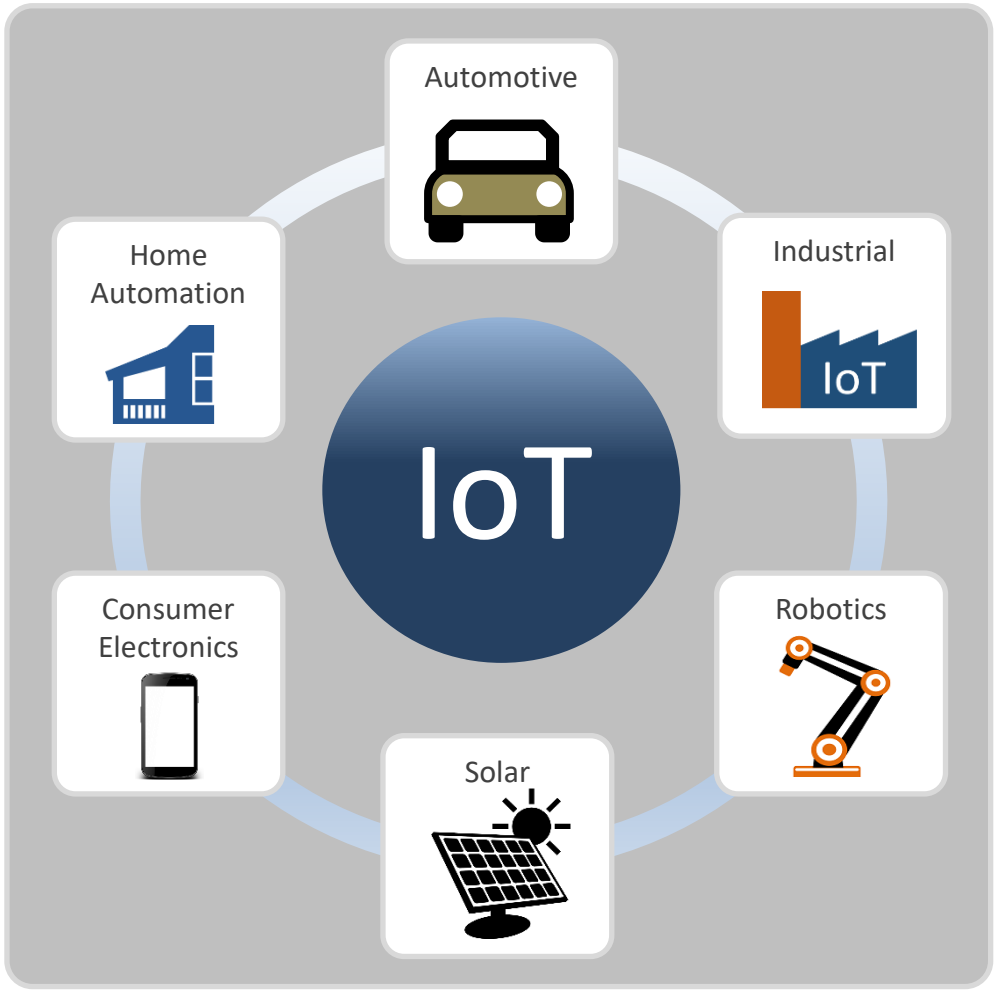
IoT Platform Capabilities

- **Egde/ Gateway Computing**
  - Microcontroller based processing
- **Upstream Communication**
  - GPRS, LTE, LTE CAT-M
  - Wi-Fi
  - LoRa
  - Bluetooth
  - GPS
- **Downstream Communication**
  - CAN
  - UART, Modbus
  - USB
  - Bluetooth
  - OBDII
  - Ethernet
- **Custom IOT Cloud platform**
  - Dashboard
  - Analytics



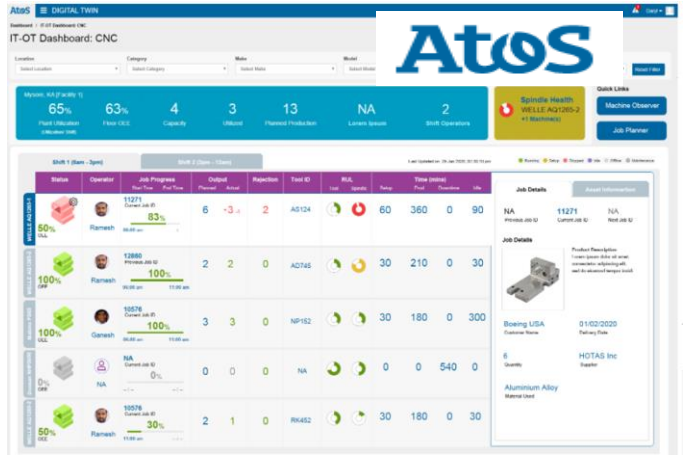
Domain experience

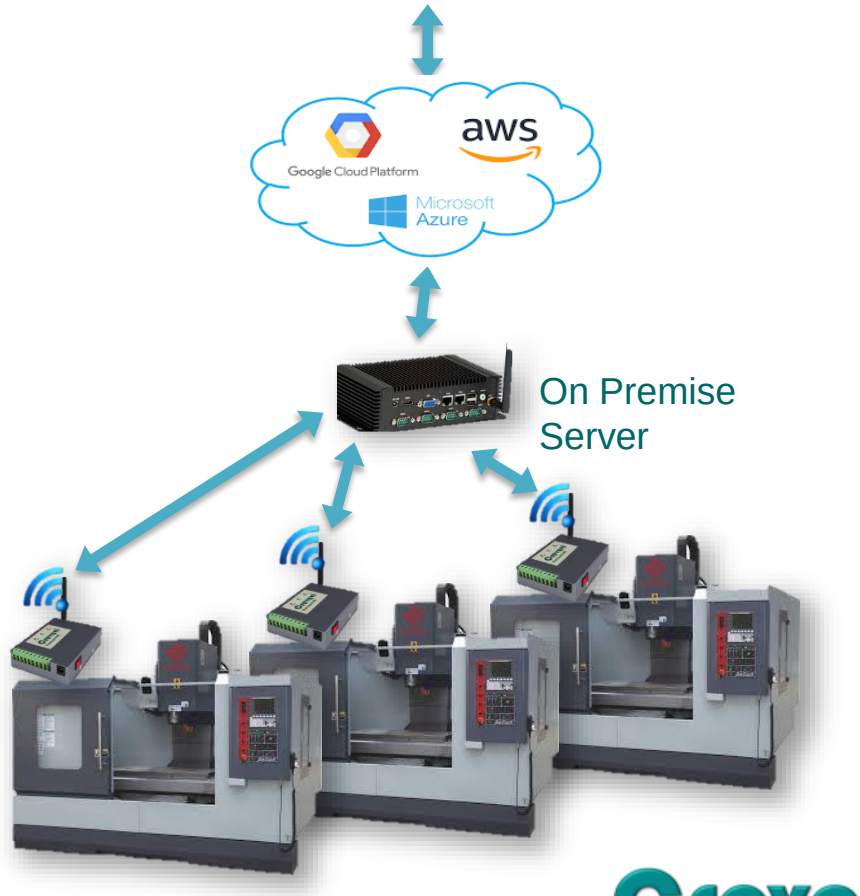
- **R&D team with decades of diverse industry experience**
- Field tested industrial grade products
  - Industrial IoT (IIoT)
  - Telematics, Automotive Diagnostics
  - Building Automation
  - Condition monitoring of Industrial assets
  - Tag and trace /Lat-Long of remote assets
- **Customer Benefits**
  - End-to-end IoT solution provider
    - From Shop-floor to cloud
  - R8D team to custom design a IoT solution to meet target costs
  - Process knowhow to implement any IoT use case
  - Desired product competencies under one roof



FactOnNet: Industrial Automation Platform

- **Condition and usage monitoring of CNC Machines and Digital Twin in Cloud**
  - Populate process parameters like Spindle RPM, Torque, Hydraulic oil temperature, cycle-time to AWS cloud
  - On-premise server communication via S7 / OPC UA with CNC machines
  - Cloud triggered alerts when process parameters go beyond limits
  - Predictive maintenance of spindle / other key parts and OEE measurement
- **Scalable platform to monitor all industrial machines**
  - Air Compressors, Chillers, Generators, smart meters, Circuit breakers
  - Provide 360 degree view of entire manufacturing process
- **Customer Benefits**
  - End-to-end solution from shop-floor to cloud
    - Single point solution provider from edge to cloud
  - Edge/Fog computing to reduce data costs, implement high end device security and device agent
  - At scale deployment and customization to meet desired total cost of ownership
  - Integration of all factory IT processes with OT to give 360 degree view of operations



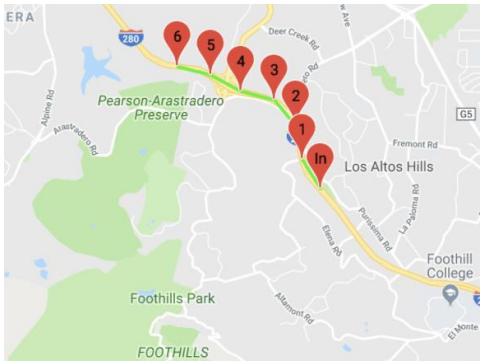


Condition monitoring of industrial asset

- **Real-time remote monitoring of compressor parameters**
  - Live demonstration to visiting Bosch IoT CEO
  - Modbus interface to read Compressor parameters
    - voltage, current, pressure, temperature of the machines
  - Parameters sent to SAP HANA cloud via GPRS (HTTPS) via cellular modem
- **Customer Benefits**
  - Custom-designed IoT end node to fit onto any machine
  - End-to-end IoT solution from edge to cloud
  - Scalable HW to meet target BOM cost
  - Custom security and device agent on IoT device
  - Edge/Fog computing to implement business logic on IoT device

Cold storage (Reefer Truck) monitoring

- **Custom-designed platform**
  - BLE nodes to measure temperature and humidity
    - Placed inside the Reefer
  - On-vehicle interface to Crevavi IoT gateway
    - receives the temperature & humidity data from all sensors over BLE
    - GPS sensor in ioT device will continuously keep track of location
    - Location and sensor data is sent to cloud at regular intervals
  - Cloud platform to display sensors' and GPS data in real-time
- **Customer Benefits**
  - Custom-designed IoT/Gateway and BLE nodes to meet target use-case
  - Scalable platform to meet target BOM cost
  - On device security, computing to implement business-logic
  - Optional interface to OBDII port for Vehicle diagnostics/Telematics



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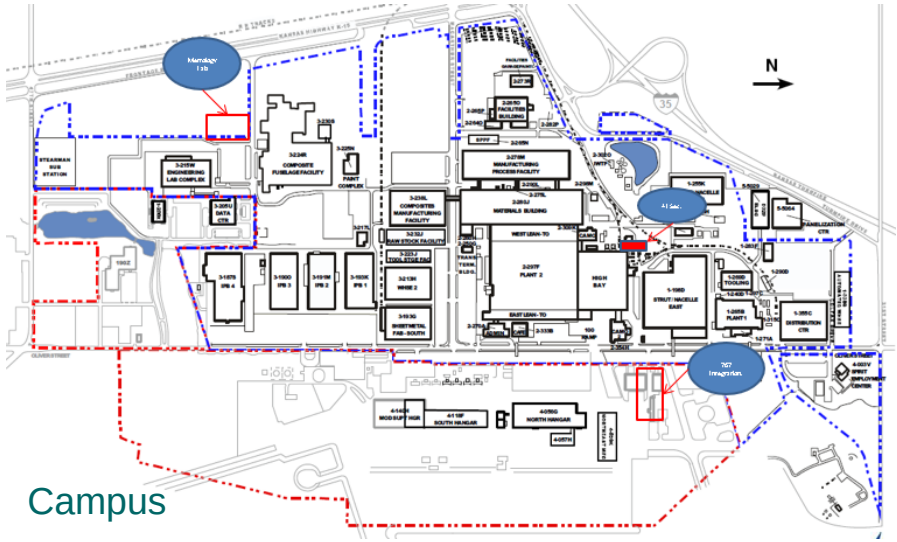
Asset Tag and Trace & Geo fencing

- Custom-built
  - Bluetooth (BLE) Beacons/tags
  - Readers/Gateways to read beacon signals and to communicate to cloud
  - Can be retrofit on high-value assets
  - Triangulation for indoor positioning
  - Customizable form-factor, firmware, security algorithm, device agent
- Geo fencing as per warehouse perimeter
- Cloud interface to gateways
- Custom IoT cloud platform to implement desired business logic/use-case

High value asset



Crevavi BLE Tag/Beacon form-factors

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Smart Devices for Building Automatic

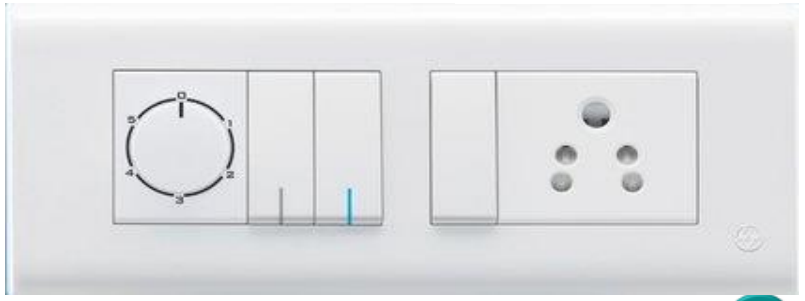
- Custom-designed smart switch, PIR and LDR sensors
  - Bluetooth(BLE)/WiFi based Smart Switch
  - To remotely control electrical appliances, detect object/light
  - Integrated relays to turn ON/OFF switches
  - Can be retro-fit onto existing switch-boards
  - Smart Switch control via mobile app
    - Optional remote control via cloud
- Customer benefits
  - Field tested devices to withstand power fluctuations in India
  - Building/Home/Factory automation at frugal cost
  - Integration of custom device agent/security algorithm
  - Made in India products with warranty

PIR

LDR

Wi Fi Smart Switch

Bluetooth®



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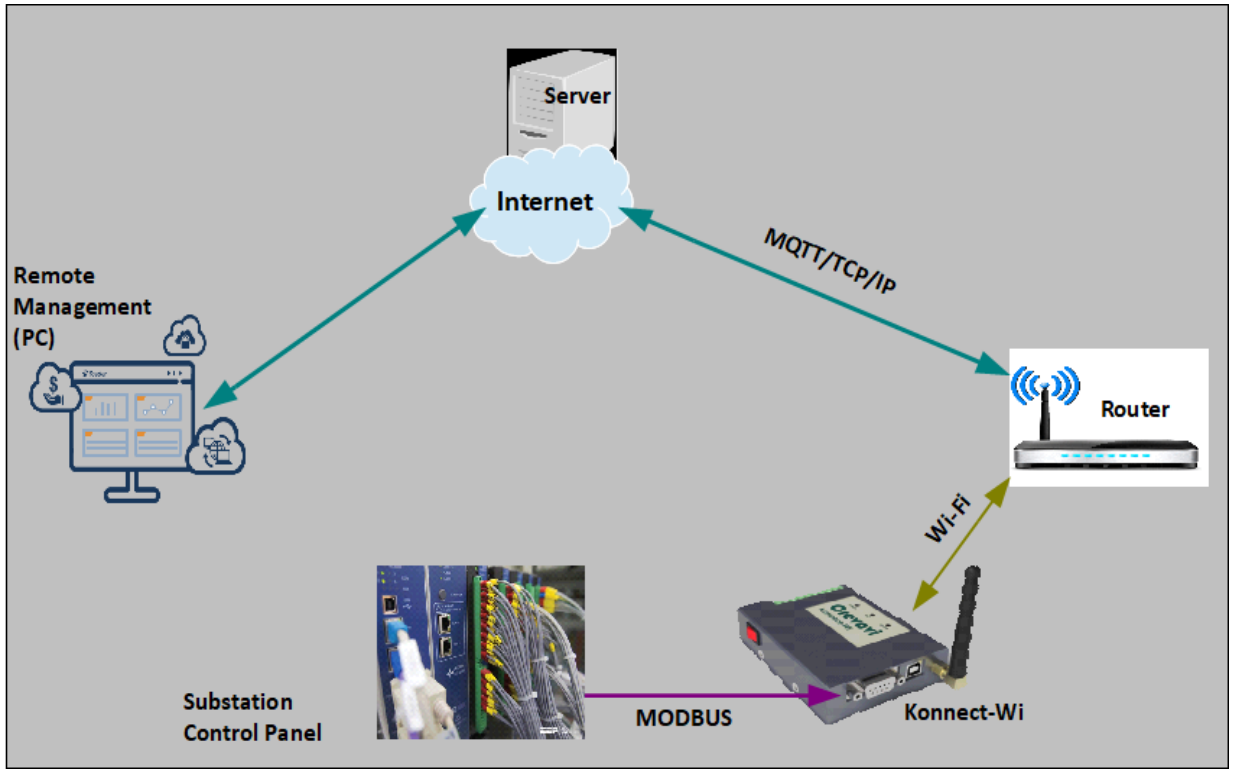
Panic button/SoS/Emergency butt

- **Custom-designed IoT enabled button**
  - GPS & GPRS based device for raising panic alerts, alarms, triggering SoS and emergency requests
  - Cloud connection configurable via mobile app
  - Location, vehicle & driver details sent regularly to cloud
- **Customer Benefits**
  - Integrated IoT enabled button with desired application
  - End-to-end solution from IoT node till cloud platform
  - Optional integration of Siren, other security features

Case Studies – Power Segment

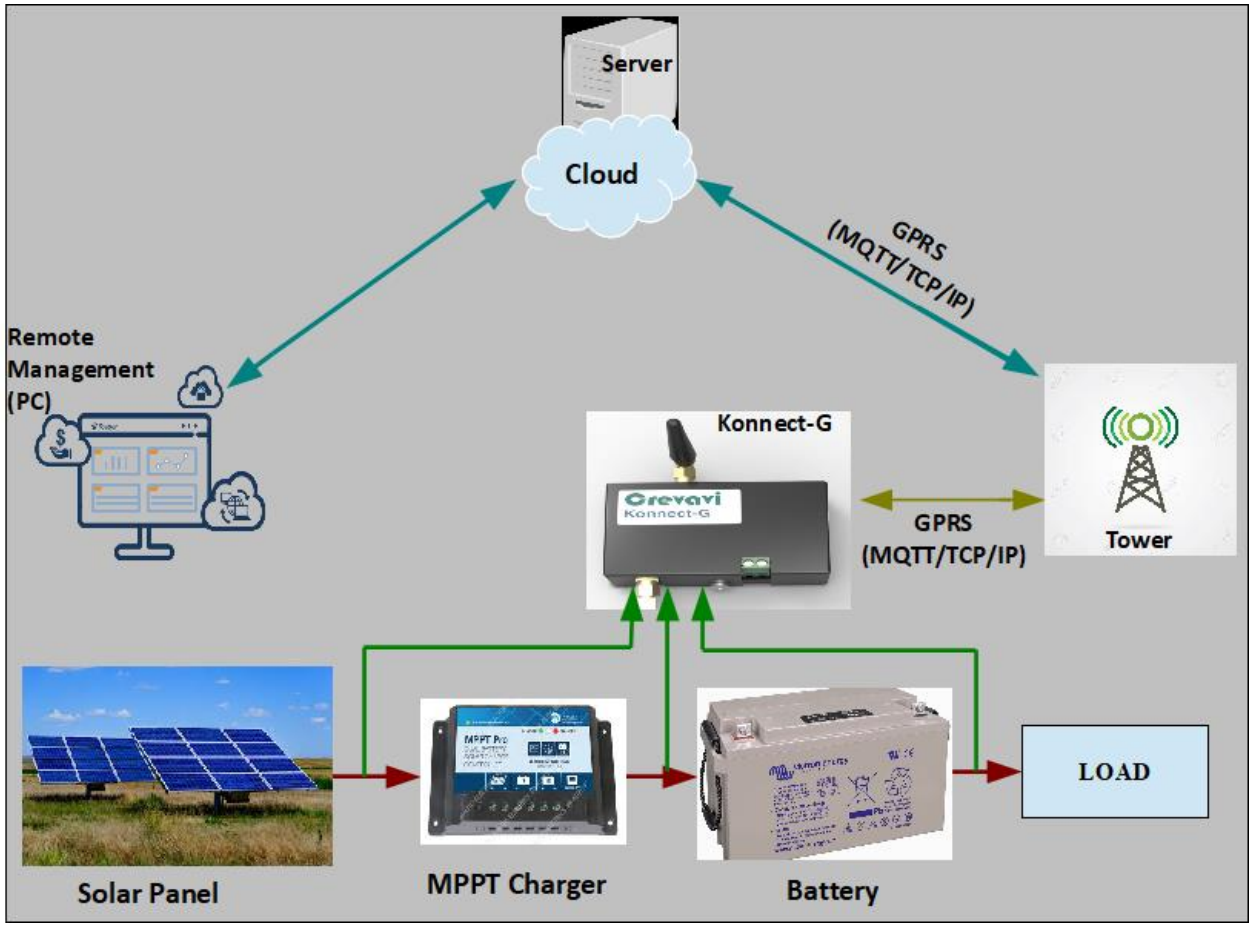
Power Substation Monitoring & Control

- **Solution Overview**
  - GPRS based IoT device
  - MODBUS RTU communication to fetch electrical parameters to monitor power quality from the control panel / SCADA through IEC 61850
  - Track changes in all electrical parameters, circuit breakers, Isolators & Relay status to identify the faults and suggest recovery tips to maintain the power quality
  - Remote monitoring of electrical parameters from cloud
- **Customer Benefits**
  - Experienced R&D Team with
    - Power Electronics knowhow
    - High Voltage engineering
    - PLC Communication protocols
    - SCADA communication



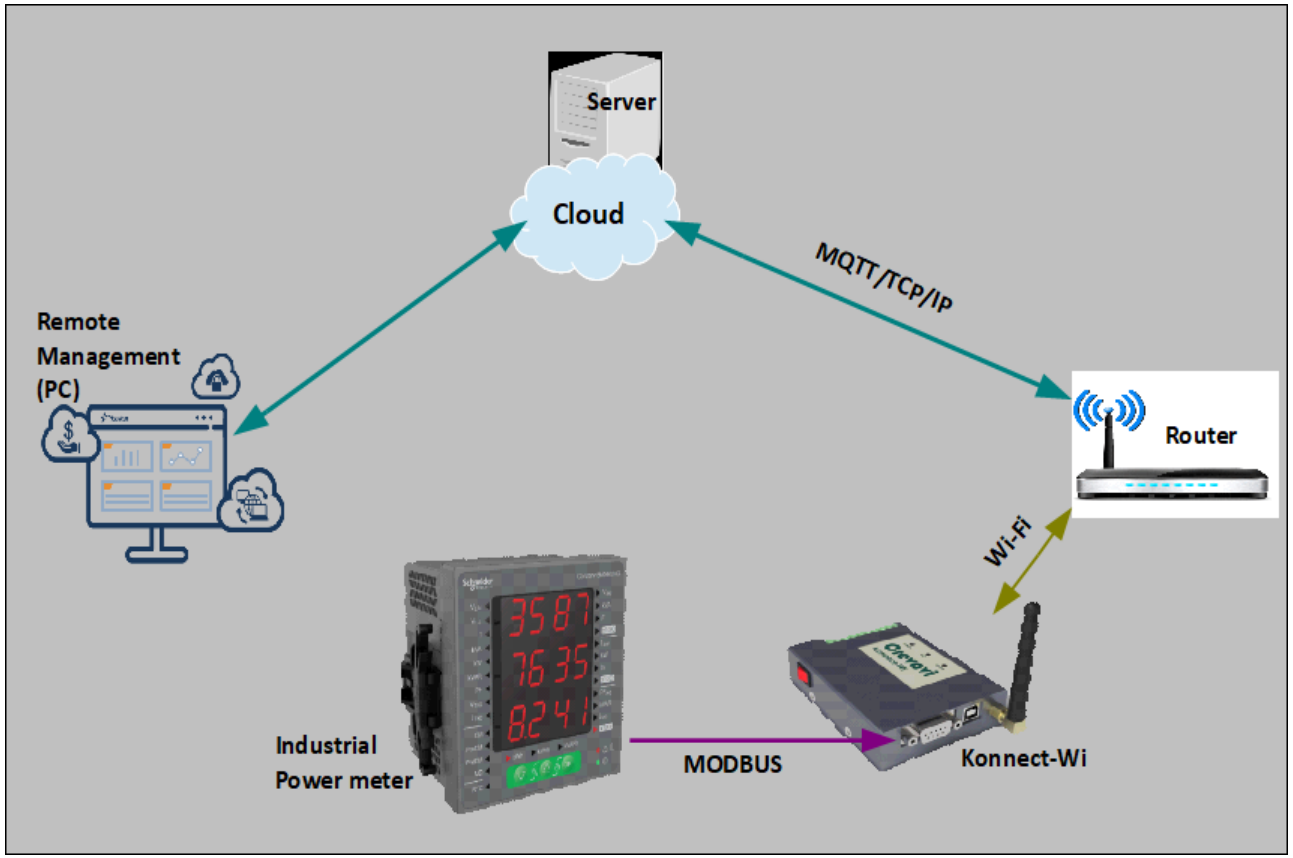
Remote monitoring of Solar farm

- **Solution overview:**
  - GPRS based, condition monitoring of solar panel, MPPT charger & Battery
  - Retrofitting of custom sensors to measure power
  - Cloud communication through MQTT
  - Condition monitoring, Predictive maintenance of Solar plant equipment
- **Customer Benefits:**
  - End-to-end IoT solution with own cloud platform
  - Rugged Industrial design, 24x7 operation
  - High-end security
  - Optional Retro-fit of custom sensors, actuators



IoT based Smart meter

- **Solution Overview:**
  - WiFi based IoT connected to Smart Energy meter via MODBUS
  - Cloud communication via WiFi through local router
  - Monitor energy in buildings, homes and factories
- **Customer Benefits:**
  - Edge processing to reduce recurring cellular data costs
  - Cloud platform to reduce cloud subscription costs
  - Rugged Industrial design for high reliability to withstand high power fluctuations and current surges
  - High-end IoT device security
  - Can meet custom certification



Thank You for your time

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