CS685 Spring 2017

Internet Of Things – Car’s Ecosystem

Milestone 2

Car Fleet Management System

Team 2

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1. Introduction

For the second milestone, the Process View Architecture had to be developed. Before drawing the Process View diagram, certain changes had to be made on ASR's from milestone 1 and some service requirements and assumptions had to be made to develop a Process View that meshed with the Reference Architecture and made sense overall. The easiest way to determine what assumptions to make was to define and describe the Quality Attributes that are architecturally significant to the fleet management system. After doing this, a diagram of the Process View was drawn to provide an explanation of how each component interacted inside the system.

Once the diagram was drawn, the Process Architectural Styles and Patterns within the architecture had to be described and labeled, along with an explanation for why those specific styles and patterns were chosen. The only thing left to do was to discuss how the architecture satisfied both the functional and non-functional requirements.

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2. Architecturally Significant Quality Attributes

The quality attributes are the primary factors that affect the performance of a system like system design, security, run time behavior and UI experience. It is of great importance to consider the quality attributes that has potential impact on other requirements. The following are the list of quality attributes that are identified for the Fleet management application and has an impact on the system. These quality attributes are identified via tradeoff analysis between multiple attributes as the priority and benefit of an attribute differs from the other.

1. Security
2. Usability
3. Availability
4. Performance
5. Scalability
6. Testability
7. Interoperability
8. Maintainability
9. Backup and Restore
10. Resilience

2.1 Requirement for Security

The fleet management software will connect the user to a central firewall cluster that has some form of end-to-end encryption of the data sent and received. The connection has to have some measure of security to prevent anyone from viewing the data sent to and from the servers, which contains sensitive information about the user and their fleet. Along with securing the communications channel, an account system will ensure that the user is indeed who they claim to be. The network will be tested with network penetration software during scheduled maintenance periods to make sure the storage cluster is not vulnerable to any newly discovered threats.

2.2 Requirement for Usability

The system will have a graphical user interface, commonly abbreviated as GUI, to provide the user with an interface that is easy to use and provides all services in the least amount of user actions. The graphical user interface will support multiple languages instead of just one to ensure there is not a language barrier that prevents users from utilizing the fleet management software.

The program will have OS independence, meaning that it will be usable on multiple operating systems (Windows, Unix/Linux, Mac OS). There will be an application designed specifically for Android and iOS devices. Usability is the most important quality attribute because it provides the user with an easy to use way to monitor their vehicles, monitor their drivers, give intuitive graphs and diagrams on cost-benefit analysis, store and view past vehicle history, and view and store each driver's driving habits.

2.3 Requirement for Availability

When the fleet management system is up and run, to what degree or proportionate of the actual system is operable for particular period of time. The plan is to make the hardware requirements negligible aside from having a method to connect to the internet, a display or monitor, a method to provide input, and a method to use an onscreen cursor. As a sophisticated application it requires software and hardware updates and patches on the server side and has down time and during this downtime, the application should be operationally available. Availability is measured either by the time interval or the mechanism for the system during downtime.

2.4 Requirement for Performance

A requirement of performance is critical to the system response to an event with time constraint. The performance of a system varies when there are thousands of users using the application compared to just few hundred users. If there are thousands of events happening at the same, the application must handle the load without any hindrance. The average latency time may just be few milliseconds if the number of users are less , whereas it may be up to few seconds when number of users are more. Thus the resource must be allocated appropriately based on the behavior of a process.

2.5 Requirement for Scalability

The fleet management software will employ a scale-out approach: running on a group of servers that form a storage cluster, connected together in a LAN network to communicate with each other. Should the current servers become overloaded or start to bottleneck, all that needs to be done is to add a new server to the cluster, or multiple if one is not enough.

2.6 Requirement for Testability

As a big application, there are lots of stuff that could go south, for starters, if any SOA service or API or be a network component fails, it could have severe impact on the applications operation and performance, thus the fleet management application must support the highest degree of ability to be tested under several test drive and controlled environment. Several defects can be easily identified and debugged if the degree of testability is high. It should also provide proper documentation and maintenance service for future cycle.

2.7 Requirement for Interoperability

The fleet management software must be able to read and parse the telemetric data stored in each vehicle for relevant data, such as the real-time fuel level, tire wear, oil level, and brake wear. This will require a program to read the telemetric data from the vehicle, a program to parse the data, and an interface to send the data from the vehicle to the servers. There are thousands of devices that a user can be using, so the software will have to be able to determine what kind of device is being used and how to send the information to it. For Android and iOS, there will be applications dedicated solely to those platforms, while Windows, Mac, and Linux will access the software through a web browser.

2.8 Requirement for Maintainability

The system will have at least 99.99% reliability, but will strive for 99.999%. There will be scheduled maintenance periods to perform any intrusion testing, hardware upgrades, software updates, and any other necessary maintenance actions. By scheduling server maintenance, the outages will be controlled and predictable instead of random and disruptive.

2.9 Requirement for Backup and Restore

To ensure that a user's data will not be lost, the software will run on a storage cluster that is connected to a group of storage devices that will all contain the same information. That is to say, the devices will being running in parallel with each other in terms of data written to them, but only one will be read at any given moment, which will be referred to as the ‘primary’ storage device. By doing this, no data is lost if the main storage device has a hardware or software failure; if one the main device fails, the data that would have been lost exists on the other storage devices, all being up to date until the exact moment that the failed hard drive crashed. This quality attribute is necessary because it is directly tied to the user’s ability to access their fleet’s vehicular information and driver roster, which are the main reasons the user ended up signing up for fleet management software.

2.10 Requirement for Resilience

In today’s world there are lots of menace that threatens the security of a software. The application is prone to virus attack, Trojan horse, worms etc,. These threats have the potential to cause disaster. Thus the requirement for resilience is so important that it should absorb or avoid those threats without shutting down completely.

3. Updated Architecturally Significant Requirements – M1

The following lists the updated Architecturally Significant Requirements from Milestone 1

3.1. Requirement of Connected Vehicle sensors to reduce risk and turmoil on the roads

By coupling the GPS tracker with a device that can read information from the OBD port, fleet management software allows for real-time diagnostics for a vehicle in addition to simply providing a location. In doing so, a much broader range of services are available to utilize, such as analyzing a driver’s driving behavior and analyzing the usage of each vehicle individually.

3.2. Requirement of Real Time vehicle Telematics Tracking to maximize productivity and stay informed

These sensors warn drivers of impending danger so that the driver can take corrective action, or can even be able to intervene on the driver’s behalf. They use on-board dedicated short-range radio communication devices to transmit messages about a vehicle’s speed, heading, brake status, and other information to other vehicles and receive the same information.

3.3. Requirement of Vehicle Scheduling and Location Tracking to effectively coordinate passengers and drivers

Vehicle Scheduling and Location Tracking System allows a way for the passenger to book a cab using the application and effectively coordinates the passengers, drivers and dispatchers to streamline operations. This provides an improvised customer service that Facilitates GPS based fleet wide visibility with real-time status updates for the customers to track a vehicle.

3.4. Requirement of Fuel Tracking and Speed Control to improvise energy efficiency and speed control

Using the on-board diagnostic port integrated with a telematics system, managers can keep track of the fleet vehicles' fuel consumption and control the speed by setting a threshold that alerts the manager if the driver exceeds said threshold.

3.5. Requirement of Vehicle Usage Analysis to maintain a balance between actual work done and fleet costs

This service enables the manager to assign work properly and avoid excess spending. It provides sensible real-time information like the vehicle's fleet number and license plate number, distance travelled, hours completed, trips made, average and total operating cost, and percentage of utilization.

3.6. Requirement of Car Ownership and Leasing for supervision of driver related information and payments

This keeps track of drivers who register with the fleet. A driver either can use their own vehicle or can lease a vehicle from the fleet. If the driver leases a vehicle, it keeps track of the payments due by the lessee each month and records the payment history.

3.7. Requirement of Fleet and Driver Management for acquisition of overall fleet related information

This gives an overall view of the fleet in a dashboard, such as the total number of registered vehicles, amount of part-time and full-time employees, total number of rides completed, total distance covered, driver monitoring, a payroll system, vehicle diagnostics, and vehicle maintenance. This allows the manager to easily monitor the fleet and take necessary action accordingly.

3.8. Requirement of Traffic and Workload Management for a balance between work and productivity

This enables the manager to create an ideal routine for the drivers, balancing their personal and professional life so they are not overworked, and managing all the assets, giving importance to densely populated areas where the projected revenue is maximum.

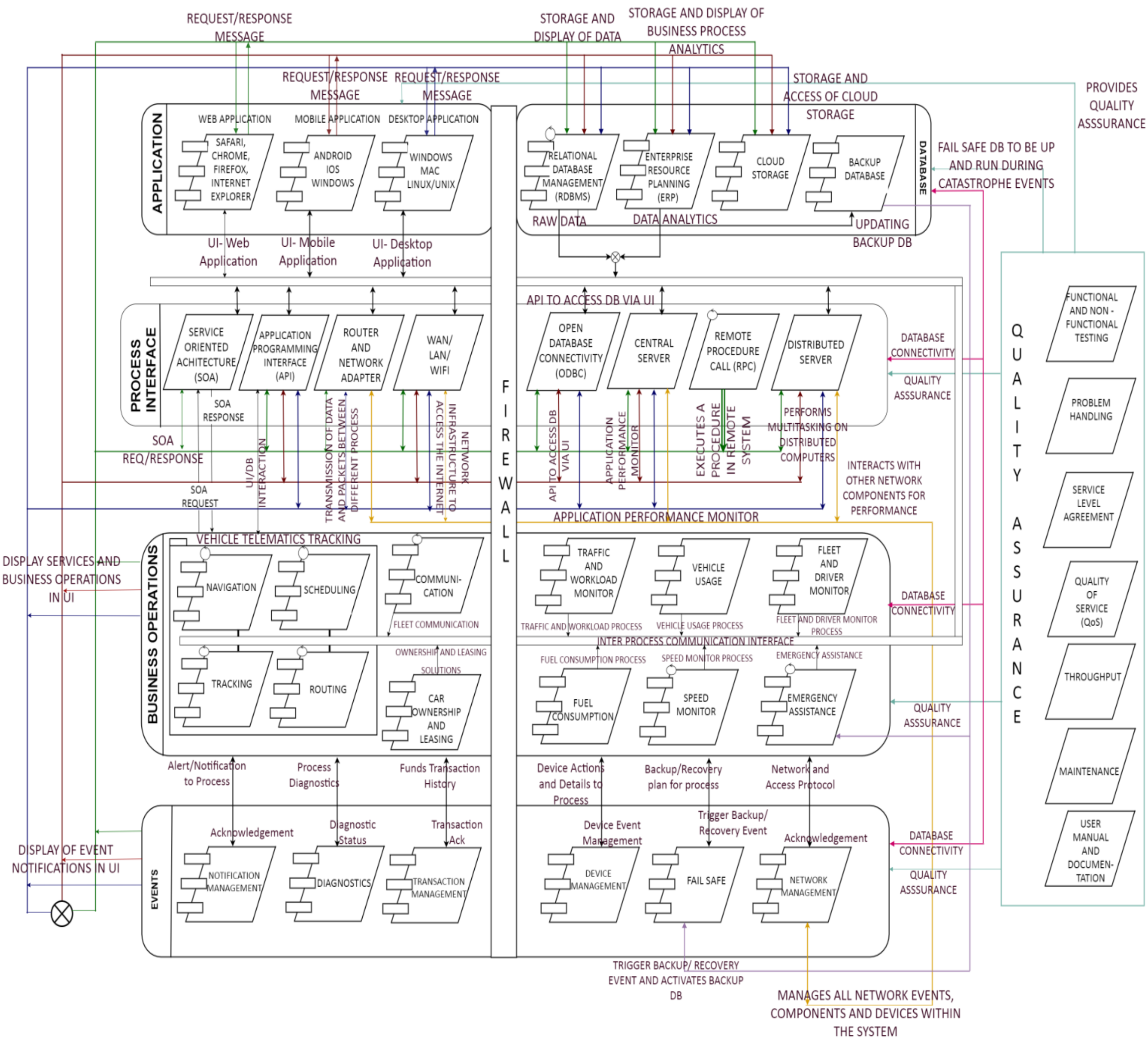
3.9. Requirement of Data Analytics for working towards performance, efficiency and prevention

Leveraging and analyzing data provide insights into vehicle and equipment usage, driver behavior, and fleet productivity schedules, fleet managers can discover various areas where cost efficiency can be applied. Armed with information on driving behaviors through telematics data, companies can put drivers in safety training programs tailored to their risky driving behaviors before a collision occurs.

3.10. Requirement of Communication for cellular system between passenger, driver and manager

Communication plays a vital role throughout the fleet; a passenger can clarify details about his/her location with the driver and vice versa. A manager can contact the driver in case of an emergency.

4. Process View Architecture


REQUEST/RESPONSE MESSAGE
STORAGE AND DISPLAY OF DATA
STORAGE AND DISPLAY OF BUSINESS PROCESS ANALYTICS
REQUEST/RESPONSE MESSAGE
REQUEST/RESPONSE MESSAGE
STORAGE AND ACCESS OF CLOUD STORAGE
PROVIDES QUALITY ASSSURANCE
FAIL SAFE DB TO BE UP AND RUN DURING CATASTROPHE EVENTS
APPLICATION
WEB APPLICATION
MOBILE APPLICATION
DESKTOP APPLICATION
SAFARI, CHROME, FIREFOX, INTERNET EXPLORER
ANDROID IOS WINDOWS
WINDOWS MAC LINUX/UNIX
UI- Web Application
UI- Mobile Application
UI- Desktop Application
DATABASE
RELATIONAL DATABASE MANAGEMENT (RDBMS)
ENTERPRISE RESOURCE PLANNING (ERP)
CLOUD STORAGE
BACKUP DATABASE
RAW DATA
DATA ANALYTICS
UPDATING BACKUP DB
PROCESS INTERFACE
SERVICE ORIENTED ACHITECTURE (SOA)
APPLICATION PROGRAMMING INTERFACE (API)
ROUTER AND NETWORK ADAPTER
WAN/ LAN/ WIFI
API TO ACCESS DB VIA UI
OPEN DATABASE CONNECTIVITY (ODBC)
CENTRAL SERVER
REMOTE PROCEDURE CALL (RPC)
DISTRIBUTED SERVER
DATABASE CONNECTIVITY
QUALITY ASSSURANCE
SOA RESPONSE
SOA REQ/RESPONSE
SOA REQUEST
UI/DB INTERACTION
TRANSMISSION OF DATA AND PACKETS BETWEEN DIFFERENT PROCESS
NETWORK INFRASTRUCTURE TO ACCESS THE INTERNET
API TO ACCESS DB VIA UI
APPLICATION PERFORMANCE MONITOR
EXECUTES A PROCEDURE IN REMOTE SYSTEM
PERFORMS MULTITASKING ON DISTRIBUTED COMPUTERS
INTERACTS WITH OTHER NETWORK COMPONENTS FOR PERFORMANCE
APPLICATION PERFORMANCE MONITOR
F I R E W A L L
QUALITY ASSURANCE
FUNCTIONAL AND NON - FUNCTIONAL TESTING
PROBLEM HANDLING
SERVICE LEVEL AGREEMENT
QUALITY OF SERVICE (QoS)
THROUGHPUT
MAINTENANCE
USER MANUAL AND DOCUMEN- TATION
DISPLAY SERVICES AND BUSINESS OPERATIONS IN UI
BUSINESS OPERATIONS
VEHICLE TELEMATICS TRACKING
NAVIGATION
SCHEDULING
COMMUNI- CATION
FLEET COMMUNICATION
TRACKING
ROUTING
OWNERSHIP AND LEASING SOLUTIONS
CAR OWNERSHIP AND LEASING
TRAFFIC AND WORKLOAD MONITOR
VEHICLE USAGE
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TRAFFIC AND WORKLOAD PROCESS
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FLEET AND DRIVER MONITOR PROCESS
INTER PROCESS COMMUNICATION INTERFACE
FUEL CONSUMPTION PROCESS
SPEED MONITOR PROCESS
EMERGENCY ASSISTANCE
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Alert/Notification to Process
Process Diagnostics
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Backup/Recovery plan for process
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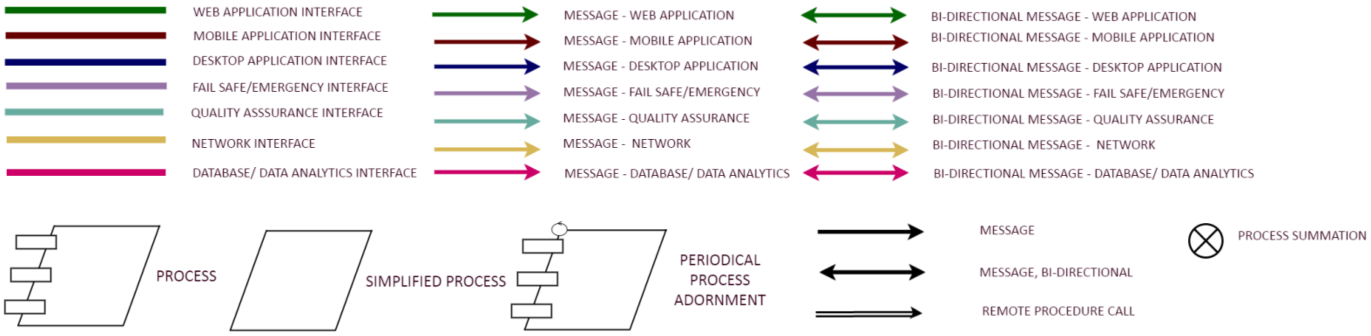
DISPLAY OF EVENT NOTIFICATIONS IN UI
EVENTS
Acknowledgement
Diagnostic Status
Transaction Ack
Device Event Management
Trigger Backup/ Recovery Event
Acknowledgement
NOTIFICATION MANAGEMENT
DIAGNOSTICS
TRANSACTION MANAGEMENT
DEVICE MANAGEMENT
FAIL SAFE
NETWORK MANAGEMENT
DATABASE CONNECTIVITY
QUALITY ASSSURANCE
TRIGGER BACKUP/ RECOVERY EVENT AND ACTIVATES BACKUP DB
MANAGES ALL NETWORK EVENTS, COMPONENTS AND DEVICES WITHIN THE SYSTEM

KEY LEGEND-


WEB APPLICATION INTERFACE
MESSAGE - WEB APPLICATION
BI-DIRECTIONAL MESSAGE - WEB APPLICATION
MOBILE APPLICATION INTERFACE
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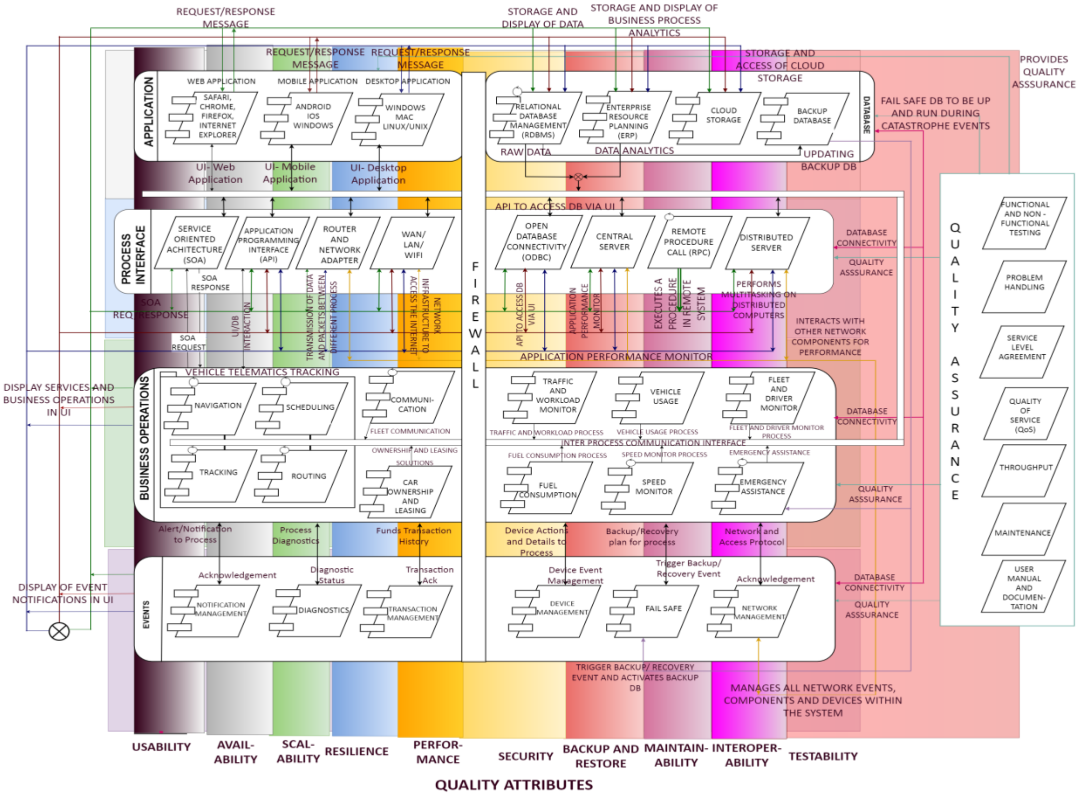
DESKTOP APPLICATION INTERFACE
MESSAGE - DESKTOP APPLICATION
BI-DIRECTIONAL MESSAGE - DESKTOP APPLICATION
FAIL SAFE/EMERGENCY INTERFACE
MESSAGE - FAIL SAFE/EMERGENCY
BI-DIRECTIONAL MESSAGE - FAIL SAFE/EMERGENCY
QUALITY ASSSURANCE INTERFACE
MESSAGE - QUALITY ASSURANCE
BI-DIRECTIONAL MESSAGE - QUALITY ASSURANCE
NETWORK INTERFACE
MESSAGE - NETWORK
BI-DIRECTIONAL MESSAGE - NETWORK
DATABASE/ DATA ANALYTICS INTERFACE
MESSAGE - DATABASE/ DATA ANALYTICS
BI-DIRECTIONAL MESSAGE - DATABASE/ DATA ANALYTICS
PROCESS
SIMPLIFIED PROCESS
PERIODICAL PROCESS ADORNMENT
MESSAGE
MESSAGE, BI-DIRECTIONAL
REMOTE PROCEDURE CALL
PROCESS SUMMATION

5. Styles and Patterns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SCAL-ABILITY
RESILIENCE
PERFOR-MANCE
SECURITY
BACKUP AND RESTORE
MAINTAIN-ABILITY
INTEROPER-ABILITY
TESTABILITY
QUALITY ATTRIBUTES

The entire architecture is broken down in to 7 Layers namely Application Layer, Database Layer Interface Layer, Business Operations Layer, Events Layer, Security and Quality Assurance layer. Each layer has several components that interact with components in their layer and with other layers in order to yield a better performance. The Security and the Quality Assurance layer bind all the Other 5 layers in order to implement the mentioned Non Functional requirements. The layers are organized in such a way that the web application lies on the top and interacts with the process using the interface, also these process can communicate with the events that is present at the bottom layer and notify the application about the events happening using the interface.

Also the database is connected with every other layers so that all the data, process communication, events are recorded and are backed up in a reserve back up database which is triggered in case of any catastrophic events such as a virus attack or Denial of Service (DoS) attack and keeps the application up and running without any hindrance.

5.1 Application Layer

The Application layer has 3 elements that support Graphical User Interface (GUI) namely, Web Application, Mobile Application and Desktop Application. Since this application has several interfaces the Platform Independence, Accessibility and Usability attribute of the requirement is resolved.

1. Web Application supports web browsers such as Safari, Google Chrome, Firefox, Internet Explorer etc.
2. Mobile Application supports platforms such as Android, iOS, Windows Phone.
3. Desktop Application supports operating system such as windows, Mac OS, Unix/Linux.

Since the Web Application is the 'Face' of the application, there are lots of interface that runs through the body of the application in order for a swift interaction between front end, back end, process and events. These Interfaces are as follows, Satisfying the Non Functional Requirements of Usability, Accessibility, Availability, Scalability:

1. Web Application Interface
2. Mobile Application Interface
3. Desktop Application Interface.

5.1.1 Web Application Interface

This Interface is represented by the Green color in the Legend. Usually a web application is accessed using web browsers such as Mozilla Firefox, Google Chrome, Safari, Internet Explorer etc. These application lies on the client side. Whenever the user loads the application a Request/Respond message of the URL takes place. The web application should communicate with several process using SOA, Database, API's etc. in order to display them in Front end. Since this application is bonded with security and database layer, it provides an authentication mechanism that supports different actors with different privileges.

The web application interface connects the Web Application's Graphical User Interface with the database, interfaces such as Application Programming Interface (API) for communication with server side scripting, Service Oriented Architecture(SOA) for process communication, Open Database Connectivity(ODBC) for the application to interact with a database etc. The data analytics tool Enterprise Resource Planning is also connected with the Web Interface in order to display the results of data analysis for better understanding and performance.

The web application interface is also connected with the Business Operations layer where all the services that are obtained from the functional requirements lies down in order to display them in UI. Since the application is predominantly used as a managerial application and with a marginal use for commercial fleet management, it provides Real-Time Vehicle Telematics Tracking, Vehicle Scheduling and Location Tracking Solution, Fuel Tracking and Speed Control, Vehicle Usage Analysis, Car Ownership and Leasing Solutions, Fleet and Driver Management, Traffic and Workload Management, Data Analytics, Communications, User Interface, Database

Web Application - Message, Web Application – Bi-Directional Message and Web Application RPC

The Web Application Message, the web application Bi-Directional and web RPC message are represented using Arrow, Double arrow and Remote Procedure Call Connectors. Since these communications happens with the web interface, they are represented using the green color as well. All the exchange of information between the application, programming interface and process happens in the web interface using Connectors, the communication may be single sided or double sided depending upon the type of request and service required for the process. But the RPC uses a standard Remote Procedure Call connector. RPC is designed to facilitate communication between client and server processes. These Connectors are responsible for transferring the request/ response message to the application and process.

5.1.2 Mobile Application Interface

This Interface is represented by the Red Color in the Legend. Since the fleet management is a commercial transport application but not limited to it, it is better to have an application that is present on the portable mobile device facilitating the users to book a cab easily by entering the pickup and drop off point.. Like the web application, the mobile application interface connects the mobile GUI with the database (RDBMS, ERP, cloud storage, backup DB). The mobile application is platform independent. Since the application is mostly used for commercial fleet management, they provide the key functionality of Real-Time Vehicle Telematics Tracking, Vehicle Scheduling and Location Tracking Solution, Communications, User Interface

Mobile Application – Message and Mobile Application – Bi-Directional Message

The Mobile Application Message and the mobile application Bi-Directional message are represented using Arrow and Double arrow. Since these communications happens within the mobile interface, they are represented using the red color. These connectors are also responsible for transfer of information between the application, process, events and the database via the Mobile application interface.

5.1.3 Desktop Application Interface

This Application Interface is represented using blue color in the legend. The desktop application is designed to operate irrespective of operating system be it windows, Mac OS, Unix/Linux. Hence it is platform independent. It is used only by the managers as a Fleet Management tool for an overall view.

Desktop Application – Message and Desktop Application – Bi-Directional Message

The Desktop Application Message and the Desktop application Bi-Directional message are represented using Arrow and Double arrow. Since these communications happens within the Desktop interface, they are represented using the red color. These connectors are also responsible for transfer of information between the application, process, events and the database via the Desktop application interface.

5.2 Database Layer

The Database Layer has 4 key elements. They are as follows:

1. Relational Database Management System
2. Enterprise Resource Planning
3. Cloud Storage
4. Backup Database

5.2.1 Relational Database management

This element stores the raw, unprocessed data and gives some meaningful insight about them. It employs commonly utilized SQL(sequel) tool to store, retrieve and modify data. With the help of ODBC, an application can access the database and display the information in UI.

5.2.2 Enterprise Resource Planning

The Data Mining and Data Analytics Tool of the Enterprise Resource planning is combined with the database and provide insights into vehicle and equipment usage, driver behavior, and fleet productivity schedules, fleet managers can discover various areas where cost efficiency can be applied. Armed with information on driving behaviors through telematics data, companies can put drivers in safety training programs tailored to their risky driving behaviors before a collision occurs.

5.2.3 Cloud Storage and Backup Storage

The cloud is a remote storage space where the data is stored and accessed using the internet. Cloud Storage reduces the bandwidth usage and easily accessible that can be accessed from remote locations too. This acts as a secondary back up storage from which the data's can be recovered in the event of a disaster recovery.

Backup storage is the primary back up storage which is synchronized with the database and the information is updated on daily basis. So in case of a catastrophic event this storage is activated by the fail safe event and business operation continues. Satisfies the Non Functional Requirements of Backup and Restore, Performance, Scalability

5.2.4 Database/Data Analytics Interface

The database/ data analytics interface is represented using pink color in the legend. The database/data analytics interface integrates all the layers whose elements have the need to exchange data, processed information. These data can be stored in the database and accessed in the future. Also this database is integrated with the ERP tool to develop a business intelligence model in order predict the performance and output in the future.

Database/Data Analytics Interface – Message and Bi-Directional Message

The Database/Data Analytics Message is represented using arrow and the bidirectional message is represented using double arrow. It facilitates in exchange of data's and information in the interface in both directions. It is represented in pink color.

5.3 Program Interface Layer

As the Name suggests, the program interface layer acts as some middleware between the application and the process where they communicate through and back application and business operations. It is represented using the Simplified process notation. This layer consists of Application Programming Interface, Service Oriented Architecture, Open Database Connectivity, Remote Procedure Call, Central server, Distributed Server. It Satisfies the Non Functional Requirements of maintainability, Interoperability

5.4 Business Operations Layer

The Business Operations Layers implements all the Functional requirements in the Milestone 1 in the form of process. These process in turn communicate with each other using the Inter Process Communication Interface, where it interacts along with other process and process interface and provides the necessary information in form of data to the Front end(GUI). The elements present in this layer are Vehicle Telematics Tracking (Navigation, Scheduling, Tracking, Routing), Traffic and Workload Monitor, Fleet and Driver Monitor, Communication, Fuel Consumption, Vehicle Usage, Speed Monitor, Car Ownership and Leasing solutions and an additional Emergency Assistance. It satisfies: - Functional Requirements.

5.5 Events

Events layer has the capability to handle event management, gives alerts and notifications. This layer has components like

1. Device Management - OBD Sensor, Mobile, computer and other devices operated within the fleet
2. Fail Safe - Comes into operation in case of a disaster. It triggers/activates the backup database and continues the business operation
3. Network Management - Manages all the Network related components using Network Management Interface
4. Transaction Management - Purchase Transaction, Transaction of procedures, calls etc.)
5. Diagnostics - The explicit purpose of it is to examine the state or location of the problem with the application, database, process and operating system, hardware

6. Notification Management – Notify any active event and gives out alert

These events communicate with the process in the operations layer which in turn communicates with the application layer and notifies or alerts about an event in the front end.

5.5.1 Network Management Interface, Message and Bidirectional Message.

This Interface, Message (Arrow) and Bi-directional (Double Arrow) message are represented using yellow color. Comprises of all the network related components such as LAN, WAN, Wifi, Central Server, Distributed Server, Routers and Network adapters. These elements are handled by the network management element. The exchange of information takes place using the arrow and double arrow for bi-directional based on the service request.

5.5.2 Fail Safe/Emergency Interface, Message and Bidirectional Message.

This Interface, Message (Arrow) and Bi-directional (Double Arrow) message are represented using Lavender color. In today's digital world, there are lots of threats that has the potential to destroy any application or database and because of that there is a need for Fail safe, Once the firewall detects any security breach or loss of data, it immediately alerts the fails safe event. The fail safe event will alert the emergency assistance and activates the backup database and the business continues without any trouble.

Satisfies – Non Functional Requirements of Resilience, Backup and Restore

5.6 Firewall and Quality Assurance

The Firewall layer provides virtual security for the entire layer it binds preventing them from outside threat. It is the virtual end point that provides authentication mechanism which denies the service to unauthorized users.

The Quality Assurance domain provides all the layers with Quality assurance services such as Functional and Non-Functional Testing, Quality Of Service (QoS), Problem handling, Maintenance Service. They have service level agreement with any third party vendor that satisfies the various level of services provided to each layer or elements. This also helps with proper User Manual and Documentation that's helpful in future migration and improvements. This Interface, Message (Arrow) and Bi-directional (Double Arrow) message are represented using Cyan color.

5.7 COMPONENTS and CONNECTORS

Component Process - All the application layer, database, service, event elements in the layers are represented using the Component Process. It is represented using a parallelogram with 3 rectangular boxes in its left edge. This Component is used in order to represent all the process for which changes can be incorporated easily without much impact on the application.

Simplified Process – This represented in the form of Parallelogram. It is used to represent all the Program interface and quality assurance components because of their ability for message passing and API's.

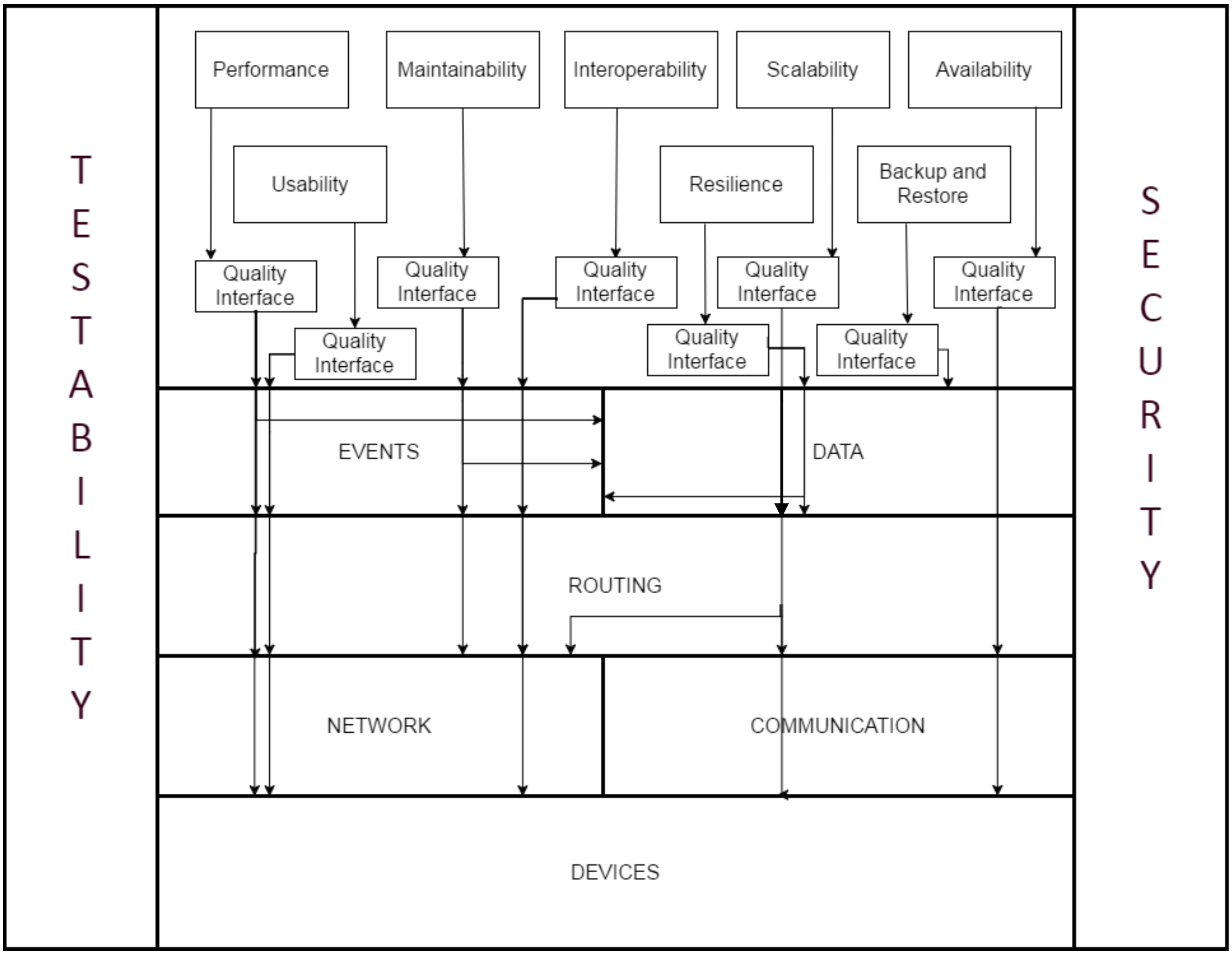
Periodical Process Adornment – It represents all the process that repeats in cycle like navigation, scheduling, routing, tracking, RPC, database. It is represented with a cyclic adornment on the tope left corner of a process.

Message, Bi-Directional Message – It represents the exchange of information between process and interface; the way of exchanging information may vary based on the need. It may be in single or both ways.

Remote Procedure Call – It is represented using a double parallel line under the roof of a single arrow. It invoke remote procedures on client side, which is helpful for a web application.

Process Summation – It is represented using a cross inside a circle. Its function is to integrate the application based interface. A web application can be accessed using mobile device.

6. View Alignment



6.1 View Alignment Assumptions

Application: Since the entire application fits in the top layer, the quality attributes of the application access the bottom layer using quality interface.

Events: It access the Non-functional requirements of Usability, Performance, Maintainability, Interoperability and Resilience

Data: It access the quality attributes of Backup and Restore, Resilience, Performance and Maintainability

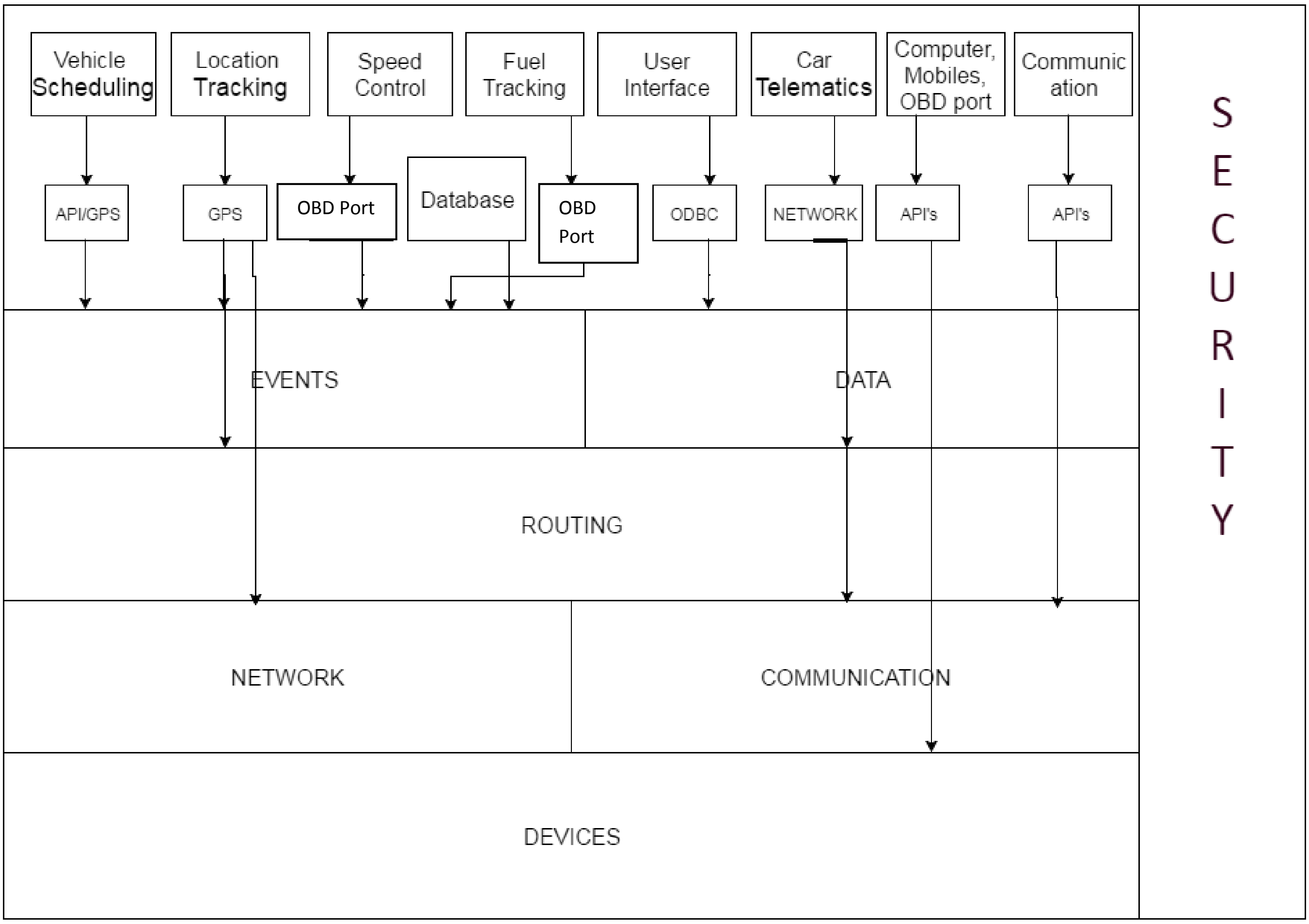
Routing: It access the Non-functional requirements of Usability, Performance, Maintainability, Interoperability and Scalability and Resilience

Network: It access the Non-functional requirements of Usability, Performance, Maintainability, Interoperability and Scalability

Communication: It access the quality attributes of scalability and Availability

Devices: It access the Non Functional Requirement of Usability, Performance, Interoperability and Scalability and Availability

6.2 View Alignment Changes– M1



6.3 Assumptions

In the Previous Milestone, Milestone 1, we assumed that the application requirements are the substitute of the underlying services and hence we mapped those app functionalities to the underlying service.

But now we understand that the application functionalities access the below services using some interface, they are mentioned as follows.

Application: The entire application including its functionalities fits in the top layer, and those functionalities has their interface through which they access this bottom service. The application also has its own database

Events: The Events service is accessed by Vehicle scheduling using API/GPS Interface, Location Tracking Using GPS Interface, Speed Control using Monitor Interface, Fuel Tracking using OBD Port.

Data: The UI access the database layer using Open Database Connectivity (ODBC) Interface, since this layer provides the log about other layers.

Routing: The Routing Service is accessed by Location Tracking using GPS Interface, Car Telematics using Network Interface

Network: The Network Service is accessed by Location Tracking using GPS Interface.

Communication: The Communication Service is accessed by Car Telematics using Network Interface and Communication using API's.

Devices: The Computer's, Mobile, OBD Port access the device layer using API's.

7. Platform Requirements

SERVICES	INPUT	OUTPUT	FUNCTIONALITY	ASSOCIATED ASR
Onboard Sensor Management	Events, Coordinates, Speed and Fuel Usage	Storing of these Events and data in remote location	Accessing data in remote location for Managerial purpose	Connected Vehicle Sensor
Device Management	All of the fleets device asset	Store and manage the fleets device		
Car Events	Current Location, Travelling Speed, Vehicle Diagnostics	Updates the location, updates the distance travelled , speed and issues with vehicle	Calculates the estimated time to destination by periodically updating location and speed. Finds out any issues with vehicle	Vehicle Scheduling and Location Tracking Solution
Event Management	1.Odometer Speed 2.Fuel Level and Distance Travelled	1. Speed Monitor and Control 2. Fuel Usage tracker	Keep track on fleet vehicles' fuel consumption and control speed by setting a threshold that gives an alert if the driver exceeds said threshold.	Fuel Tracking and Speed Control
Reporting	Speed and Fuel Level	Alerts Manager/Superior about over speeding		
Car Monitoring	Gather performance data about the car and its usage	Store and Analyze the data for future use.	It provides information about the total vehicle's in the fleet, license plate number, distance compiled, hours completed, trips made, average and total operating cost, and percentage of utilization.	Vehicle Usage Analysis
Car Registration	Gather Driver's Info from DMV using legacy system	Fleet Registration with self-car or car is leased	It keeps track of drivers who register with the fleet. This service keeps track of the payments due by the lessee each month and records the payment history.	Car Ownership and Leasing Solutions

Security Management	Security to all the layers of application like firewall, anti-virus, encryption	1. Safety and security of the Application	Capability to handle any outside threats that endangers the functionality of the application	Security
Analytics	Data from all the services	Store and Analyze the data for performance, improvements	Provide Insights into vehicle and equipment usage, driver behavior, fleet productivity, areas where cost efficiency could be applied	Data Analytics
Communication – System - Mobile	Any Mobile or Communication device	Mobile Communication within fleet and passengers and drivers.	Communication in case of emergency, a driver can call a passenger to clarify about the location and vice versa	Mobile Communication

Reference:

1. Architectural Blueprints—“4 + 1” View Model of Software Architecture - Kruchten, Philippe. "