Solution Architecture for IR0411- VoWiFi

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TABLE OF CONTENTS

1 BACKGROUND 4

1.1 BUSINESS PURPOSE 4
1.2 DELIVERY APPROACH 4
1.3 SEQUENCING 4

2 SOLUTION ARCHITECTURE 5

2.1 LOGICAL ARCHITECTURE 5
2.2 SYSTEMS AND COMPONENTS 7
2.3 INTERFACES 13

3 ARCHITECTURALLY SIGNIFICANT USE-CASES 16

3.1 PROVISIONING VOWIFI CAPABLE ANDROID PRE-SEEDED DEVICES (NEEDS TO BE UPDATED) 17
3.1.1 NEW DEVICE ACTIVATION FOR VOLTE AND VOWIFI 19
3.2 FRAUDX 21
3.3 REPORTING FOR VOWIFI 21
3.4 INTEGRATION WITH WEDO 22
3.5 EPC AND BPT IMPACTS 23

4 DATA IMPACTS 24

5 DESIGN DIRECTION 24

5.1 OPERATIONAL IMPACTS 24

6 PARTITIONING REQUIREMENTS 25

7 PROJECT AND RELEASE DEPENDENCIES 25

8 ASSUMPTIONS 25

1 Background

1.1 *Business Purpose*

Voice over WiFi (VoWiFi) offers customers the ability to use their phone number and the native dialer of the phone for voice and SMS over WiFi. The benefit for the customer is high definition call quality and additional in building coverage.

1.2 *Delivery approach*

Agile delivery is adapted to implement and deliver business benefits through working software much earlier than traditional model. As the implementation involves external vendor, implementation partners and internal teams, development is split and spread across the following:

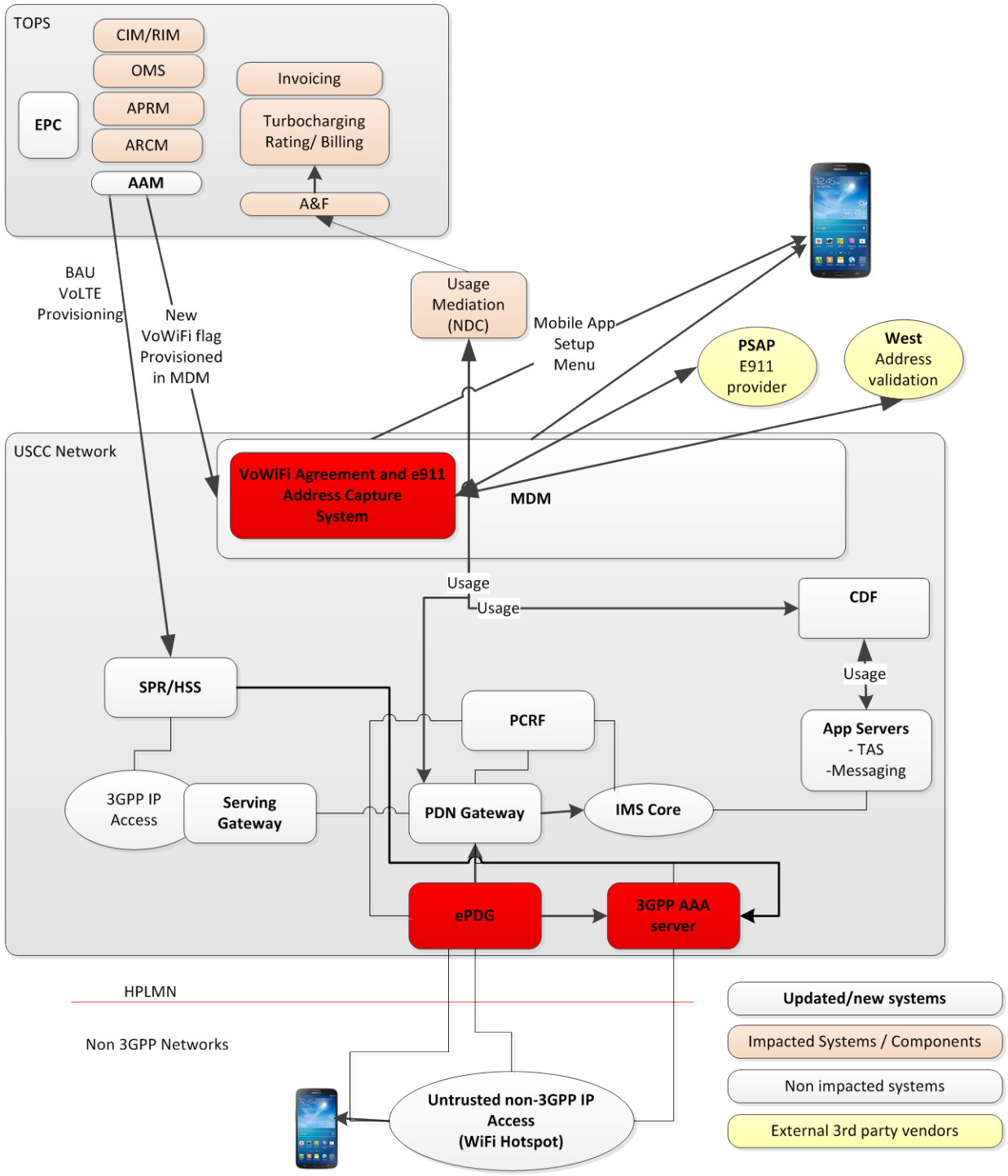
- Device Activation (USCC Engineering)
- Mediation
- AmDocs

1.3 *Sequencing*

With the current program vision, all the stories defined and agreed upon will be delivered in single increment. Program increments within the individual components are provided in detail below by respective applications.

2 Solution Architecture

2.1 Logical Architecture

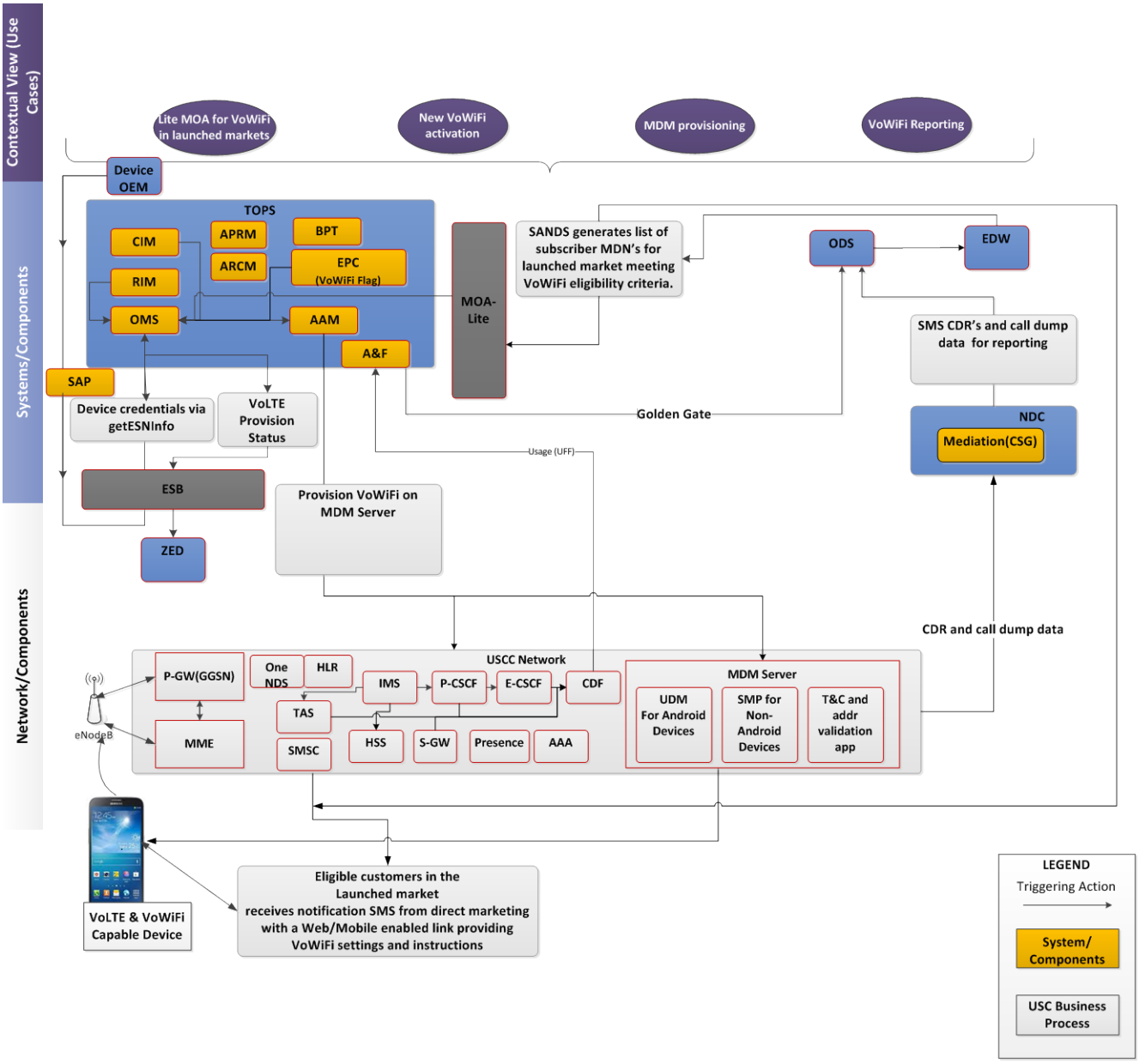


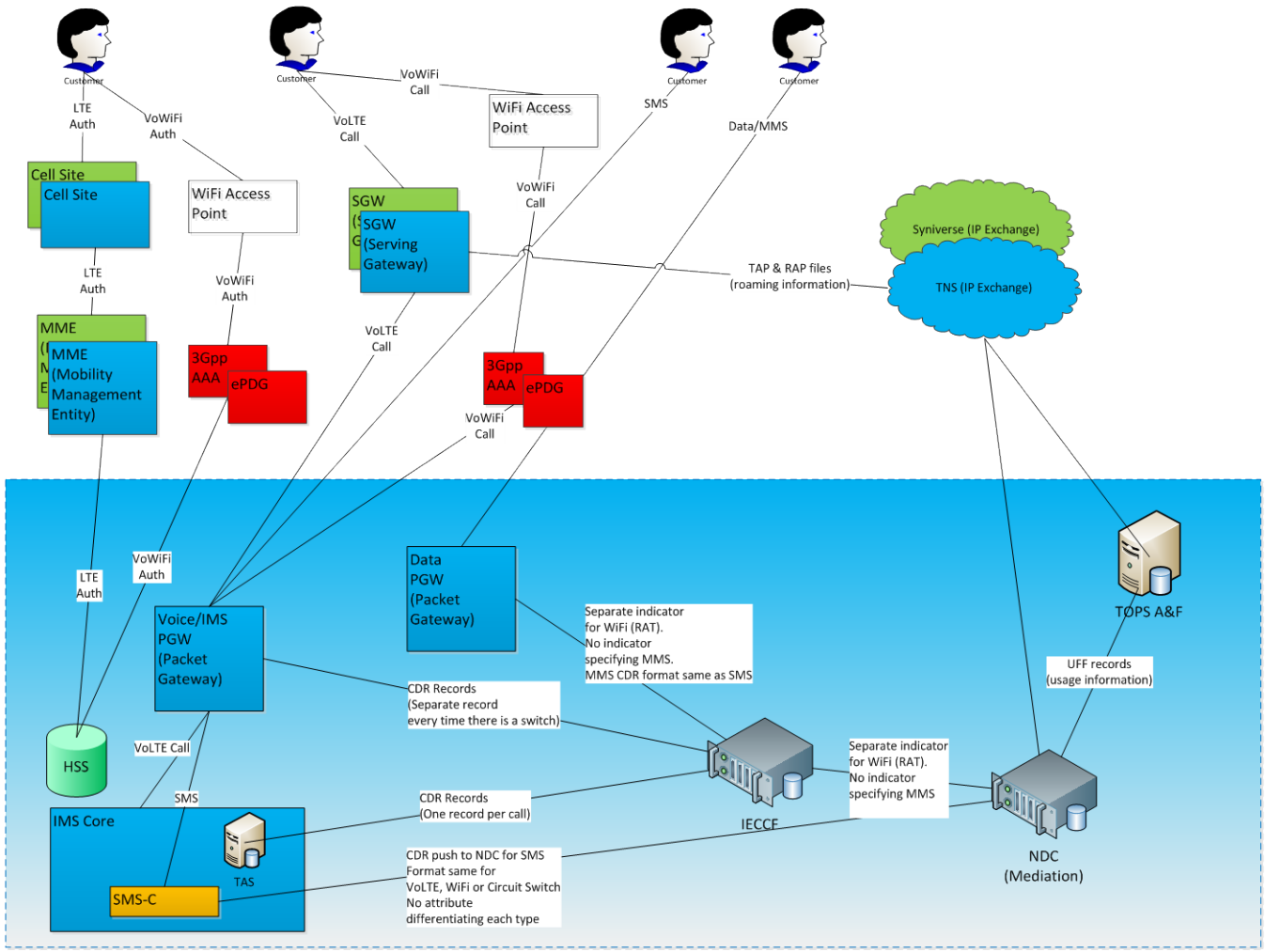
Steps below depict high level flow of activities for provisioning VoWiFi on VoLTE and VoWiFi capable Android and non-Android devices:

Step #	Description
	Device Provisioning
1	EPC will be enhanced by adding new flag to the devices for VoWiFi SPS attribute(s) to identify VoWiFi capability.
2	Provisioning in the network for VoLTE will also provision for VoWiFi. TOPS is only provisioning the VoWiFi flag to MDM.
3	Android devices shall have a custom MDM client to handle the VoWiFi flag
4	VoWiFi enabled flag will be provisioned by AAM using MDM (SMP for non-Android and UDM for Android).
	Device Activation
5	Customer activates the VoWiFi flag on the device
6	Custom T&C page hosted at MDM will be displayed for customer to accept. Acceptance of T&C will be captured by the hosted application. • Customer will update the address for PSAP (e911) provider. • Address is validated by the application • Captured address will be sent to PSAP provider by the application
7	Customer can disable and re-enable VoWiFi any time after. Above steps to be repeated in such a case.
8	Activation and Deactivation of VoWiFi can be performed from CIM by USCC associates

2.2 Systems and Components

This section lists the various systems and components that are impacted and introduced by the solution.





No	System/ Component	Description	Existing/ New	Responsibility / Impact
1	TOPS	TOPS - U.S. Cellular® Billing and Operations System (B/OSS), is responsible for defining products, subscriber lifecycle management, provisioning the network, rating, and Billing.	Existing	TOPS will be enhanced to incorporate logic for – VoWiFi enablement, VoWiFi event processing, and usage presentment. TOPS will provide required support in-line with the solution approach defined in this document. Amdocs is responsible for the related tasks.

No	System/ Component	Description	Existing/ New	Responsibility / Impact
2	AAM	Amdocs Activation Manager. Responsible for activating the devices	Existing	OMS will send a new attribute VoWiFi Enabled to AAM. AAM will provision VoWiFi enabled flag to MDM. An additional global flag for VoWiFi Prepaid will be set with a default value of False. AAM will use this flag to separate logic for prepaid and postpaid VoLTE. MDM/UDM and MDM/SMP are network elements that are impacted along with new formatting rules. Amdocs is responsible for the related tasks.
3	A&F	Acquisition and Formatting processes the offline UFF files and passes it to Turbo charging	Existing	UFF to hold 2 RAT indicators. For VoWiFi, only 1 of these will be used to hold the RAT on audio bearer PGW records in the call dump. Future USC projects are expected to have 2 RAT indicators and this will allow for the secondary RAT indicator to go into the call dump at that time. A&F ignores the indicators as they are call dump only. Amdocs is responsible for this application.
4	COGNOS / CXM	New Invoice Reports Needed to report the VoWiFi usage	Existing	Current Invoice Report will be modified to include VoWiFi usage.
5	EPC	The Amdocs Enterprise Product Catalog is a central repository for all U.S. Cellular® products and services.	Existing	EPC will be updated to identify VoWiFi. A new attribute for VoWiFi capability will be added to appropriate device SPS's and a new attribute will be added at the subscription level, "VoWiFi enabled flag". New dedicated service filters will be created for VoWiFi events.

No	System/ Component	Description	Existing/ New	Responsibility / Impact
				User defined validations to ensure that VoWiFi capable device is also VoLTE capable. USCC EPC team and Amdocs will be responsible for the corresponding tasks.
6	Mediation	Mediation is responsible for collecting and processing usage from various network elements and feed it into TOPS for retail and wholesale charging	Existing	Mediation will collect and process usage from CCF and PDN gateway. The voice, SMS CDRs will be retrofitted into the current UFF structure with additional values as needed. VoWiFi records in CDR will be identified with "LTE Handoff" field. Data bearer flow from PGW will be filtered by Mediation. UFF to hold 2 RAT indicators. For VoWiFi, only 1 of these will be used to hold the RAT on audio bearer PGW records in the call dump. Future USC projects are expected to have 2 RAT indicators and this will allow for the secondary RAT indicator to go into the call dump at that time. A&F ignores the indicators as they are call dump only. Within IMS CDRs, the P-ANI is used to populate the serving SID in the UFF (field 12), the originating (field 13) or terminating (field 14) cell trunk and to determine the local time zone of the subscriber originating or terminating the call. If the call is purely within WiFi and the actual location of the subscriber cannot be determined, the serving SID shall again be based

No	System/ Component	Description	Existing/ New	Responsibility / Impact
				upon the home SID, the originating and terminating cell trunk (fields 13 and 14) shall be left 0 and the time zone shall be assumed local to the EPC P/SGW instead of the actual subscriber. Increased volume of voice and SMS might be expected due to VoWiFi.
7	ODS	Operational Data Store enabling operational reporting and batch mode integration	Existing	Potential change in data model because of the new VoWiFi attributes.
8	EDW	Enterprise data warehouse	Existing	Total Number of Calls and Minutes of Use on Wi-Fi calls report responsibility of IM team New FDW source tables are not required
9	MDM	Mobile device management server will be introduced in USCC network for device management	Existing	MDM server will have capability to communicate with devices in USCC network to hide/show settings for VoWiFi. AAM will provision the new attribute for VoWiFi only to MDM/UDM and MDM/SMP network elements. Existing interface for MDM will be updated to provision this attribute. MDM team will also host the application to display T&C details to users and capture address details for e911 Engineering team is responsible for the related activities.
10	ESB	USCC Enterprise Service Bus Facilitates real time communication between impacted systems.	Existing	No impact for ESB.
11	Telephony	Interactive Voice	Existing	IVR modifications are out of

No	System/ Component	Description	Existing/ New	Responsibility / Impact
		Recording(IVR), OTA and Routings systems to support customer service		scope for this project. Note that there will be discrepancy in the details provided by channels such as MyAccount, bill to the user when compared to IVR as IVR is not aware of VoWiFi details.
12	FraudX	Fraud detection and alert system provided by Syniverse	Existing	No additional interfaces required. Binary file from Engineering will have additional values for VoWiFi. USCC Mediation is responsible to provide the feeds to FraudX. Syniverse will consume the feeds and process it in FraudX, including the additional VoWiFi data.
12	Call Dump	Call Dump is used to store usage data for subpoena purposes	Existing	The modified UFF files and data UFF files will be sent to Call dump. This data can be used in future to generate reports about call usage. USCC Mediation team is responsible for this unit of work.
18	NPGW (ALU SAM)	Provisioning gateway to support provisioning of VoLTE network elements.	Existing	TAS and ENUM network elements will be provisioned/de-provisioned using NPGW as per specifications provided by engineering. No impact for VoWiFi Engineering is responsible for NPGW.
19	SAP	Enterprise system for inventory management and financials	Existing.	Changes to identify VoWiFi devices. Change the characteristic on the article and potential programming changes as well.

No	System/ Component	Description	Existing/ New	Responsibility / Impact
				TDS is responsible for this module
20	APRM	Amdocs Partner Management	Existing	• No additional interfaces for APRM required. • APRM will treat the VoWiFi records from mediation and Turbocharging as VoLTE records
21	ARCM		Existing	• No impact to ARCM other than the additional VoWiFi attribute value

2.3 Interfaces

This section lists the various interfaces that are impacted and introduced by the solution. These interfaces are the ones that cross the USCC boundary and include all relevant interfaces impacted by the solution.

No	Source	Destination	Description	Existing/New	Responsibility / Impact
1	MOA-lite	OMS	Tool introduced in R9 for processing bulk requests feeding to OMS cluster for VoLTE mass provisioning/de-provisioning	Existing	SANDS to provide MDN list meeting certain qualifying criteria to MOA-lite for mass provision of VoWiFi for eligible devices This tool can also be used to disable VoWiFi capability if required.
2	AAM	MDM	Provisioning interface for MDM, Video and Presence provisioning	Existing	AAM will trigger provisioning of android devices on UDM and non-android on SMP component of MDM server as long as the device is VoLTE capable and VoWiFi capable and the VoWiFi enabled flag is set to

No	Source	Destination	Description	Existing/New	Responsibility / Impact
					Yes.
4	MDM (Mobile App Server)	Device	New Mobile App hosted at MDM	New	Display T&C after turning on the VoWiFi flag. Capture the acceptance by subscriber.
5	MDM (Mobile App Server)	PSAP provider	PSAP provider for e911 services	New	Provide the following details from MDM: • User acceptance of T&C along with version number and date time stamp • Address captured for 911 service along with date time stamp
6	Device	MDM → West	Perform address validation	New	Subscriber enters address which will be validated by interface with West
7	Mediation	Call Dump	Usage (voice and data) feed to call dump for subpoena.	Existing	UFF files with IMS usage and PGW usage including voice, signaling and video bearer information need to be sent to Call dump. All UFF records go to Call Dump, including unbilled records USCC Mediation team is responsible for this
8	Mediation	FraudX	Voice and data usage feed for fraud identification	Existing	No changes to the interface. Include the VoWiFi related records as part of the data.
9	Mediation	Rural Carrier Compliance	Voice and data usage feed	Existing	• No change to the binary data dump from Mediation for

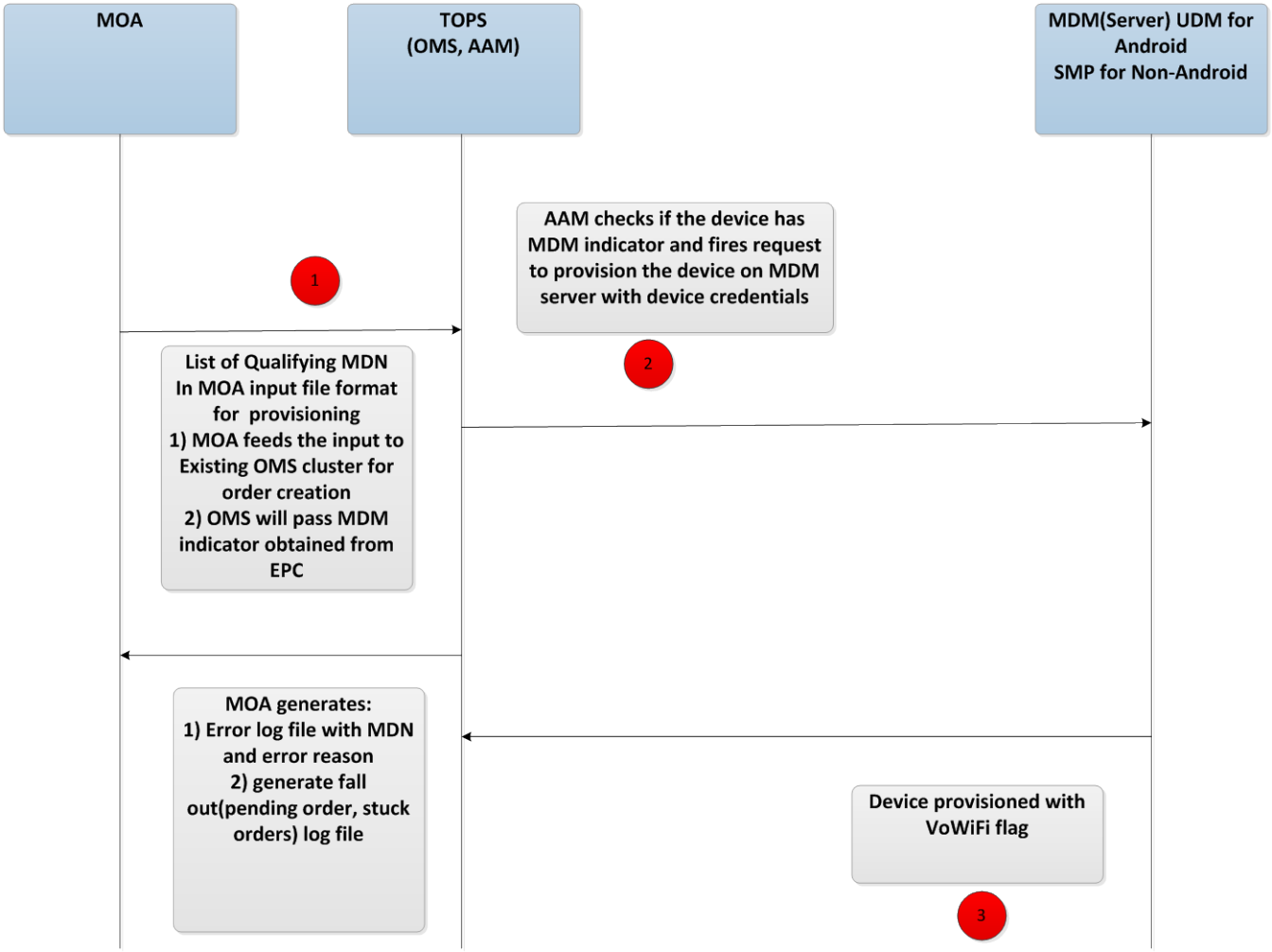
No	Source	Destination	Description	Existing/New	Responsibility / Impact
					Rural Carrier Compliance
10	Mediation	WeDo	All records in source format from network appliances	Existing	• No change in the CDR feed from Turbocharging as it allows for filters for event types of Voice, Data 2G and 3G, LTE and VoLTE records. VoWiFi records are filtered from Turbocharging • No change in the feed from Call Dump to WeDo by Billing and Revenue team as they are not performing special changes for VoLTE records unless they contain a specific MDN or MSID.
11	PDN Gateway	Mediation	Data CDR's are sent to Mediation for formatting and rating	Existing	Send data CDR with zero rating. No change to the interface
12	CDF	Mediation	ASN.1 interface for usage collection	Existing	Mediation retrieves the information from CDF for processing in the form of CDRs. There is no CDR correlation for calls switching between

No	Source	Destination	Description	Existing/New	Responsibility / Impact
					VoLTE and WiFi. USCC Mediation is responsible for this interface.
13	Mediation	A&F	Usage feed into TOPS for rating/charging	Existing	Voice and SMS usage will be populated in the current UFF format with additional values as needed in the existing attributes. Data bearer flow with data portion of the call from PGW will be filtered by Mediation. Note: Exact values and positions of UFF records will be defined by Amdocs in the design.  VoLTE UFF (Unified File Format).xlsx USCC Mediation is responsible for populating the values. Amdocs is responsible for consuming the files and processing it.

3 Architecturally significant Use-Cases

This section identifies and defines the architecturally significant use cases and interfaces that will ensure a valid solution approach for this project

3.1 Provisioning VoWiFi capable Android pre-seeded devices



High level solution flow describing the sequence of activities to provision pre-seeded devices:

1) SANDS will generate a list MDN's meeting following qualifying criteria:
    a. Subscriber line is 'active' or 'Suspended'
    b. Subscriber has a postpaid plan – based on offer type
    ~~c. MDN that is within a VoLTE launched market.~~
    d. VoLTE Enabled flag 'Y'
    ~~e. VoLTE enabled NPA-Nxx~~
    f. Subscriber has a VoLTE & VoWiFi capable device.

2) List of MDN's from step#1 will need to fed as input to the MOA-lite tool with following format: MDN, Feature (Example: VoWiFi), Value (action to take: Y/N), reason code (reason code will drive the creation of Memo in CRM).
3) Location and directory where the input file needs to be placed by SANDS will be provided during design phase.
4) The input file format will be .xls
5) Process provision/de-provisioning request via Lite-MOA will need to adhere to following guidelines established between USCC operations/production support and Amdocs operations:

    a. Execution window will be from 10PM-12AM (2 hours)
    b. The number of orders handled by MOA will not exceed 10,000 orders per hour
    c. In case there are additional production activities which require MOA execution, USCC production operations team will setup the priority for the tasks execution. In case there are more urgent activities which should be executed in the same time window, execution of mass provisioning tool will be delayed to the next available window.
    d. Execution of Mass Provisioning Tool is not recommended during holiday blitzes, campaigns, etc. (events with expected volume spikes and high load on the system)

6) Number of orders per hour specified in above is a cumulative number including all types of orders from production (existing MOA). Number of MDNs targeted for a particular MOA run for VoLTE will be determined by USCC operations. Example: If the VoWiFi Lite MOA input file contains 20K MDN's, USCC operations may decide to run only 5K as part of Lite MOA run which would identified based on volume of other production orders planned as part of the existing MOA run.
7) Lite- MOA is anticipated to run 1 to 3 times a week depending upon the CAB approval. Actual frequency and other relevant details will be identified during design phase.
8) Targeted list of MDNs to be provisioned per day will need to be approved by CAB prior MOA run. Business partners will be responsible for obtaining the approval prior to each MOA run.
9) Log/report for failed provisioning requests and fall out (MDN's with pending orders and/or stuck orders. Check implemented in MOA-Lite tool) log details will be provided

by USCC production support/Amdocs operations to business partners after each MOA run. The exception log will contain a) MDN and provisioning failures with reasons 2) MDN with pending orders in OMS. MDNs for provisioning failures after appropriate/necessary treatment will be included in the subsequent MOA runs or processed manually. Fall out MDN's will be included in the subsequent Lite- MOA runs. Detailed process will need to be defined in design phase.

10) TOPS will create memo only for the successfully processed provisioning request via Lite-MOA.
11) Detailed process for creating input file, input file directory/location, transmitting file to USCC operations, ticket management etc. will be hashed out in detailed design phase.
12) Business (direct marketing) will initiate SMS notification via existing process with no involvement from IS. (I.e. the BAU process used for campaign notifications.)
13) RIM, RIM for Agents and CIM will display VoWiFi enabled flag – 'Y' only for subscribers for a 'launched market' provisioned for VoLTE on IMS core.
14) CIM will display VoWiFi Capable flag, which is maintained as a SPS in EPC. This flag is not editable by associates.
15) MDM will pass the VoWiFi flag to the subscriber device and provision OMA DM client on the device to enable VoWiFi calling menu.
16) Subscribers can enable VoWiFi on the device
    1. Mobile page server hosted by MDM will display the T&C page
    2. T&C are accepted by the subscriber
    3. Upon acceptance, subscriber will enter the address for the e-911 provider
    4. Address will be validated by MDM with external provider West
    5. MDM will integrate with PSAP provider to send the address details
    6. Subscriber can disable and re-enable VoWiFi feature at the device and can update the e-911 address

3.1.1 New device activation for VoLTE and VoWiFi

High level solution design and transaction flow for new device activation in TOPS:
OMS performs qualifying checks for VoLTE & VoWiFi eligibility (eligible customer, in appropriate region, VoLTE and VoWiFi capable device)

1. If the device is setup as VoLTE and VoWiFi capable device in EPC, OMS to perform qualifying checks for VoLTE eligibility i.e. subscriber active/suspended, subscriber has postpaid plan, VoLTE enabled flag 'N', subscribers primary use of address based on zip code belongs to a "Launched Market". If the above

mentioned qualifying checks are successfully met, OMS creates the order for AAM to provision the device on MDM. CIM will display VoWiFi Capable flag, which is not editable by associates.

2. CIM will display VoLTE enabled flag – 'Y' along with VoWiFi enabled flag – 'Y'
3. MDM will pass the VoWiFi flag to the subscriber device and provision OMA DM client on the device to enable VoWiFi calling menu.
4. Subscribers can enable VoWiFi on the device
    a. Mobile page server hosted by MDM will display the T&C page
    b. T&C are accepted by the subscriber
    c. Upon acceptance, subscriber will enter the address for the e-911 provider
    d. Address will be validated by MDM with external provider West
    e. MDM will integrate with PSAP provider to send the address details
    f. Subscriber can disable and re-enable VoWiFi feature at the device and can update the e-911 address

3.2 FraudX

. Voice and data records sent for fraud identification.

1. All CDRs from IMS core and packet core (signaling including text messaging, voice and video) with VoWiFi information
2. Service filters for each chargeable usage type in TOPS for FraudX detection/prevention will be applied by Syniverse/USCC business partners.
3. Specific details of identifying particular usage type (if required) will be provided in design phase.

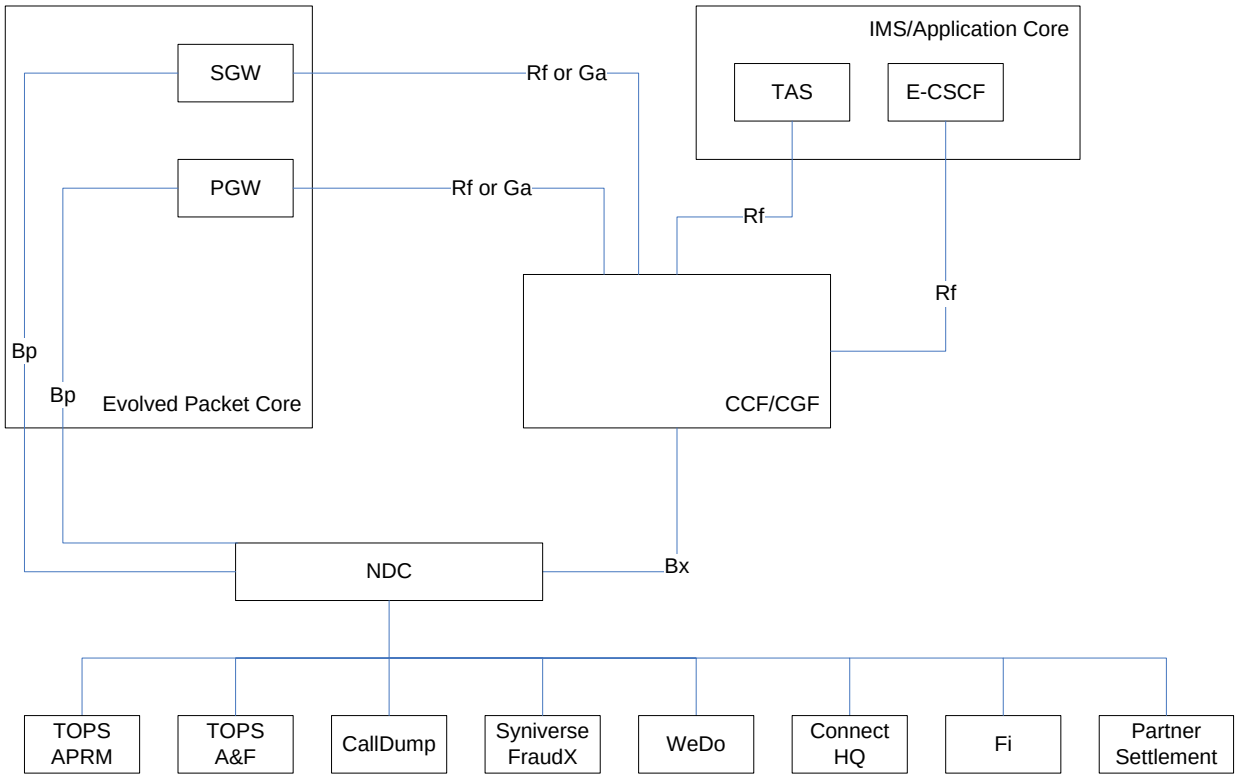
3.3 Reporting for VoWiFi

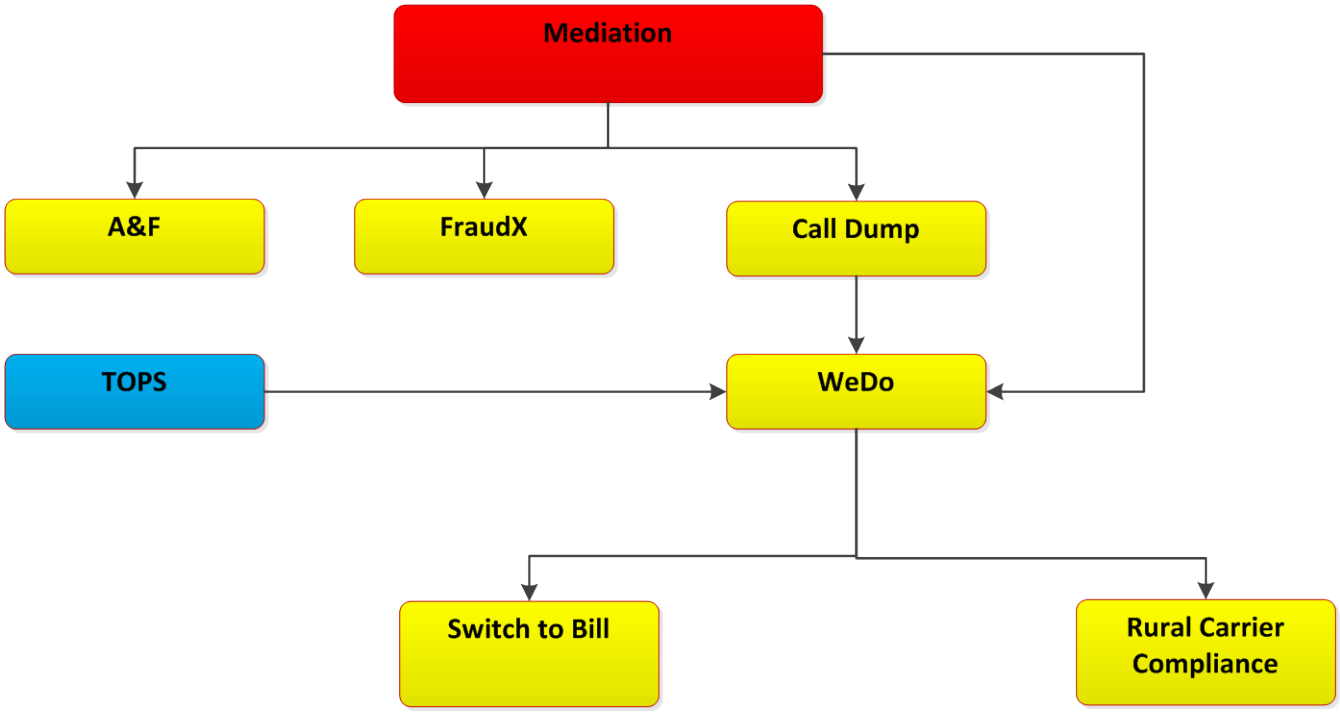
Table below outlines high level solution for all the reports pertaining to VoLTE commercialization reports:

Report/Metric Name or Purpose	**Primary Data Source for Reporting**	**High Level Solution**
Total Number of Calls and Minutes of Use on Wi-Fi calls (VOWF_3.19.1)	ODS->EDW	➢ Bytes of use is out of scope for FDW due to a lack of source data within USCC (Metric VOWF_3.19.3) ➢ New FDW source tables are not required ➢ The following FDW tables will be modified: o Order Subscriber Detail o Master Subscriber o Equipment NFS o Dim Equipment

		o Dim Subscriber
Dropped Calls (Metric VOWF_3.19.2) **Count & Percentage of Active and Inactive Users (Metric VOWF_3.19.3)** **Wi-Fi Provider (Metric VOWF_3.19.4)**	Engineering	➢ Engineering NSAA team is responsible for generating these reports with support from ODS team ➢ Recommended to use MFT for delivery of reports

3.4 Integration with WeDo





- Mediation, TurboCharging and Call Dump will provide records to WeDo
- The feeds will need to filter VoLTE and VoWiFi usage records.
- Testing will need to be done to ensure VoWiFi feature will not impact Rural Carrier Compliance reports and unnecessary alarms are avoided due to VoWiFi records

3.5 EPC and BPT Impacts

- New attribute for VoWiFi capability will be added to the relevant SPSs and to relevant device components.
    - All VoWiFi Capable devices must be VoLTE Capable. However not all VoLTE Capable devices are VoWiFi capable.
- New dynamic property will be added on SPS level to mark relevant SPSs as capable for Voice over WiFi (VoWiFi).
    - Rules will be created to copy value from SPS dynamic property to the device component attribute for existing assigned devices in case the value on assigned device is different from the value on the SPS dynamic property.
- New attribute (i.e. VoWiFi Enabled) will be added to the main component and will be set by compatibility rule on new activations based on device VoWiFi Capable definitions / VoLTE enabled definition and MDN eligibility for VoLTE.
    - This attribute will provide the VoWiFi capability thru MOA process and manually by associate.

    - VoWiFi Enabled attribute will be set to No in case of non-VoLTE enabled subscriber.
- New dedicated Service Filters will be created for the VoWiFi events – for Voice and SMS (will be under USCC BPT responsibility)
    - New prices (for Voice and SMS) with $0 rate will be created and will be qualified for the new Service Filters
    - These new prices will be added to the market level billing offer
    - Service filter groups for toll charges will be updated to include new VoWiFi related service filters
- User defined validations will be defined in EPC to ensure that:
    - the value on SPS attributes is in-sync with the value on SPS dynamic property
    - VoWiFi capable device is also VoLTE Capable

4 Data Impacts

Data impacts have been covered in appropriate use cases.

5 Design Direction

- In order to reduce architectural complexity, CDR Correlation is no longer part of the project
- MDM will host the T&C display and address capture mobile site.

5.1 *Operational Impacts*

1. Identification of an operational process including marketing blitz in order to notify subscribers about this feature. For example, inform the subscriber about this feature once the flag is deployed to the phone using SMS.
2. There is a dependency of ~10k for the MOA tool to run nightly. The MOA tool is only able to be run during the nightly outage window.
3. Market rollout activities such as updating uscc.com with VoWiFi related details, training associates with the features, etc.

4. Update to Remedy, Switch Query and other tools in order to provide support. Training of associates to provide support.

6 Partitioning Requirements

The RD published for this project has responsibility assigned to each requirement. Please refer to the RD for requirements partitioning.

7 Project and Release Dependencies

Project /Release	System / Component	Description

8 Assumptions

ID	Assumption
1	There is no impact to the functionality of WeDo and Intra Company roaming
2	Device software update and OEM dependency is handled by the device management team
3	Sizing conversion and estimates for CDRs is based on a single day analysis of delivered data from Revenue Assurance.
4	
5	
6.	