

Solution Description Wi-Fi Calling

Ericsson Dynamic Activation 1

TECHNICAL SOLUTION DESCRIPTION

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1 Introduction

Ericsson Wi-Fi Calling for multi-device provides a simple and cost efficient way to extend operator coverages to multiple Wi-Fi capable devices of the user. With this new capability, Wi-Fi Calling is offered for devices without a SIM-card device, which is called Non-SIM device, over Wi-Fi network.

1.1 Purpose and Scope

The purpose of this document is to describe Wi-Fi Calling for multi-device (Non-SIM) provisioning supported by Ericsson™ Dynamic Activation (EDA) from a solution perspective.

1.2 Target Group

The target groups for this document are as follows:

- System administrator
- Network administrator
- System integrator

For more information about different target groups, refer to *Library Overview*, Reference [1].

1.3 Typographic Conventions

Typographic conventions are described in the document *Library Overview*, Reference [1].

For information about abbreviations and terms used throughout this document, refer to *Glossary of Terms and Acronyms*, Reference [2].



2 Solution Overview

Wi-Fi Calling for multi-device (Non-SIM) solution provides a new opportunity for operators to facilitate the use of broad-band mobile network resources, without using a SIM card. Dynamic Activation, as an activation node, can provide the provisioning capability for the Non-SIM device user subscription and service activation.

2.1 General Concepts

Non-SIM device users need to be connected to an existing SIM subscription, which in turn needs to be pre-configured in the operator network.

Since the solution is based on IMS (IP Multimedia Subsystem), the Non-SIM device user subscription concerns the new dedicated IMPIs (Private User) in HSS, associated to the existing IMS subscriber in HSS. The Non-SIM device simply reuses the existing IMS subscriber service, for example, Voice, messaging.

HSS data model for Non-SIM device

There are two HSS data models supported in this solution:

- Shared IMS Private Identity (IMPI) data model

One HSS subscriber uses one single shared IMPI for all Non-SIM devices.

- Individual IMPI data model

One HSS subscriber uses individual IMPIs for each of the Non-SIM devices.

Besides Non-SIM IMPIs in HSS, the device profile and access information must be stored in IPWorks (AAA NSD user). Also, the device certificate management is needed for Non-SIM device activation in the network.

2.2 Architecture

Wi-Calling for multi-device (Non-SIM) solution consists of the following Ericsson nodes:

- Service Entitlement (SES)

SES is the node in the Non-SIM device solution system that is exposed for all entitlement, authentication, and provisioning requests from the SIM or associated Non-SIM devices in the Northbound Interface.



SES is the node in this solution system that is used for generating and managing the key parameters for Non-SIM devices. It also interacts with other nodes to accomplish the Non-SIM device user and service profile provisioning and SIP registration process. SES initiates the provisioning request towards Dynamic Activation.

- EDA

EDA is the activation node that is responsible for user and service profile provisioning towards IPWorks (AAA NSD user), HSS (IMPI user profile), and ECAS (Certificate Authority).

- HSS (Monolithic, 5.0 or later)

Home Subscriber Server (HSS) is the master user database for IMS, which contains the fundamental subscription information of the user. In the Non-SIM solution, HSS must contain both the user SIM and Non-SIM device subscription-related information.

Dynamic Activation supports Non-SIM device subscription through the CAI3G interface.

- IPWorks

There are two deployment scenarios for IPWorks:

- Monolithic 14B FD1 or later, see Figure 1
- Layered IPWorks on UDC 1, see Figure 2

IPWorks Authentication Authorization Accounting (AAA) server is responsible for authenticating the Non-SIM devices. Dynamic Activation is able to support AAA NSD user subscription through the CAI3G interface.

- ECAS (Monolithic)

The Non-SIM Device Solution uses Extensible Authentication Protocol – Transport Layer Security (EAP-TLS) authentication for mutual authentication between the Non-SIM devices and the operator network, thus enabling a trusted relationship. ECAS functions as a certificate authority server. It can issue and maintain the life cycle of digital certificates. Dynamic Activation supports Non-SIM devices certificate subscription through the CAI3G interface.

The Wi-Fi Calling for multi-device (Non-SIM) provisioning solution is illustrated in the following figure:

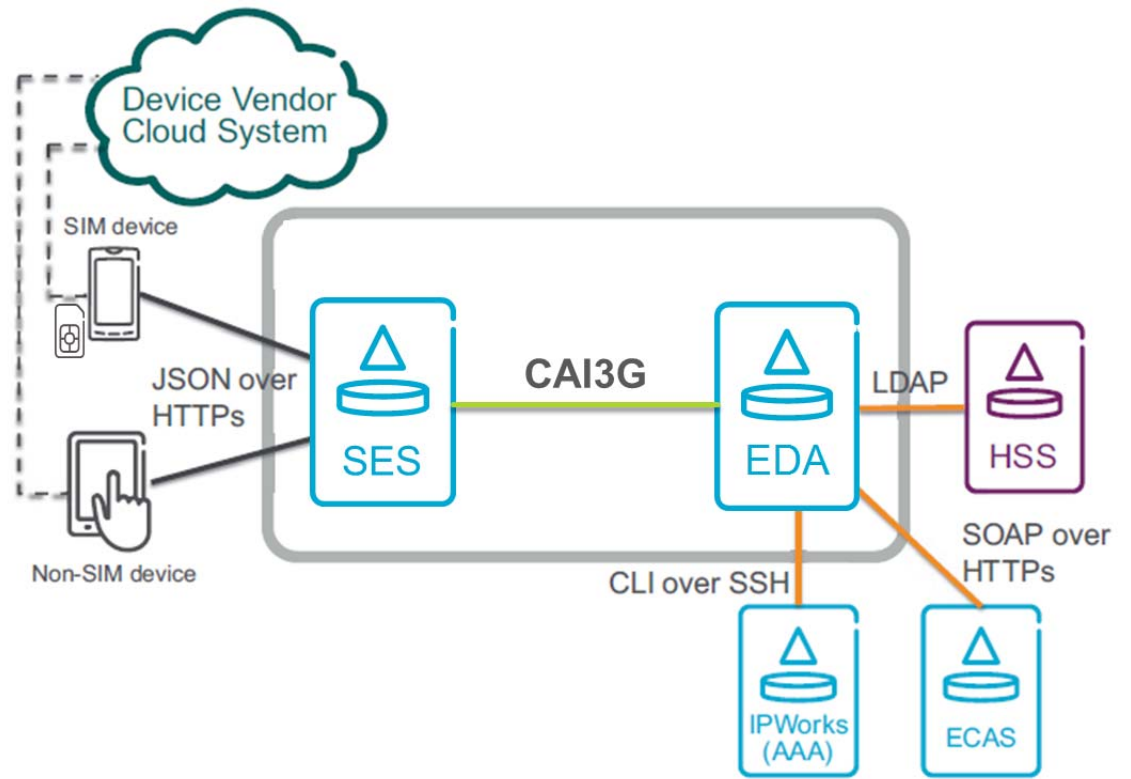


Figure 1 Monolithic Provisioning Architecture

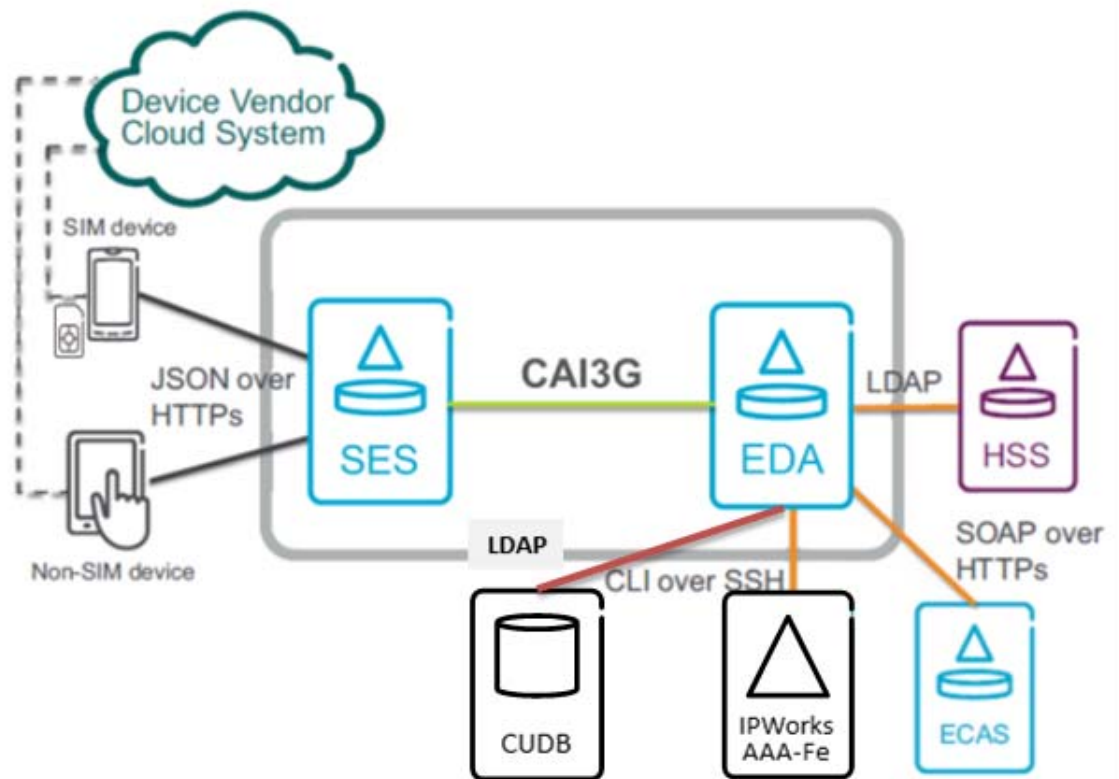


Figure 2 Hybrid Provisioning Architecture

In the above figure, layered IPWorks AAA includes CUDB and AAA-FE, monolithic HSS, and ECAS.

SES initiates CAI3G requests toward Dynamic Activation to accomplish all Non-SIM device provisioning use cases. Dynamic Activation and NEs communication interfaces are as follows:

- Monolithic IPWorks AAA (NSD)
 - CLI over SSH for user subscription and session notification
- IPWorks AAA-FE (NSD) and CUDB
 - LDAP for user subscription towards CUDB, CLI over SSH for session notification towards AAA-FE
- Monolithic HSS
 - LDAP for private user subscription
- ECAS
 - HTTPs for certification subscription



2.3 Provisioning Use Cases

Dynamic Activation provides CAI3G interface towards upstream node for the following use cases:

- Non-SIM device on-boarding
 - Initiate the Non-SIM device IMPI profile in HSS for Shared IMPI data model
- Non-SIM device activation
 - Initiate the Non-SIM device user profile in IPWorks AAA
 - Initiate the Non-SIM device IMPI profile in HSS for Individual IMPI data model
 - Generate the certificate for Non-SIM regarding to the Certificate Signing Request (CSR) of the device in ECAS
- Non-SIM device deactivation
 - Delete the Non-SIM device user profile in IPWorks AAA
 - Delete the Non-SIM device IMPI profile from HSS for Individual IMPI data model
 - Revoke the certificate of the device from ECAS
- Non-SIM device enable/disable/reset
 - Enable/disable/reset the Non-SIM device in the traffic. It does not affect the device subscription data
- Non-SIM device certificate management
 - Non-SIM device CSR enrollment, device certificate renewal
- Non-SIM device user password management
 - Non-SIM device user password updating



3 Dynamic Activation Provisioning Solution

This section describes the Non-SIM provisioning interfaces and provisioning functions.

For detailed information about interfaces, configuration, and more, refer to *Wi-Fi Calling Provisioning over CAI3G*, Reference [3].

3.1 Interface

This section includes information about the northbound provisioning interfaces used in the solution.

- VoWifiService

This interface is for SES to implement an integrated operation for all provisioning use cases in terms of individual IMPI data model. It initiates, modifies, or terminates Wi-Fi Calling Voice service by orchestrating IPWorks, HSS, and ECAS subscription procedures.

Note: Monolithic HSS and monolithic IPWorks AAA are applicable for this interface.

- NonSIMHSSUser

This interface is for SES to implement individual HSS IMPI Non-SIM device on-boarding use case in terms of shared IMPI data model. It initiates or terminates the device IMPI profile in the HSS through the CAI3G *Set* operation.

- AAANSUser

This interface is for SES to implement individual IPWorks AAA NSD user subscription for general device management purpose. It initiates, modifies, or terminates the Non-SIM device subscription data in IPWorks AAA through the CAI3G *Create*, *Set*, and *Delete* operations.

- ECASCertificate

This interface is for SES to implement individual ECAS certificate subscription for general device management purpose. It initiates, modifies, or terminates the Non-SIM device certificate data in ECAS through the CAI3G *Create*, *Set*, and *Delete* operations.

- ISMSubscription



This interface is for monolithic HSS ISM management purpose. It offers the CAI3G Set operation to initiate or terminate the IMPI profile in monolithic HSS.

3.1.1 Northbound Interfaces

Dynamic Activation has two Northbound Interfaces for Non-SIM provisioning:

- NonSIMHSSUser

This interface implements the Non-SIM device on-boarding use case. It initiates the device IMPI profile in the HSS through the CAI3G operation Set.

- VoWifiService

This interface implements all other Non-SIM use cases by the CAI3G Create, Set, and Delete operations.

Table 1 Non-SIM Provisioning Interface and Use Cases

Northbound Interface (MO)	Operation	Non-SIM Provisioning Use Case
NonSIMHSSUser	Create	Non-SIM device on-boarding
	Set	Non-SIM device user password management
	Delete	Non-SIM device deactivation
VoWifiService	Create	Non-SIM device activation
	Set	Non-SIM device enable/disable/reset
		Non-SIM device certificate management
		Non-SIM device user password management
	Delete	Non-SIM device deactivation

3.2 Provisioning Functions

This section contains information about Dynamic Activation provisioning functions.

3.2.1 VoWifiService Provisioning

The VoWifiService provisioning involves three NEs, IPWorks (AAA NSD user), HSS (IMPI), and ECAS. The provisioning sequence for all three operations, Create, Set, and Delete subscriptions, are shown as follows:



Table 2 Provisioning Sequence

Create VoWifi	HSS, IMPI data
	ECAS
	Monolithic IPWorks, AAA Non-SIM (NSD) User
Set VoWifi	Monolithic IPWorks, AAA Non-SIM (NSD) User
	HSS, IMPI data
	ECAS
	Monolithic IPWorks, AAA Non-SIM (NSD) User if certificate handling is involved
Delete VoWifi	Monolithic IPWorks, AAA Non-SIM (NSD) User
	HSS, IMPI data
	ECAS

3.2.1.1

Create VoWifiService

Dynamic Activation provides transaction rollback for the `CreateVoWifiService` operation among the subscriptions of the Network Element (NE). If a failure occurs in the midst of an NE subscription, the provisioning is ended and the transaction rollback is triggered. A cleanup of the previous successful subscription(s) is conducted. As a result, the transaction rollback information and original NE error messages are returned.

If the transaction rollback fails, data inconsistency occurs. In this occasion, it is necessary to manually clear the error, according to the Dynamic Activation processing log records. When the error has been taken care of, the request needs to be resent through Dynamic Activation.

3.2.1.2

Set VoWifiService

Dynamic Activation provides transaction rollback for revoking certificate and renewing cases in the `SetVoWifiService` operation. If the last sequence step of IPWorks AAA NSD user updating failed, Dynamic Activation triggers the cleanup of the previous successful subscriptions to roll back the certificate from ECAS. At last, the transaction rollback information and original NE error messages are returned.

In other cases, there is no extra transaction handling for the `SetVoWifiService` operation.

If any error occurs, the provisioning is ended and the error messages are returned. In this occasion, it is necessary to manually clear the error, according to the Dynamic Activation processing log records. When the error has been taken care of, the request needs to be resent through Dynamic Activation.



3.2.1.3 Delete VoWifiService

The `DeleteVoWifiService` operation does not offer any transaction rollback. Instead it offers the error tolerance `Subscription Data Doesn't Exist`. When this error is returned from the NE, Dynamic Activation ignores it and continues the provisioning to the next NEs.

If other errors occur, the provisioning is ended and the error messages are returned. In this occasion, it is necessary to manually clear the error, according to the Dynamic Activation processing log records. When the error has been taken care of, the request needs to be resent through Dynamic Activation.

3.2.2 NonSIMHSSUser Provisioning

The `NonSIMHSSUser` interface is for Non-SIM shared IMPI subscription. It concerns HSS provisioning.

AO is able to perform `Create`, `Set`, and `Delete` operations over `NonSIMHSSUser` interface. See Table 1 for Non-SIM provisioning interfaces and use cases.

For the `Create` and `Set` operations, if provisioning fails, the error message is returned. In this occasion, it is necessary to manual clear the error, according to the Dynamic Activation processing log records. When the error has been taken care of, the request needs to be resent through Dynamic Activation.

For the `Delete` operation, the error tolerance `No Such Object` is supported. Otherwise, if provisioning fails, the error message is returned. In this occasion, it is necessary to manual clear the error, according to the Dynamic Activation processing log records. When the error has been taken care of, the request needs to be resent through Dynamic Activation.

3.2.3 AAANSUser, ECASCertificate, and ISMSubscription Provisioning

The interfaces `AAANSUser`, `ECASCertificate`, and `ISMSubscription` are used for individual NE provisioning of IPWorks AAA, ECAS, and HSS. For more information, refer to *Wi-Fi Calling Provisioning over CAI3G*, Reference [3].

- **AAANSUser**

This interface is used for IPWorks `AAADNSUser` provisioning. The CAI3G `Create`, `Set`, `Delete`, and `Get` operations are offered to create, change, delete, or retrieve `AAANSUser` subscription data towards IPWorks AAA.

The `AAANSUser Delete` operation and the user Non-SIM device disable/reset use case in the `Set` operation can trigger user session termination notification towards AAA.

- **ECASCertificate**



This interface is used for ECAS provisioning. The CAI3G `Create`, `Set`, `Delete`, and `Get` operations are offered to create, change, delete, or retrieve ECAS user subscription data towards ECAS.

Users can configure ECAS delete behavior by applying user identity or user certification identity on ECAS activation logic configuration. For details, refer to *User Guide for Resource Activation*, Reference [5]. If user identity is used for ECAS `Delete` operation, all certification records of the user are removed.

- **ISMSubscription**

This interface is used for HSS IMS IMPI data provisioning. CAI3G `Create`, `Set`, `Delete`, and `Get` operations are offered to create, change, delete, or retrieve IMS IMPI subscription data towards HSS.

4 Monolithic IPWorks Geographic Redundancy Provisioning

Geographic Redundancy is a mandatory requirement in the Non-SIM solution. In the following two scenarios, Dynamic Activation provides different solutions:

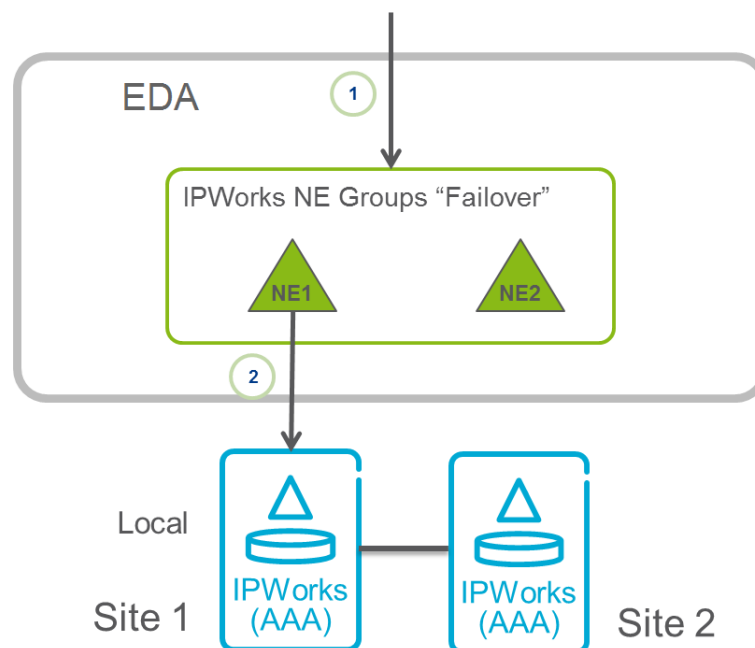
- **Network Element Group Failover**

When IPWorks is applied with the Geographic Redundancy solution, the AAA user subscription data can be synchronized within two IPWorks geographic sites. Dynamic Activation needs to select an available IPWorks site for data provisioning. Once a site is not available, the provisioning traffic must be switched over to the other one.

Dynamic Activation can monitor the IPWorks connection status through Network Element “heartbeat” function. When an IPWorks AAA NE is configured in Dynamic Activation, the NE status is monitored and displayed on the GUI.

Through the Dynamic Activation NE group **Failover**, the IPWorks Geographic Redundancy provisioning can be achieved. The following pictures illustrate the NE group **Failover** for IPWorks geographic provisioning:

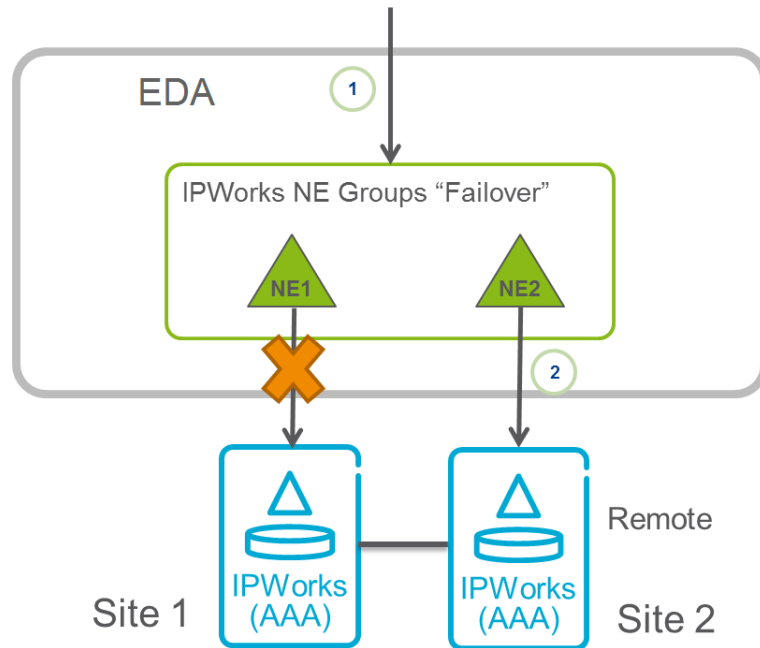
- When site 1 (the local site) is available, the provisioning workflow is as follows:





- When site 1 (the local site) is down, the provisioning workflow is as follows:

Note: Once site 1 is recovered and available again, the provisioning traffic goes back to initial status as shown in previous picture.



- **Network Element Group AAACluster Working as Double Provisioning**

When IPWorks is not applied with the Geographic Redundancy solution, the AAA user subscription data is not synchronized between two geographic sites by IPWorks. Instead, Dynamic Activation performs double provisioning across both sites through NE group `AAACluster` to secure the identical subscription data within two sites.

Dynamic Activation implements the double provisioning logics to handle IPWorks geographic redundancy subscription, especially for different provisioning failure scenarios.

In double provisioning, two IPWorks NEs need to be configured in a group. Dynamic Activation provisions the NEs sequentially, the first NE is always the master one.

The following picture shows the IPWorks double provisioning architecture. One incoming request is split into two sequential operations, first to Site 1 (Master) and then to Site 2.

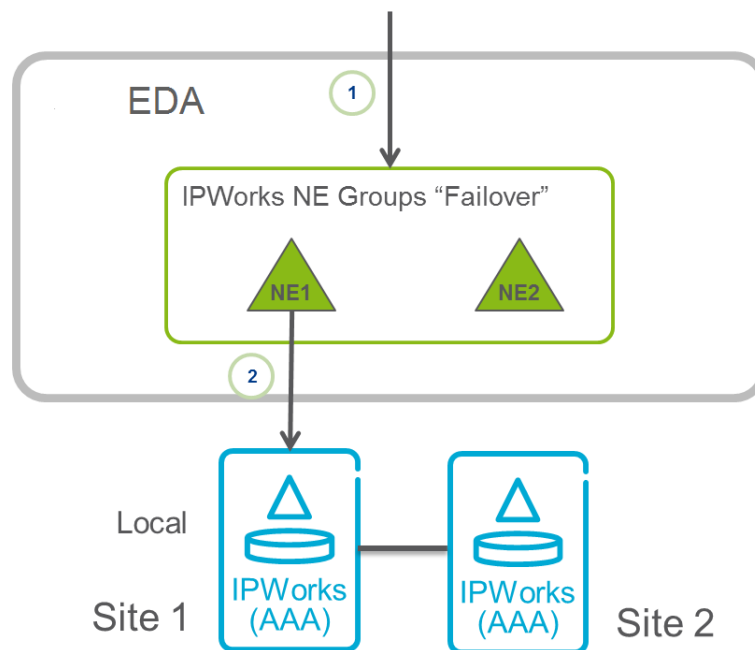


Figure 3 IPWorks Double Provisioning Architecture

Depending on the different IPWorks failure cases, Dynamic Activation uses different strategies to handle the provisioning logics:

- Site 1 - failure case (Master):

The provisioning is ended without any operations duplicated on Site 2

- Site 2 - failure case:

Once the Master IPWorks provisioning succeeds, the whole provisioning transaction is considered to be *successful*.

To ensure the data consistency across the two sites, Dynamic Activation provides two ways to handle the failure operation:

- IPWorks Subscription Retry Mechanism

The subscription retry mechanism configuration is offered for IPWorks provisioning logics. It conforms to the IPWorks “temporary” failure case. Once such failure occurs, Dynamic Activation resends the subscription commands according to the *Retry* configuration (NE response message, retry times, retry interval).

- IPWorks Failure Commands Logging

If the second IPWorks operation fails, it will, eventually, cause data inconsistency between the sites. In such scenario, all IPWorks failure commands are logged on the Dynamic Activation server and an alarm



is raised to the Operations Support System (OSS). Therefore, the administrator is able to get the occurrence of the failure.

Figure 4 depicts the IPWorks failure log files procedure.

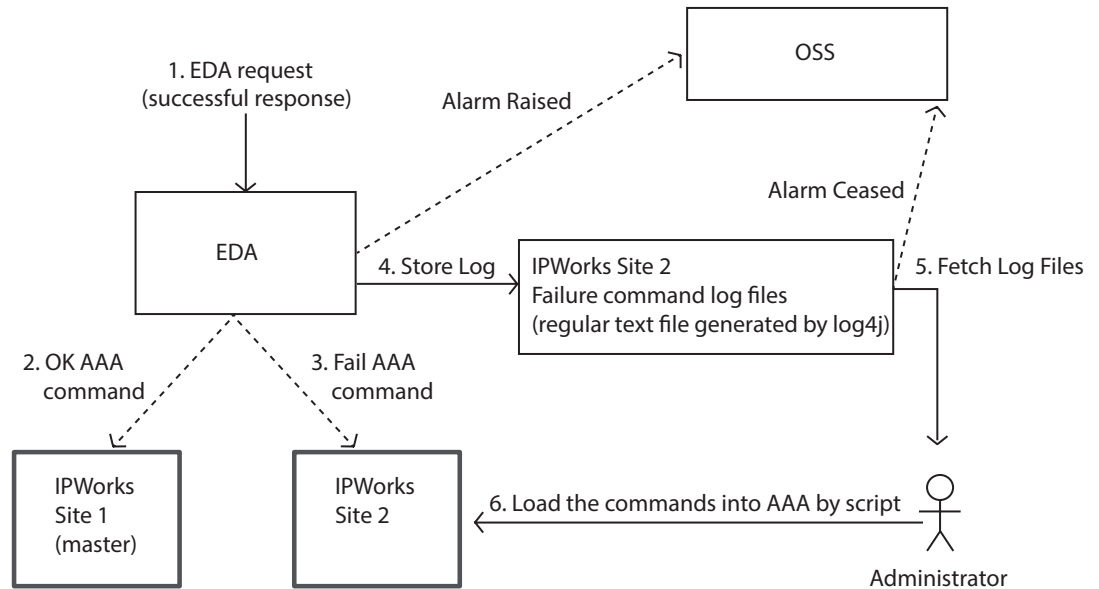


Figure 4 IPWorks Failure Log Files Procedure

- 1 Dynamic Activation receives the request for IPWorks AAA subscription.
- 2 Dynamic Activation succeeds to provision the subscription towards IPWorks Site 1 (Master).
- 3 Dynamic Activation fails to provision the subscription towards IPWorks Site 2.
- 4 Dynamic Activation generates an error log for failure AAA commands and an alarm is raised towards OSS.
- 5 To correct the data inconsistency, because of the IPWorks site 2 failure, an administrator needs to log on to the Dynamic Activation server, consolidate the log files, and dump the failure AAA commands into a file. This file is later used as the data source file for IPWorks Site 2.

For details, see instructions in *Configuration Manual for Resource Activation*, Reference [4].

When the error logs have been processed, the alarm is automatically ceased and a notification is sent to OSS.

- 6 The administrator corrects the data inconsistency by loading the failure commands (data source file) into IPWorks site 2.



Reference List

Ericsson Documents

- [1] *Library Overview*, 18/1553-CSH 109 628 Uen
- [2] *Glossary of Terms and Acronyms*, 0033-CSH 109 628 Uen
- [3] *Wi-Fi Calling Provisioning over CAI3G*, 14/155 19-CSH 109 628 Uen
- [4] *Configuration Manual for Resource Activation*, 2/1543-CSH 109 628 Uen
- [5] *User Guide for Resource Activation*, 1/1553-CSH 109 628 Uen