IPWorks Dimensioning Guideline

USER GUIDE

1/192 02-FGC 101 3568 Uen C

Copyright

© Ericsson AB 2016–2018. All rights reserved. No part of this document may be reproduced in any form without the written permission of the copyright owner.

Disclaimer

The contents of this document are subject to revision without notice due to continued progress in methodology, design and manufacturing. Ericsson shall have no liability for any error or damage of any kind resulting from the use of this document.

Trademark List

All trademarks mentioned herein are the property of their respective owners. These are shown in the document Trademark Information.

Contents

1	**Introduction**	**1**
1.1	Scope	1
1.2	Tools Required	1
1.3	Related Information	1
2	**Dimensioning Method**	**3**
2.1	Mobile Broadband (MBB) and Wi-Fi	3
2.2	IP Multimedia Subsystem (IMS)	12
2.3	Internet DNS	13
3	**Dimensioning with CANDI**	**15**
3.1	Starting CANDI	15
3.2	Selecting IPWorks Classic	16
3.3	Selecting IPWorks Layered	26
3.4	CANDI Input	34
3.5	IPWorks Classic Output	38
3.6	IPWorks Layered Output	41
Reference List		**45**

1 Introduction

This document is served as a dimensioning guideline for IPWorks 2 release. It describes methods and procedures in CANDI to dimension the product. For dimensioning guideline of previous releases, refer to the dimensioning guideline of corresponding release.

1.1 Scope

This document presents the methods and examples to dimension the IPWorks system for different scenarios:

— Mobile Broadband (MBB) and Wi-Fi

- AAA Server
- DNS Server
- DHCP Server

— IP Multimedia Subsystem (IMS)

- DNS/ENUM Server

1.2 Tools Required

Download the latest release of CANDI tool for IPWorks dimensioning.

1.3 Related Information

Trademark information, typographic conventions, and definition and explanation of abbreviations and terminology can be found in the following documents:

— Trademark Information

— Typographic Conventions

— Glossary of Terms and Acronyms

2 Dimensioning Method

An IPWorks system is dimensioned according to the following:

— The functions that the system is used for: AAA, DNS/ENUM, and DHCP

— The number of subscribed users

— The number of active sessions

— The expected traffic rates

— The number of DNS/ENUM records

— The number of core networks nodes

— The number of IP access contexts to support

The following sections show dimensioning method and examples for different scenarios and services.

2.1 Mobile Broadband (MBB) and Wi-Fi

2.1.1 AAA Server

An AAA server requires the following data for dimensioning:

— AAA Scenarios: AAA for GPRS, AAA for EPC, AAA for Wi-Fi and AAA for Fixed Access.

— Deployment: Classic (monolithic) or Layered (front-end)

— Functions: authentication and authorization with session-enabled

— Deployment configurations:

For more information about the configurations, refer to IPWorks 2 Characteristics.

— Number of user records to be supported

— Number of user sessions to be supported

An AAA server supports the following functions:

— AAA for GPRS (Radius)

— AAA for EPC (Diameter)

- Trusted CDMA access (SIM device)

- Untrusted Wi-Fi access (SIM device)
- Untrusted Wi-Fi access (Multi-device)

— AAA for Wi-Fi (Radius)

- SIM-based authentication
- Non-SIM based authentication

— AAA for Fixed Access (Radius)

- Authentication for fixed access users

Tested Scope:

— A maximum of 8 million user records and 4 million concurrent IP sessions for AAA for GRPS, AAA for Wi-Fi, and AAA for Fixed Access

— A maximum of 2 million attached SIM devices and 4 million AAA Sessions for AAA for EPC SIM-based service

— A maximum of 12 million non-SIM device profiles and 6 million AAA sessions for AAA for EPC non-SIM based service (Multi-Device)

When IPWorks AAA is deployed as front-end service, or SIM-based authentication methods are chosen, the number of user records limit lies on other network node (such as HLR/HSS, or back-end database). However, IPWorks AAA is licensed on IP sessions, with aforementioned 4 or 6 million IP Session limit per configuration regardless of deployment or authentication method chosen because of system memory limit. The processing capacity is measured in terms of TPS for IPWorks AAA.

Dimensioning methods described for IPWorks AAA in following sections show how IP session and TPS can be calculated with certain input and assumptions. Both IP session and TPS are taken into account when calculating the number of VNF and VM required for IPWorks AAA.

The provisioning rate has little impact on processing capacity of IPWorks services.

The AAA Front-End (GRPS and Wi-Fi non-SIM) is part of the UDC solution. For the dimensioning of AAA Front-End together with external DB (CUDB), refer to vUDC Dimensioning and Deployment Guideline.

Note: AAA server has scalability limitation. If one system configuration is not enough, the operator must order another system configuration for extension. The operator cannot only order PL VM for extension.

2.1.1.1 Dimensioning on AAA for GPRS

This section describes the dimensioning method for IPWorks AAA for GPRS. IPWorks AAA for GPRS is deployed on the Gi/SGi interface to serve the RADIUS authentication/authorization/accounting requests from GGSN/P-GW.

2.1.1.1.1 IP Session Calculation

To calculate the maximum IP sessions for AAA for GPRS license ordering, the users must know the number of GPRS/LTE subscribers and maximum active ratio during the busy hour. The formula is as follows:

IP Session = #subscriber * p

Where:

p is the maximum active ratio during the busy hour.

Note: The minimum IP Session license for AAA is currently 5,000, and the license increases in steps of 1,000 IP sessions.

For example, if the customer has 1,000,000 subscribers for its GPRS network, and the maximum active ratio is 80% during the busy hour. The IP Sessions needed for the AAA for GPRS license are:

1,000,000 * 80% = 800,000

2.1.1.1.2 QPS Calculation with Accounting

Accounting is only used with RADIUS AAA currently. If Accounting is enabled, QPS processed by AAA for GPRS is calculated as follows:

For GPRS

QPS = #subscriber * (2 * #pdp_context_activation + #pdp_context_deactivation + #irat_gprs) / 3600

Where:

— #subscriber: the number of GPRS subscribers

— #pdp_context_activation: the statistical numbers for PDP context activation per subscriber during busy hour

— #pdp_context_deactivation: the statistical numbers for PDP context deactivation per subscriber during busy hour

— #irat_gprs: the statistical number of inter-radio changes to GPRS network

For LTE

QPS = #subscriber * (2 * #attach + #detach + #irat_lte) / 3600

Where:

— #subscriber: the number of LTE subscribers

— #attach: the statistical numbers for LTE attach per subscriber during busy hour

— #detach: the statistical numbers for LTE detach per subscriber during busy hour

— #irat_lte: the statistical number of inter-radio changes to LTE network

For detailed description and recommended values for `#pdp_context_activation/deactivation`, `#attach/detach`, and `#irat_gprs/lte`, refer to Reference Traffic Model for Signaling Traffic in GSM, WCDMA, and Evolved Packet System (EPS). The factor 2 in the above formulas takes into consideration of Authentication Request and Accounting Start messages when activating PDP context or creating EPC bearer.

For example, with 1,000,000 GPRS subscribers, the default value for both `#pdp_context_activation` and `#pdp_context_deactivation` is 0.34, and for `irat_grps` is 0.15:

QPS = 1,000,000 * (2 * 0.34 + 0.34 + 0.15) / 3600 = 325

2.1.1.1.3 TPS Calculation

The TPS processed by AAA for GPRS is calculated as follows:

For GPRS

TPS = #subscriber * #pdp_context_activation / 3600

Where:

— #subscriber: the number of GPRS subscribers

— #pdp_context_activation: the statistical number of PDP context activations per subscriber during busy hour

For LTE

TPS = #subscriber * #attach / 3600

Where:

— #subscriber: the number of LTE subscribers

— #attach: the statistical number of attach per subscriber during busy hour

For example, with 1,000,000 GPRS subscribers and default value 0.34 of `#attach`:

TPS = 1,000,000 * 0.34 / 3600 = 95

2.1.1.2 Dimensioning on AAA for EPC

This section describes the dimensioning method for IPWorks AAA. IPWorks AAA is deployed in the 3GPP EPC network to authenticate and authorize subscribers attached to EPC through the non-3GPP access.

UE connects to EPC via either trusted or untrusted non-3GPP access, corresponding to STa or SWm interface to IPWorks AAA respectively. The processing capacity of IPWorks AAA might differ for STa and SWm interfaces.

2.1.1.2.1 IP Session Calculation

To calculate the maximum IP Sessions handled by AAA for EPC, the users must know the number of AAA subscribers and SAU ratio during busy hour. The formula is as follows:

IP Session = #aaa_subscriber * p

Where:

— p is the SAU ratio of AAA subscribers during the busy hour.

Note: The minimum IP Session license for AAA is 5,000, and the license increases in steps of 1,000 IP sessions.

For example, if the customer has 1,000,000 AAA subscribers who have Wi-Fi subscription, and the SAU ratio is 60% during the busy hour. The IP Sessions needed for AAA trusted non-3GPP license is:

1,000,000 * 60% = 600,000

2.1.1.2.2 TPS Calculation

For AAA, TPS is used for dimensioning purpose. If one AAA session includes Authentication, Authorization, and Accounting, they are counted as one Transaction.

AAA does not support Accounting via Diameter currently. The following formula calculates the TPS of AAA:

TPS = #aaa_subscriber * #attach / 3600

Where:

#attach is the average number of attach per AAA subscriber during the busy hour.

For example, with 1,000,000 AAA subscribers and default value 0.54 of #attach:

TPS = 1,000,000 * 0.5 / 3600 = 139

2.1.1.3 Dimensioning on AAA for Wi-Fi

This section describes the dimensioning method for IPWorks AAA for Wi-Fi. IPWorks AAA for Wi-Fi accepts Authentication / Authorization / Accounting requests from the user devices with or without a SIM/USIM card. Depending on SIM or non-SIM based authentication method chosen, the processing capacity of IPWorks AAA differs.

2.1.1.3.1 IP Session Calculation

To calculate the maximum IP Sessions for AAA for Wi-Fi license ordering, the users must know the number of Wi-Fi subscribers and maximum active ratio during the busy hour. The formula is as follows:

IP Session = #wifi_subscriber * p

Where:

p is the maximum active ratio of Wi-Fi subscribers during busy hour.

Note: The minimum IP Session license for AAA is 5,000, and the license increases in steps of 1,000 IP sessions.

For example, if the customer has 1,000,000 Wi-Fi subscribers to access its 3GPP-based core network, and the maximum active ratio is 60% during the busy hour, the IP Sessions needed for AAA for EPC license are:

1,000,000 * 60% = 600,000

2.1.1.3.2 TPS Calculation

For AAA for Wi-Fi, TPS is used for dimensioning purpose. If one AAA session includes Authentication, Authorization and Accounting, they are counted as one Transaction.

TPS for AAA for Wi-Fi is calculated as follows:

TPS = #wifi_subscriber *#attach_wifi / 3600

Where:

#attach_wifi is the statistical number of attach per Wi-Fi subscriber during the busy hour.

If with 1,000,000 Wi-Fi subscribers and default value 0.5 of `#attach_wifi`, the TPS is:

TPS = 1,000,000 * 0.5 / 3600 = 139

2.1.1.4 Dimensioning on AAA for Fixed Access

This section describes the dimensioning method for IPWorks AAA for Fixed Access. IPWorks AAA for Fixed Access accepts Authentication / Authorization / Accounting requests from NAS in the fixed access network.

2.1.1.4.1 IP Session Calculation

To calculate the maximum IP sessions for AAA for Fixed Access license ordering, the users must know the number of fixed access subscribers and maximum active ratio during the busy hour.

The formula is as follows:

IP Session = #fixed_subscriber * p

Where:

p is the maximum active ratio of fixed access subscribers during busy hour.

Note: The minimum IP Session license for AAA is 5,000, and the license increases in steps of 1,000 IP sessions.

For example, if the customer has 1,000,000 fixed access subscribers, and the maximum active ratio is 60% during the busy hour. The IP Sessions needed for AAA for EPC license are:

1,000,000 * 60% = 600,000

2.1.1.4.2 TPS Calculation

For AAA for Fixed Access, TPS is used for dimensioning purpose. If one AAA session includes Authentication, Authorization and Accounting, they are counted as one Transaction.

TPS for AAA for Fixed Access is calculated as follows:

```
TPS = #fixed_subscriber * #attach_fixed / 3600
```

Where:

#attach_fixed is the statistical number of attachment per fixed access subscriber during the busy hour.

For example, if the customer has 1,000,000 fixed access subscribers, and the default value of #attach_fixed is 0.5:

TPS = 1,000,000 * 0.5 / 3600 = 139

2.1.2 DNS Server

2.1.2.1 Dimensioning on DNS for GPRS

This section describes dimensioning method for IPWorks DNS server deployed in the GPRS packet core network. When IPWorks DNS server is used in the GPRS

packet core, it is responsible for APN name resolution and receives DNS queries from SGSN.

To calculate TPS needed for DNS server in GPRS packet core network, the number of SGSN and the number of GPRS APN need to be known. The formula is as follows:

TPS = #sgsn * #apn / BH

Where:

— #sgsn: the number of SGSN

— #apn: the number of GPRS APN

— BH: Busy hour duration in seconds

Note: The formula is valid on condition that TTL of each DNS record is long enough (longer than 1 hour) and cache is enabled on SGSN. The minimum required license for DNS TPS is 20, and increases in steps of 1 TPS.

For example, if the customer has 10 SGSN and 10 APN, BH=3600:

TPS = max (10 * 10 / 3600, 20) = 20

2.1.2.2 Dimensioning on DNS for LTE/EPC

This section describes dimensioning method for IPWorks DNS server deployed in LTE/EPC packet core network. The DNS server deployed in LTE/EPC packet core network is responsible for APN resolution, core network node selection, and mobility-related resolution.

To calculate TPS for DNS server in LTE/EPC packet core network, the users must input the following parameters:

— naptr_factor: the average number of DNS queries per DNS resolution due to use of NAPTR resource record in DNS server, default value is 3

— #enodeb: the number of eNodeB

— #sgsn-mme: the number of SGSN-MME

— #apn: the number of local APN and roaming APN

— #tai_per_eNB: the number of tracking areas that one eNodeB belongs to

— #tai: the total number of tracking areas

— BH: Busy hour duration in seconds

— dnsLookupTimer: the number of times per hour that eNodeB queries DNS, 0 means disabled.

- If `dnsLookupTimer > 0`, it means eNodeB queries DNS server at fixed interval.

  The formula is as follows:

  TPS = naptr_fator * (#sgsn-mme * #apn /BH + #enodeb * #tai_per_eNB * dnsLookupTimer/3600 + 3 * #sgsn-mme * #tai / BH)

- If `dnsLookupTimer = 0`, it means that the timer is disabled and eNodeB queries DNS server when needed.

  The formula is as follows:

  TPS = naptr_fator * (#sgsn-mme * #apn + #enodeb * #tai_per_eNB + 3 * #sgsn-mme * #tai) / BH

Note: The minimum required license for DNS TPS is 20, and increases in steps of 1 TPS.

For example, if `BH=3600`, `dnsLookupTimer = 0`, the customer has 10 SGSN-MME, 100 APN, 10000 eNodeB, 2 TAI per eNodeB, and total 1000 TAI:

TPS = 3 * (10 * 100 + 10000 * 2 + 3 * 10 * 1000) / 3600 = 43

2.1.3 DHCP Server

The DHCP server supports single server configuration or failover configuration. The failover configuration offers redundancy.

A system with a failover configuration has worse capacity than that of a system in single server configuration and the latency performance is worse. This is because in a failover configuration, the server must update each other with information about the addresses leased. The server synchronization causes load in the system, and delays in the response times.

When the system is started or at a "force renewal", the number of leases is greater than the number of renewals. As the system gets in stable operation, it is expected that the number of leases decrease and the number of renewals increase.

2.1.3.1 Dimensioning on DHCP for GPRS

This section describes dimensioning method for IPWorks DHCP server deployed in the GPRS network.

To calculate TPS needed at DHCP server in GRPS, the users must know the number of subscribers and the statistical number of PDP Context Activation/Deactivation. The formula is as follows:

TPS = #subscriber * (2 * #pdp_context_activation + #pdp_context_deactivation) / 3600

Where:

— #subscriber: the number of GPRS subscribers

— #pdp_context_activation: the statistical number for PDP context activation per subscriber during busy hour

— #pdp_context_deactivation: the statistical number for PDP context deactivation per subscriber during busy hour

Note: The minimum required license for DHCP TPS is 20, and increases in steps of 1 TPS.

For example, for 1,000,000 subscribers, and default value 0.34 for both `PDP_Context_Activation` and `PDP_Context_Deactivation`:

TPS = 1,000,000 * (2 * 0.34 + 0.34) / 3600 = 284

2.1.3.2 Dimensioning on DHCP for LTE/EPC

This section describes dimensioning method for IPWorks DHCP server deployed in the LTE/EPC network.

To calculate TPS needed at DHCP server in LTE/EPC, the users must know the number of subscribers and the statistical number of Attach/Detach. The formula is as follows:

TPS = #subscriber * (2 * #attach + #detach)/ 3600

Where:

— #subscriber: the number of LTE/EPC subscribers

— #attach: the statistical number for LTE attach per subscriber during busy hour

— #detach: the statistical number for LTE detach per subscriber during busy hour

Note: The minimum required license for DHCP TPS is 20, and increases in steps of 1 TPS.

For example, for 1,000,000 subscribers, and default value 0.4 for both Attach/Detach:

TPS = 1,000,000 * (2 * 0.4 + 0.4) / 3600 = 334

2.2 IP Multimedia Subsystem (IMS)

This section describes the dimensioning for DNS/ENUM Service in IMS solution.

The system is tested with a maximum of 2 million DNS A records and 24 million ENUM records. The number of records configured in the system has little impact on the system processing capacity.

With IPWorks VP IMS Interconnect enabled, the processing capacity is usually smaller than that of basic ENUM.

ERH is a module within ENUM to handle number portability queries. Besides traditional NP query over SS7, ERH now supports NP query over LDAP. The processing capacity of NP query differs depending on either SS7 or LDAP is selected.

Dimensioning on DNS/ENUM for the IMS solution follows the MMTel traffic model, which mandates the number of queries for each service under each use case. The input parameter required is the number of IMS subscribers. Use the CANDI tool to dimension DNS/ENUM in IMS solution. For the use of CANDI tool, see Section 3 on page 15 for details.

2.3 Internet DNS

IPWorks DNS supports deployment as Internet DNS server. When deployed as Internet DNS, IPWorks DNS works as a cache DNS server. For an incoming DNS query, if it is not found in the local cache, IPWorks DNS initiates a recursive query towards external DNS servers until the query is resolved or an error is returned. The DNS query result is cached before it is returned to the DNS client.

Cache hit rate and network latency for a recursive query affect the processing capacity of IPWorks DNS server greatly. Measurements are made for scenarios of 100% cache hit rate and 100% recursive query under different network latencies. For details, refer to Section Internet DNS in IPWorks 2 Characteristics.

The formula to calculate the processing capacity of IPWorks DNS server deployed as Internet DNS is as follows:

TPS = #tps_cache * p + #tps_recursive * (1-p)

Where:

- #tps_cache: the engineered capacity of IPWorks DNS with 100% cache hit rate
- #tps_recursive: the engineered capacity of IPWorks DNS with 100% recursive query under certain network latency
- p: average cache hit rate on IPWorks DNS server

Once the processing capacity is determined, the number of hardware can be derived based on the required TPS.

3 Dimensioning with CANDI

Capacity And Node Dimensioning (CANDI) is a tool that dimensions node capacity for many Ericsson products. This section describes the procedures to dimension IPWorks with CANDI. For dimensioning of previous releases with CANDI, refer to the dimensioning guideline of corresponding release.

To start dimensioning IPWorks with CANDI, do the following:

— Starting CANDI, see Section 3.1 on page 15

— Selecting IPWorks Classic or Layered, see Section 3.2 on page 16 or Section 3.3 on page 26

  - Selecting IPWorks release, configuration, and service

— Entering IPWorks service low level parameters, see Section 3.4 on page 34

— Checking CANDI output for either IPWorks Classic or Layered, see Section 3.5 on page 38 or Section 3.6 on page 40

3.1 Starting CANDI

To start CANDI:

1. Download the latest CANDI release according to Section 1.2 on page 1.
2. Open CANDI, and the **Start CANDI** screen is displayed as Figure 1 below.
3. Select either **User Management: IPWorks**, or **UDC (..., AAA-FE and CUDB)**.

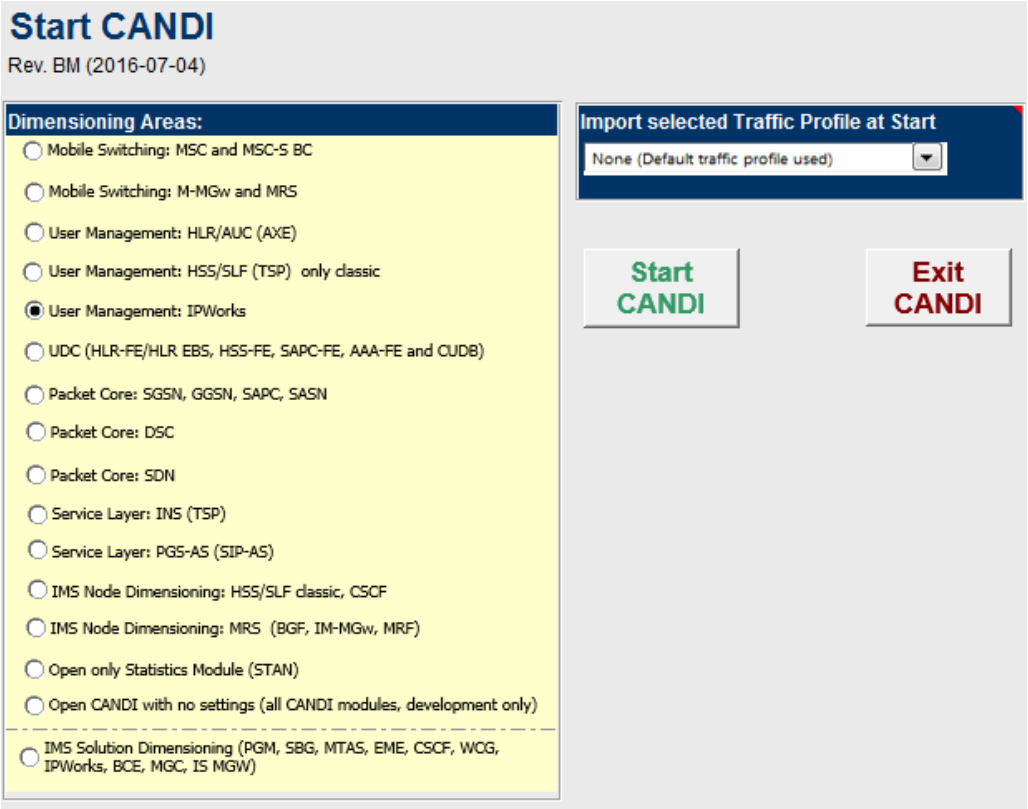

Figure 1 Start CANDI

4. Click **Start CANDI** to start the dimensioning.

3.2 Selecting IPWorks Classic

This section describes procedures to dimension IPWorks classic.

— For Virtualization solution, start from Section 3.2.1 on page 16 and Section 3.2.2 on page 18. Meanwhile, Ignore the Section 3.2.3 on page 21.

— For Native Replacement solution, start from Section 3.2.3 on page 21.

3.2.1 Selecting Virtualization Solution

In order to dimension IPWorks virtualized release, the **Virtualization Solution** check box must be enabled first, as shown in Figure 2.

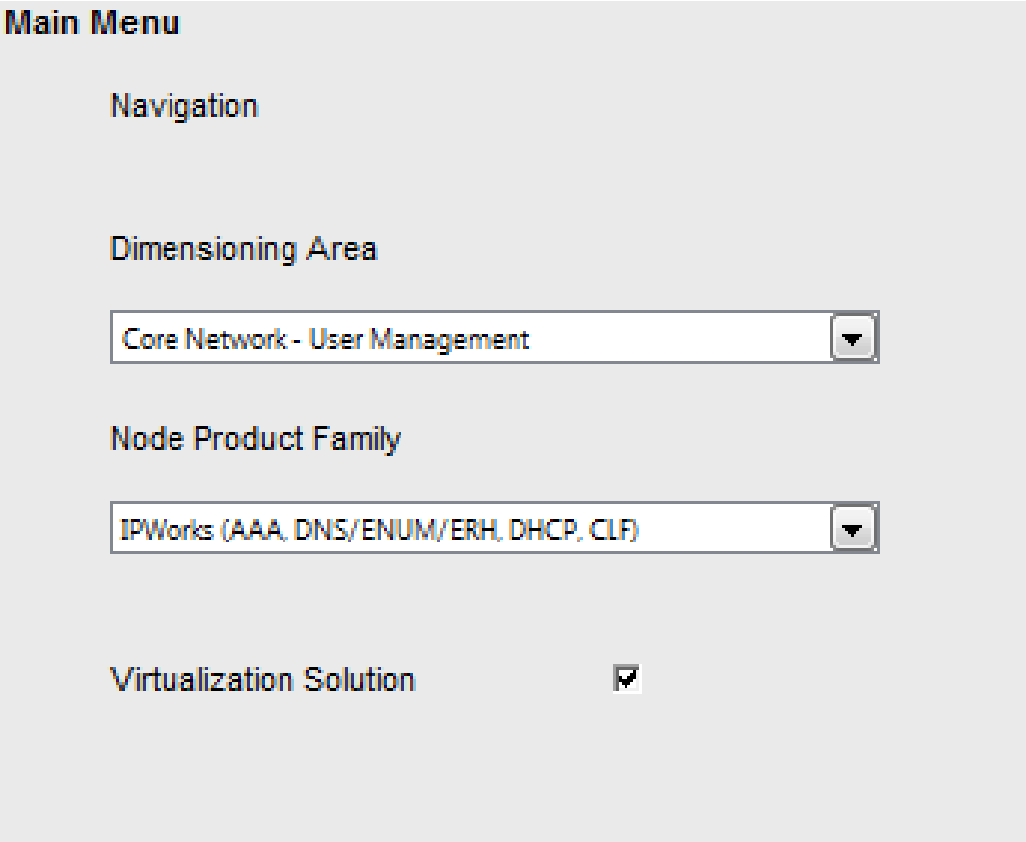

Figure 2 Selecting Virtualization Solution

Then, the **Cloud General Parameters** menu displays, the cloud general parameters can be changed when needed, as shown in Figure 3.

Cloud General Parameters

Cloud SW	ECEE 16A			
Cloud Infra Reserved Resources	Default	Manual	Used	
OS+Hypervisor	2		2	Cores/CPU
vSwitch size	1		1	Cores/vSwitch
vSwitch capacity (Simplex)	5900		5900	kpps/vSwitch
DRAM	5		5	Gbyte/Server
Cloud HW	GEP5			
CPU Model	E5-2658v2 (10C,2.4 GHz)			
Compute Server Specification	Default	Manual	Used	
CPU per Server	1		1	CPU/Server
Cores per CPU	10		10	Physical cores/CPU
Hyperthreading enabled	yes		yes	yes/no
Clock Rate	2.4		2.4	GHz
Traffic Ports per Server	2		2	Ports/Server
Capacity per Port	10		10	Gbps/Port
DRAM	64		64	Gbyte
Local Storage	1200		1200	Gbyte
Max vSwitch utilization	80%		80%	

Figure 3 Cloud General Parameters

3.2.2 Selecting IPWorks Release and Configuration

In the part of **IPWorks Specific Parameters** of input sheet, select the IPWorks release. Then, select IPWorks configuration. Supported configurations are Standard, Compact, and Flexible.

Standard configuration corresponds to 2 SC VMs and 2 PL VMs. AAA, DNS/ENUM, or DHCP can be selected for Standard configuration. They cannot be selected at the same time. IPWorks supports scaling for Standard deployment configuration. When the user selects the Standard configuration, CANDI activates the scaling function automatically.

Compact corresponds to 2 SC VMs and 2 PL VMs. AAA, DNS/ENUM, or DHCP can be selected for Compact configuration. They cannot be selected at the same time.

Flexible corresponds to 2 SC VMs and 2 PL VMs in which VM size is flexible according to the required capacity. AAA, DNS/ENUM, or DHCP can be selected for Flexible configuration. They cannot be selected at the same time.

Figure 4 shows the selection of Standard configuration for IPWorks Classic.

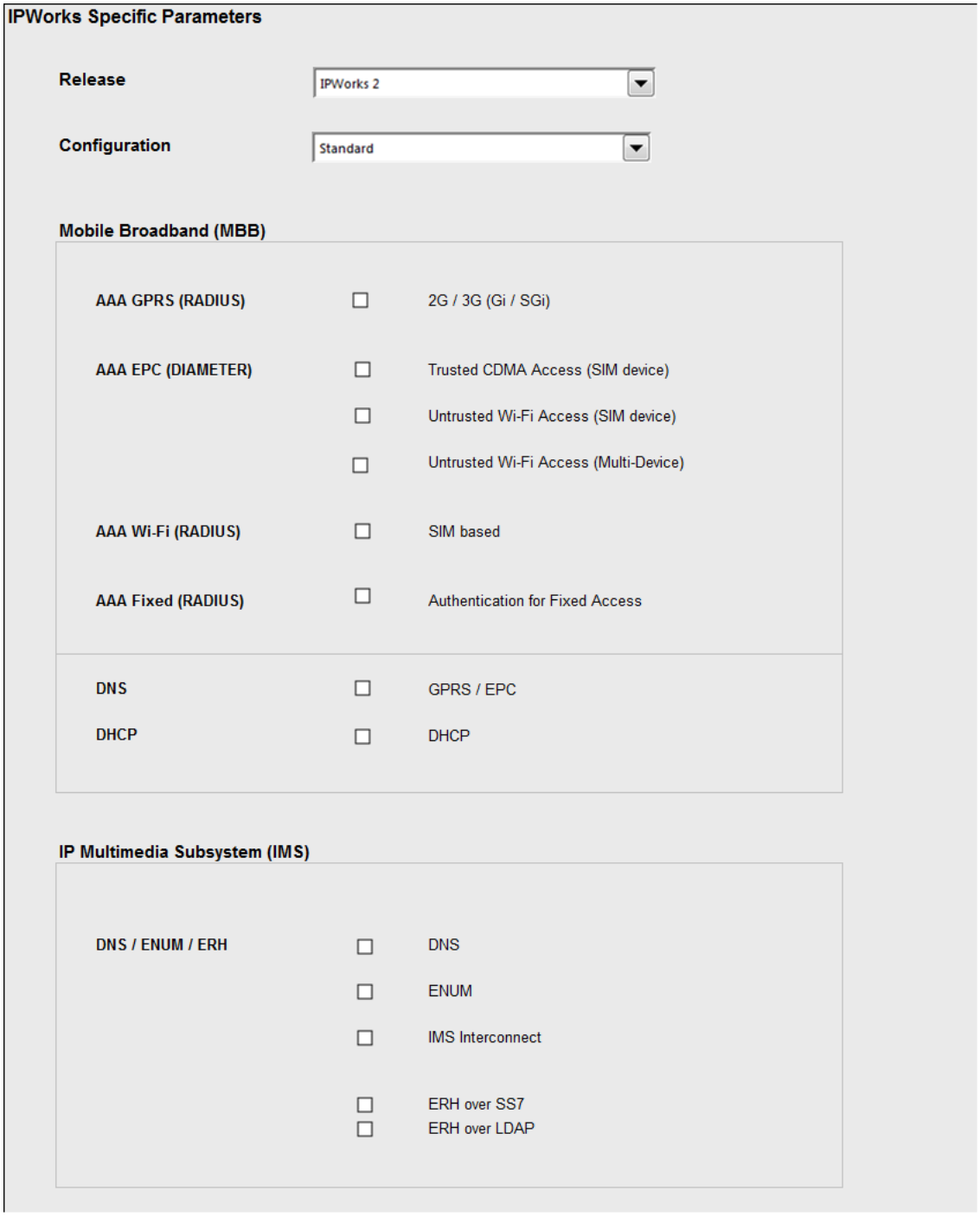

Figure 4 Selecting Standard Configuration for IPWorks Classic

Figure 5 shows the selection of Compact configuration for IPWorks Classic.

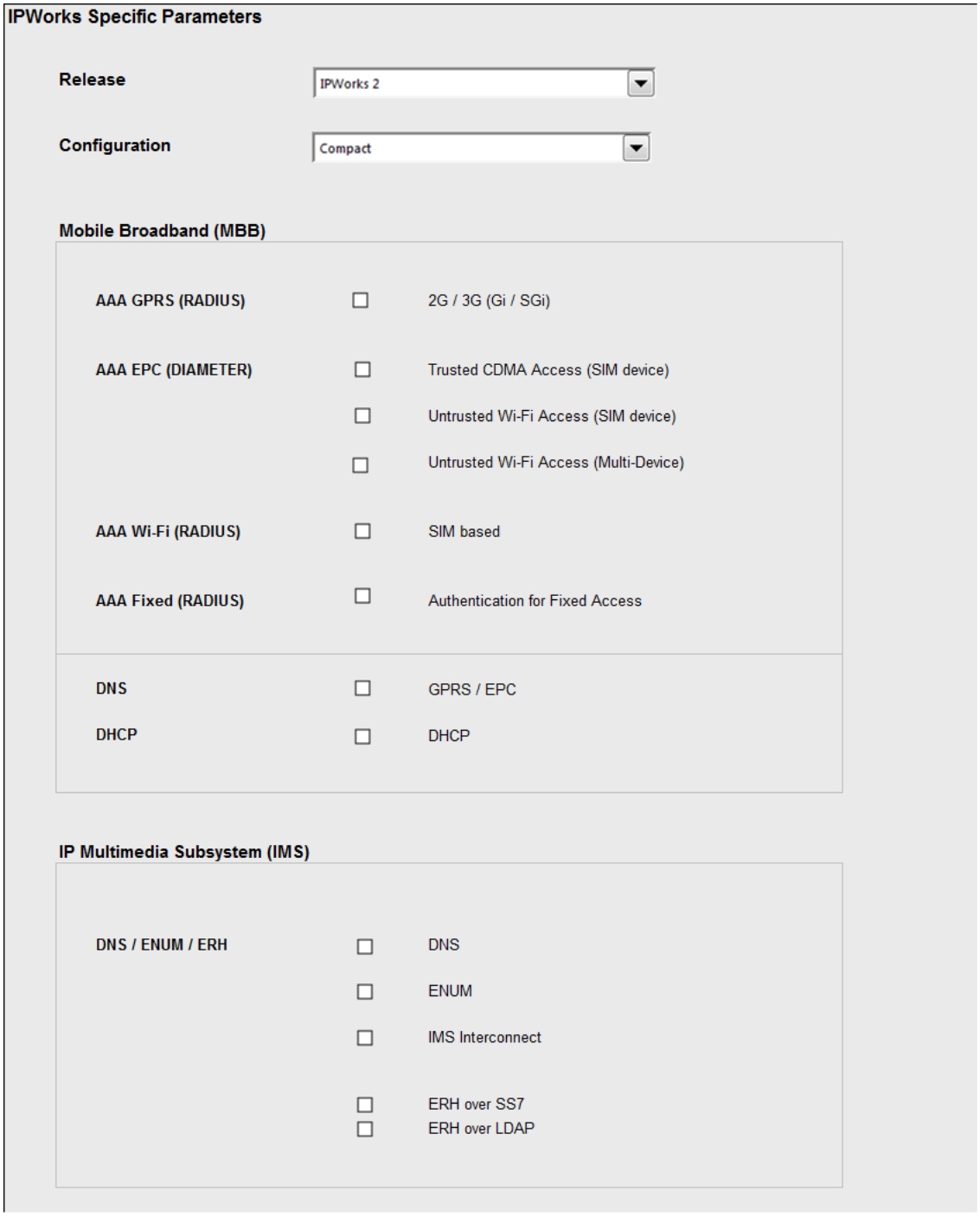

Figure 5 Selecting Compact Configuration for IPWorks Classic

Figure 6 shows the selection of Flexible configuration for IPWorks Classic.

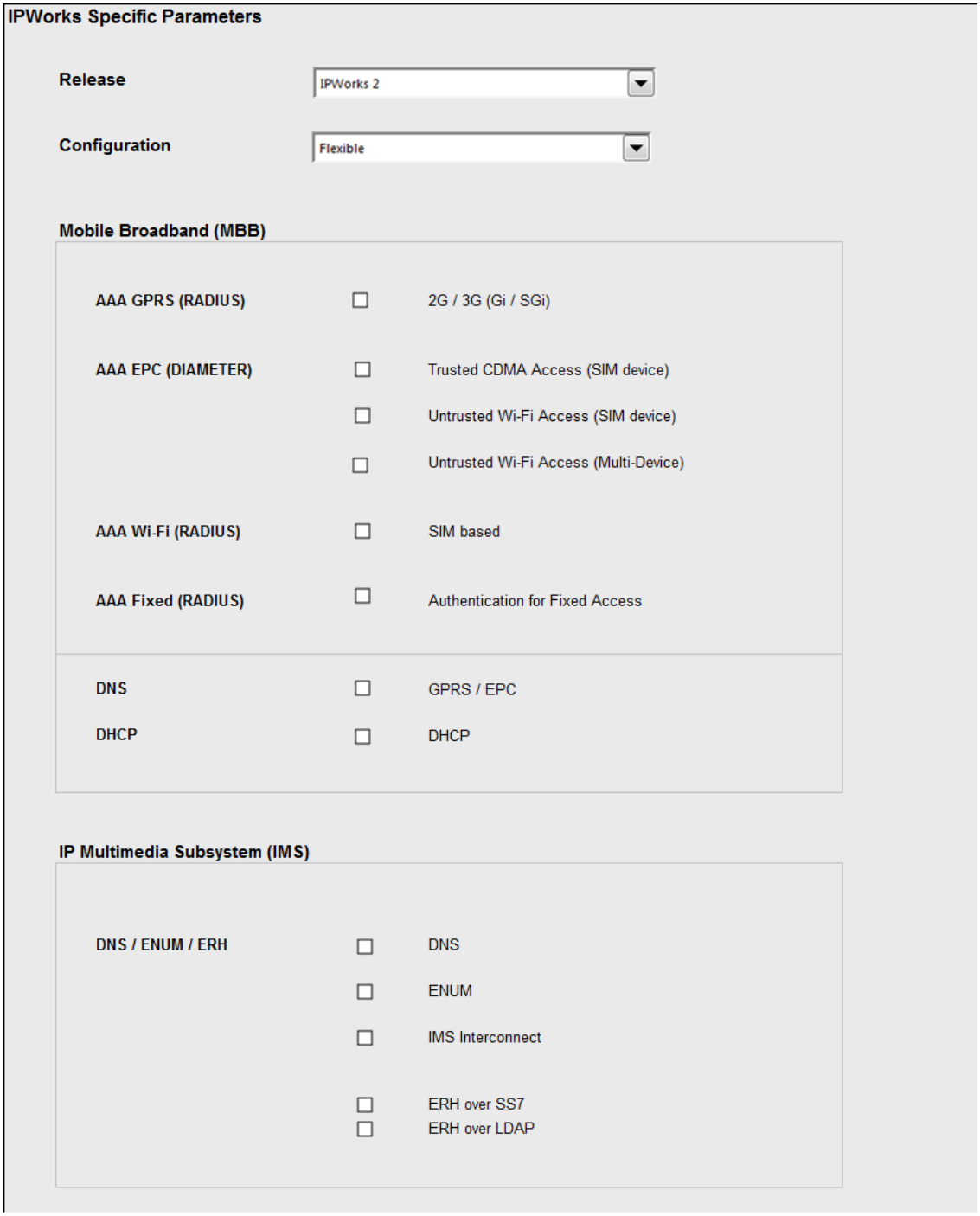

Figure 6 Selecting Flexible Configuration for IPWorks Classic

3.2.3 Selecting IPWorks 2 Native

In the part of **IPWorks Specific Parameters** of Input sheet, select the IPWorks release, IPWorks 2 Native. Then, select IPWorks configuration. Three configurations are supported, Basic, and Single Server.

Basic corresponds to 2 SC VMs and 2 PL VMs. AAA, DNS/ENUM, or DHCP can be selected for Basic configuration. They cannot be selected at the same time.

Single Server corresponds to 2 SC VMs and 2 PL VMs. AAA, DNS/ENUM, or DHCP can be selected for Single Server configuration. They cannot be selected at the same time.

Figure 7 shows the selection of Basic configuration for IPWorks Classic.

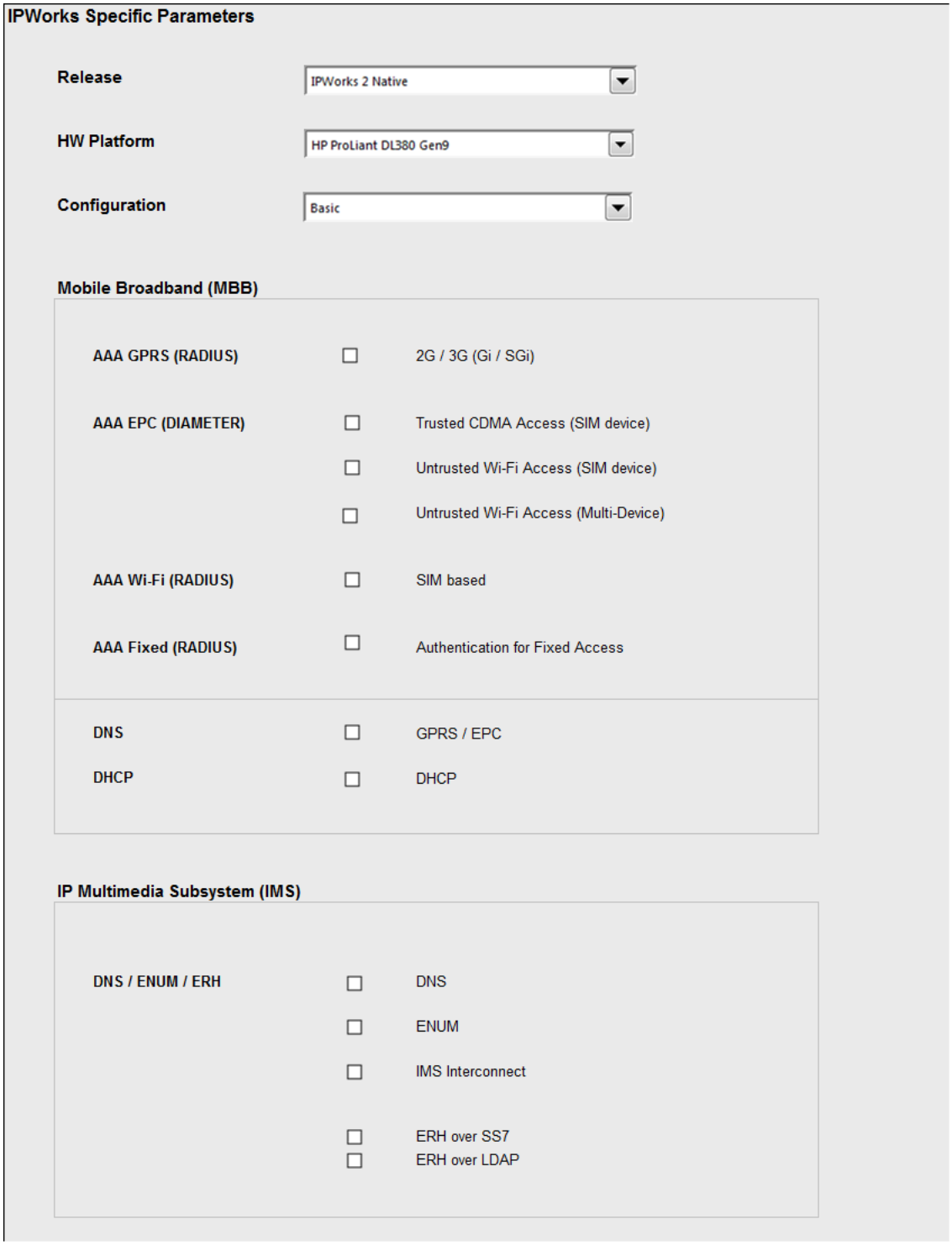

Figure 7 Selecting Basic Configuration for IPWorks Classic

Figure 8 shows the selection of Single Server configuration for IPWorks Classic.

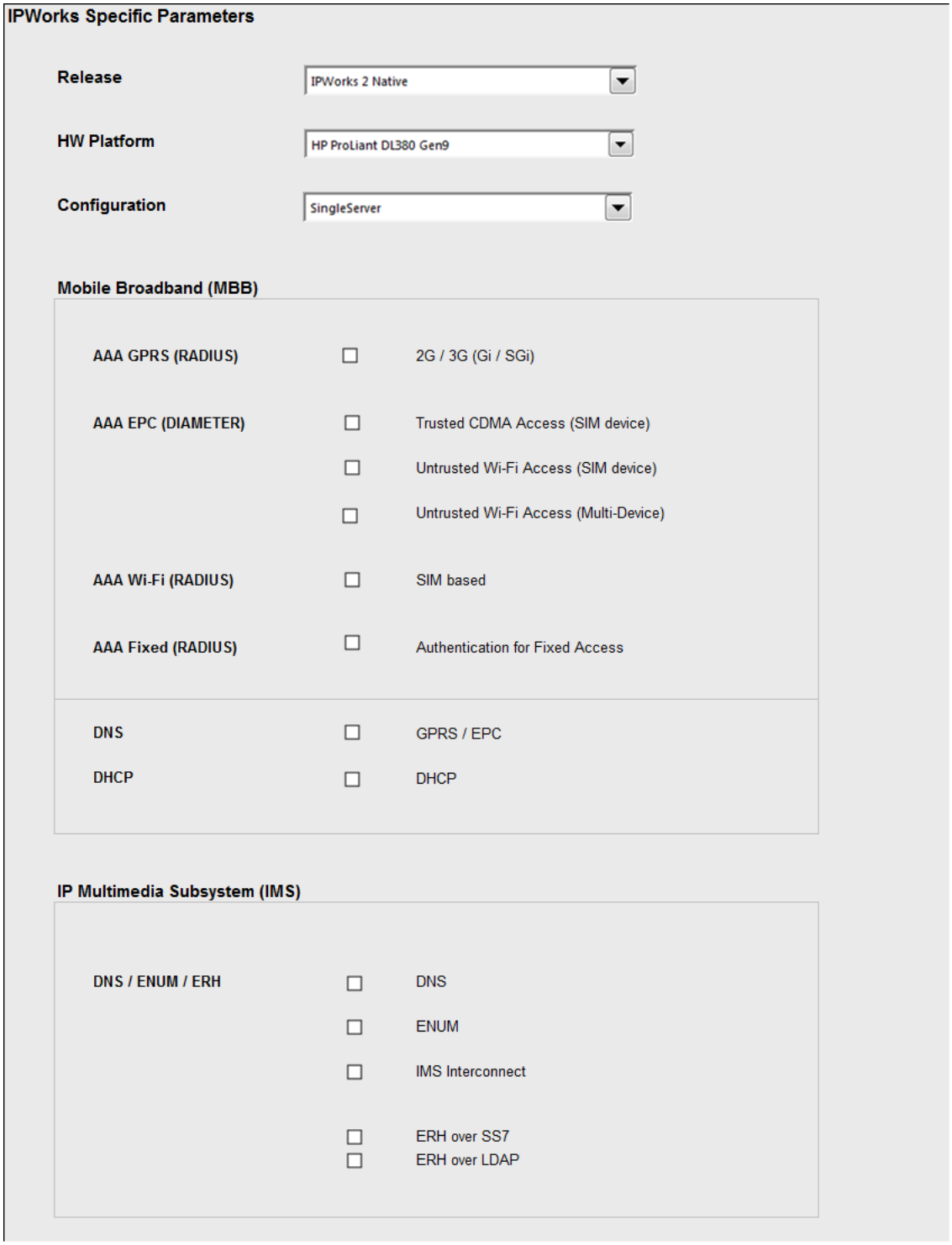

Figure 8 Selecting Single Server Configuration for IPWorks Classic

3.2.4 Selecting IPWorks Service

3.2.4.1 Mobile Broadband (MBB)

IPWorks MBB services are listed under the part Mobile Broadband (MBB).

— AAA for GPRS (Radius)

  - Gi interface

— AAA for Wi-Fi (Radius)

  - SIM-based authentication /Non-SIM based authentication

— AAA for Fixed Access (Radius)

  - IPWorks AAA supports user Authentication, Authorization, and Accounting for fixed access network based on RFC and BBF standards

For AAA for EPC, three scenarios are supported by CANDI as follows:

— **Trusted CDMA access (SIM device)**

  SIM-based UE with EPC subscription is attached to CDMA access, and is authenticated and authorized by AAA for EPC.

— **Untrusted Wi-Fi Access (SIM device)**

  SIM-based UE with EPC subscription is attached to public or private Wi-Fi access, and is authenticated and authorized by AAA for EPC.

— **Untrusted Wi-Fi Access (Multi-Device)**

  Non-SIM device sharing the same EPC subscription with the SIM device is attached to public or private Wi-Fi access, and is authenticated and authorized by AAA for EPC. One SIM device can be associated with multiple non-SIM devices. If only Untrusted Wi-Fi Access (Multi-Device) is selected, AAA for EPC is dimensioned by taking into account only non-SIM devices. When selecting both Untrusted Wi-Fi Access (SIM device) and Untrusted Wi-Fi Access (Multi-Device), AAA for EPC is dimensioned by taking into account the requests from both SIM devices and non-SIM devices.

DNS in EPC resolves queries for core network nodes, such as eNodeB, MME, P-GW. When DNS is selected, corresponding low level input must be filled. See Section 3.4 on page 34 for more details of IPWorks low level input.

DHCP only requires to enter the number of GPRS and/or LTE subscriber to dimension DHCP.

3.2.4.2 IP Multimedia Subsystem (IMS)

IPWorks services for IMS solution include DNS, ENUM and ERH. IMS Interconnect is an VP on top of ENUM.

— DNS in IMS resolves queries for IMS network nodes, such as CSCF, MTAS, etc.

— ENUM helps translates E.164 number into URI. For example, SIP URI can be used to establish VoLTE session.

— IMS Interconnect enables seamless IMS service across operator domains even for ported numbers.

— ERH is a module of ENUM, which queries legacy NPDB via SS7 protocol for ported number. ERH also supports LDAP protocol for NP query. ERH over SS7 and ERH over LDAP cannot be selected simultaneously.

3.3 Selecting IPWorks Layered

This section describes procedures to dimension IPWorks layered.

3.3.1 Selecting Virtualization Solution

When UDC is selected upon starting CANDI as described in Section 3.1 on page 15, layered IPWorks services are displayed. To be able to dimension IPWorks virtualized release in UDC, **UDC 1** must be selected first, and **Virtualization Solution** check box is enabled as shown in Figure 9. Cloud general parameters are displayed as in Figure 3.

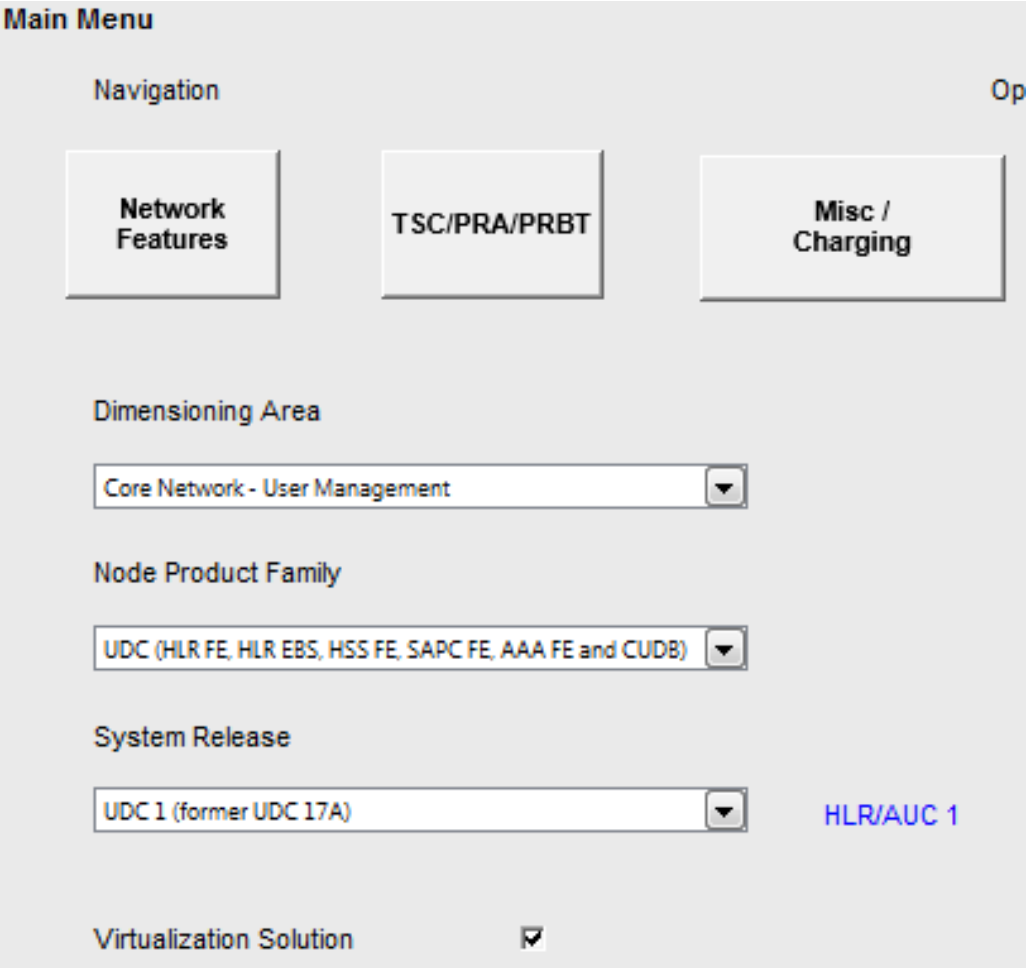

Figure 9 Selecting UDC Virtualization Solution

3.3.2 Selecting IPWorks Release and Configuration

In the part of **IPWorks Specific Parameters** of Input sheet, select the IPWorks release. Then, select IPWorks configuration. For description of supported configurations, refer to Section 3.2.2 on page 18.

Either AAA-FE or ENUM-FE can be selected for Standard, Compact, or Flexible configuration, as shown in Figure 10, Figure 11 and Figure 12.

IPWorks supports scaling for Standard deployment configuration. When the user selects the Standard configuration, CANDI activates the scaling function automatically.

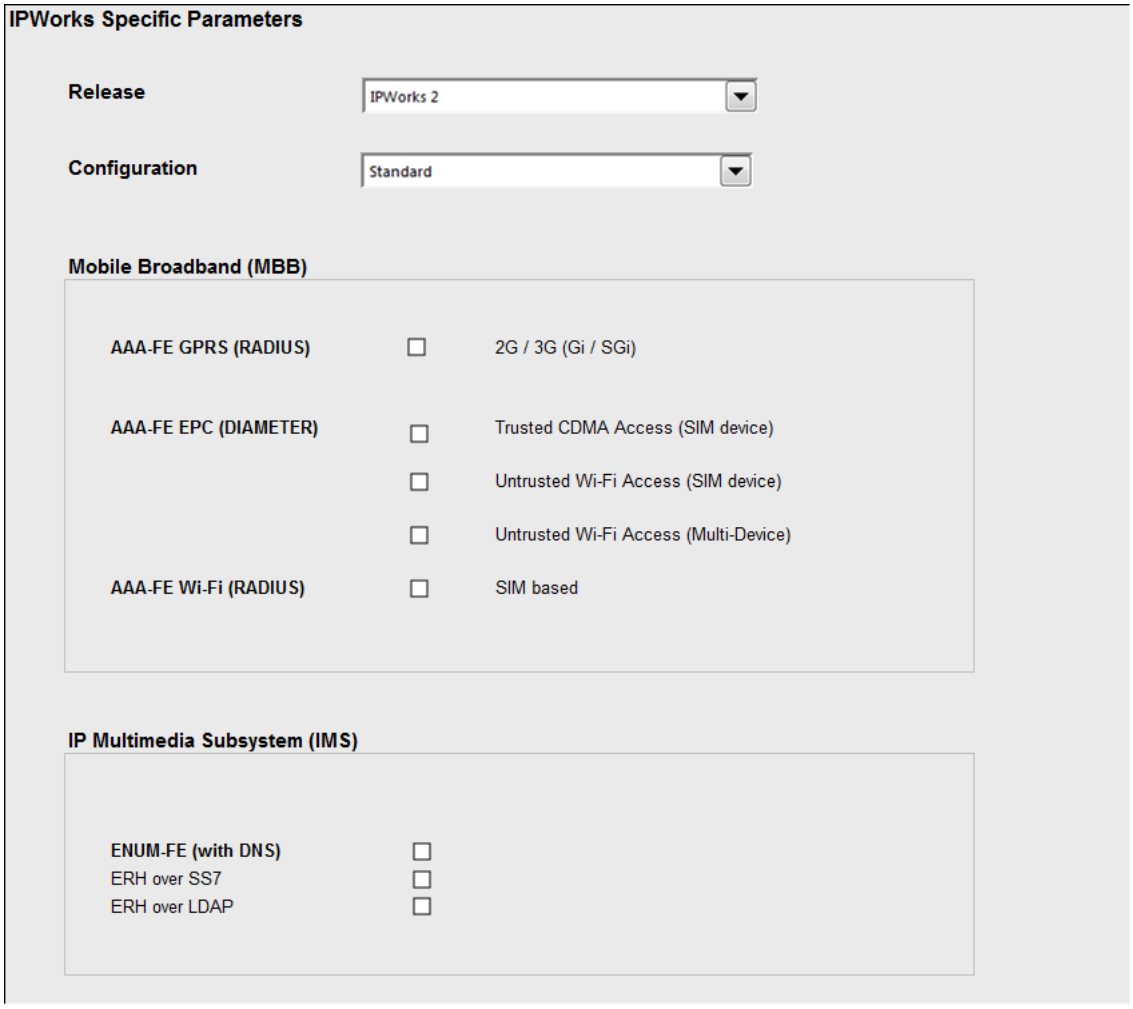

Figure 10 Selecting Standard Configuration for IPWorks Layered

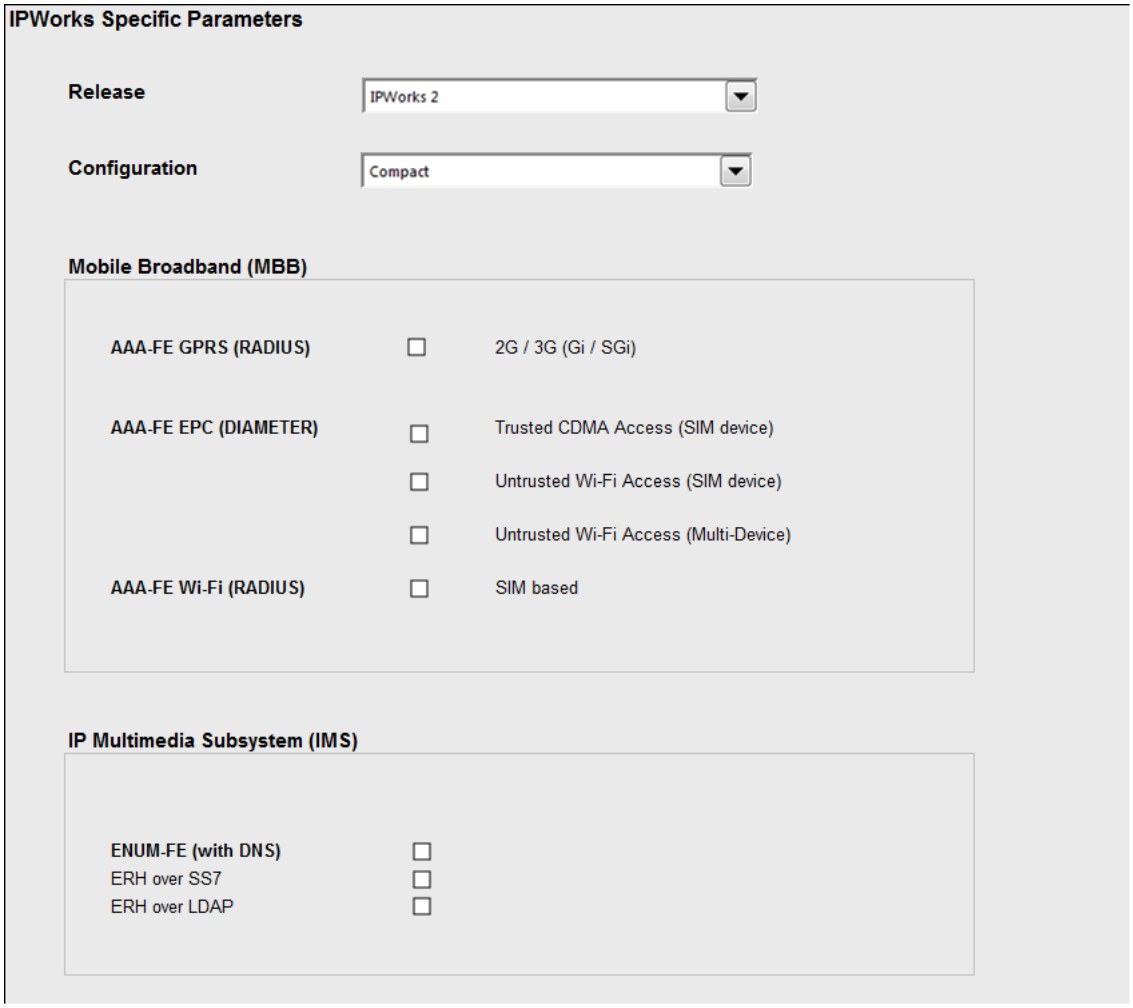

Figure 11 Selecting Compact Configuration for IPWorks Layered

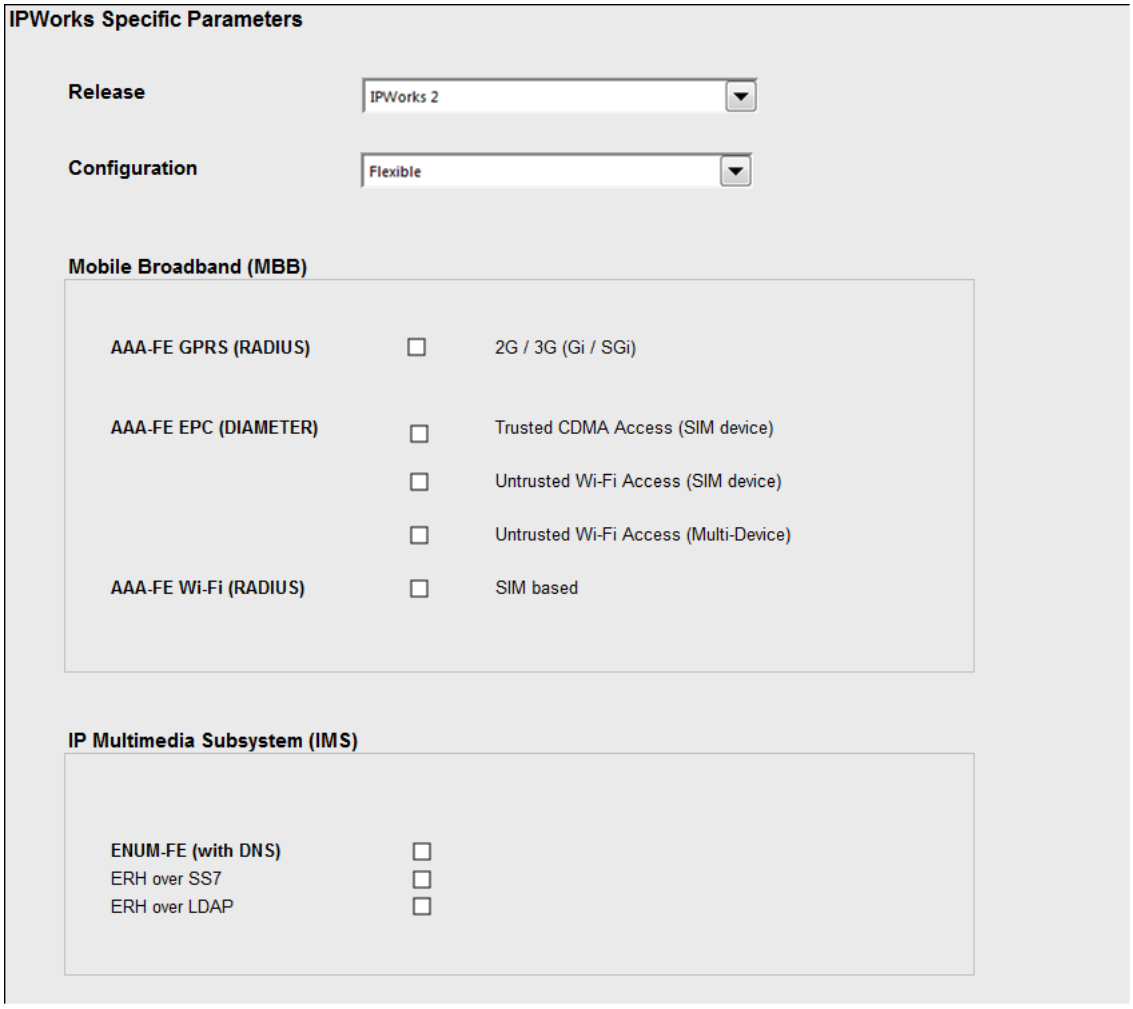

Figure 12 Selecting Flexible Configuration for IPWorks Layered

3.3.3 IPWorks 2 Native

When UDC is selected upon starting CANDI as described in Section 3.1 on page 15, layered IPWorks services are displayed. To be able to dimension IPWorks virtualized release in UDC, **UDC 1** must be selected first as in Page 31, do not choose Virtualization solution for IPWorks 2 Native configuration.

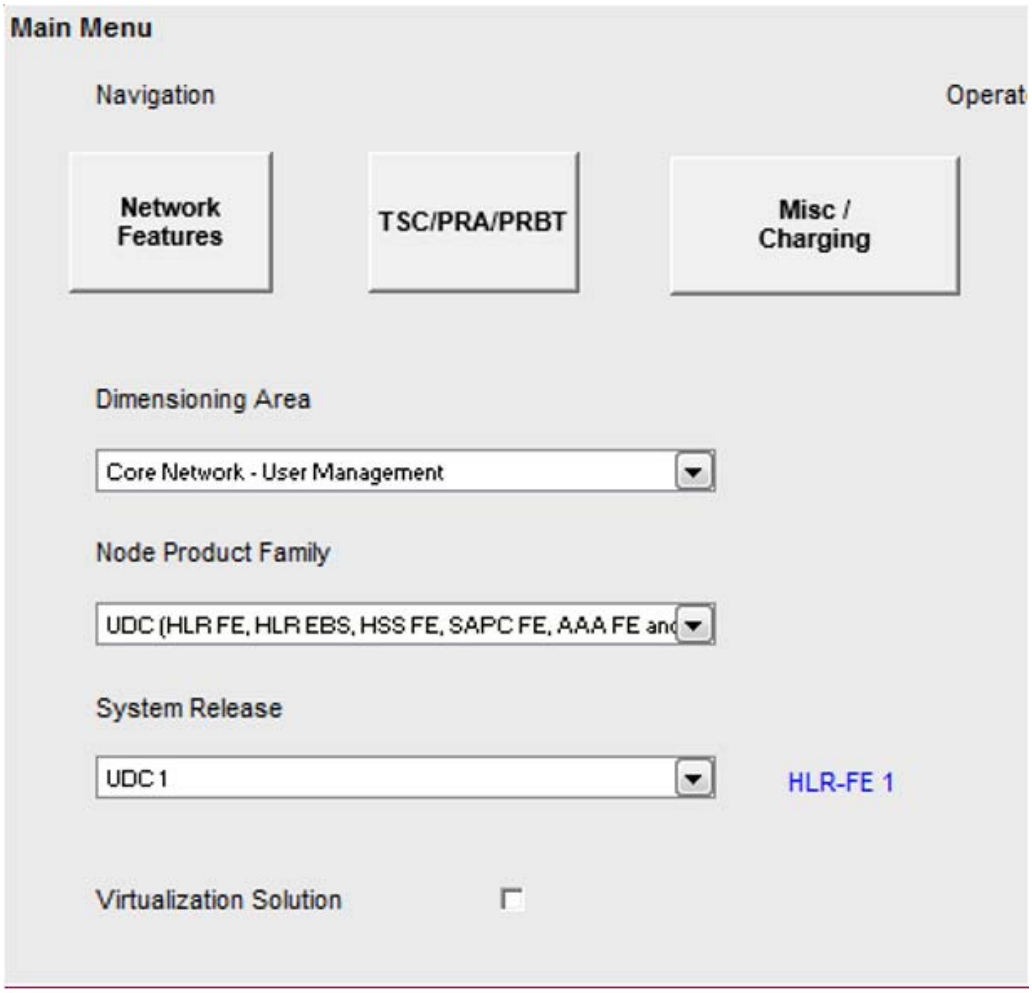

Figure 13 Selecting Native Configuration for IPWorks Layered

In the part of **IPWorks Specific Parameters** of Input sheet, select the IPWorks release, IPWorks 2 Native. Then, select IPWorks configuration. For description of supported configurations, see Section 3.2.3 on page 21.

Either AAA-FE or ENUM-FE can be selected for Basic and Single Server configuration, as shown in Figure 14 and Figure 15.

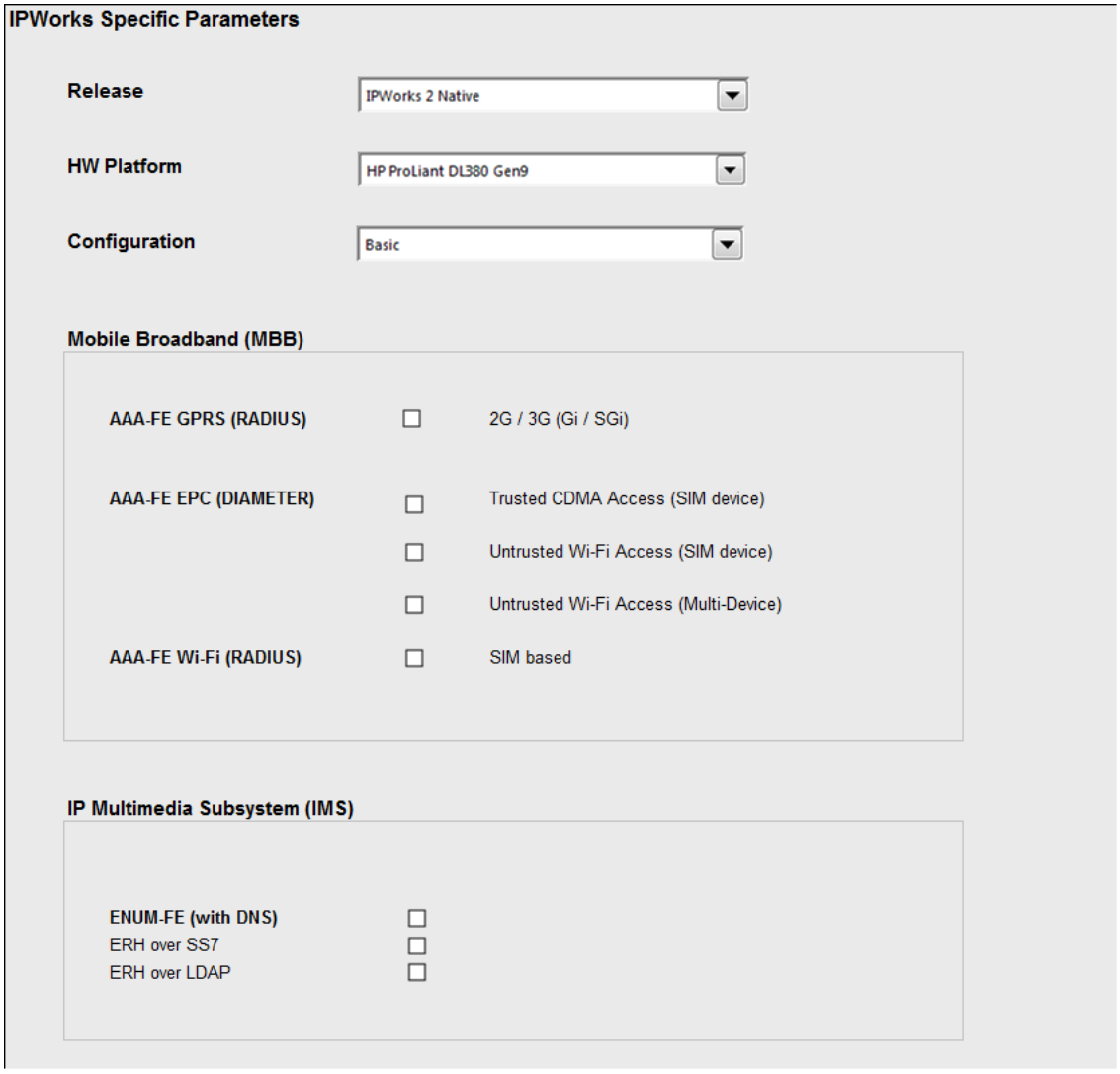

Figure 14 Selecting Basic Configuration for IPWorks Layered

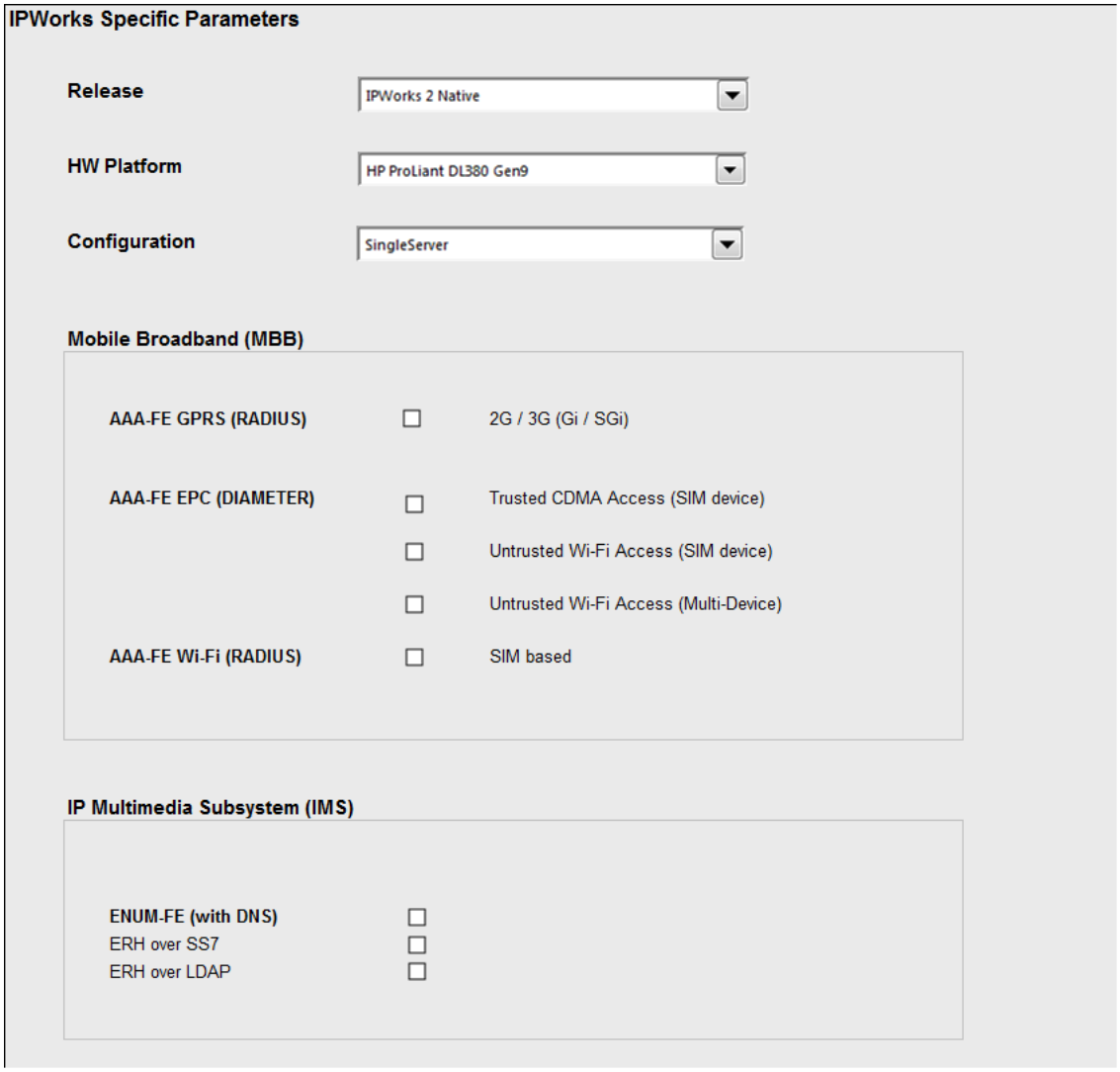

Figure 15 Selecting Single Server Configuration for IPWorks Layered

3.3.4 Selecting IPWorks Service

3.3.4.1 Mobile Broadband (MBB)

In IPWorks Layered, only Trusted CDMA Access (SIM device) and Untrusted Wi-Fi Access (SIM device) are supported for AAA-FE. In the two cases, subscriber profiles are provisioned to CUDB, and accessed by AAA-FE via HSS-FE. During authentication and authorization, AAA sessions are kept in IPWorks SC VM.

For description of the two scenarios, please refer to Section 3.2.4.1 on page 25.

Untrusted Wi-Fi Access (Multi-Device) is not supported by IPWorks Layered.

3.3.4.2 IP Multimedia Subsystem (IMS)

In IPWorks Layered, ENUM-FE can be selected together with ERH FE in IMS solution.

IMS Interconnect is not supported by IPWorks Layered.

3.4 CANDI Input

This section describes low level input of selected IPWorks service.

`IPWorks_low` in `cand_inp` is the place to enter low level parameters for selected service(s). Three sections are dedicated to MBB, IMS, and FBB scenarios for dimensioning respectively. They must be dimensioned separately, otherwise the output result is the maximum of them.

For dimensioning of IPWorks 2, only AAA for EPC, DNS in MBB, and IMS input are valid.

3.4.1 MBB Input

IPWorks MBB services are listed under the part Mobile Broadband (MBB). Figure 16 shows IPWorks low level input for MBB in CANDI.

Mobile Broadband (MBB)

AAA GPRS (RADIUS - Classic/Layered)

	default	manual	used	
Number of AAA Subscribers			0	
SAU Ratio during Busy Hour	70%		70%	

AAA EPC (DIAMETER - Classic/Layered)

	default	manual	used	
Number of AAA Subscribers			0	
Percentage of Non-SIM Subscribers	0%		0%	
Avg. Number of Non-SIM Devices per Subscriber	2		2	max. 5
SAU Ratio during Busy Hour	70%		70%	
Using IMSI Masking	0		0	

AAA Wi-Fi (RADIUS - Classic/Layered)

	default	manual	used	
Number of AAA Subscribers			0	
Percentage of Non-SIM Subscribers	0%		0%	
SAU Ratio during Busy Hour	70%		70%	

AAA Fixed (RADIUS - Classic)

	default	manual	used	
Number of AAA Subscribers			0	
SAU Ratio during Busy Hour	70%		70%	

DNS

GPRS (2G&3G)

	default	manual	used	
Number of SGSN			0	
Number of GPRS APN			0	
Time to live (TTL)	3,600		3,600	Sec

EPC

	default	manual	used	
Number of SGSN-MME			0	
Number of EPC APN			0	
Number of eNodeB			0	
Number of Tracking Area			0	
DNS Lookup Timer (eNodeB)	0		0	Times/Hr
Time to live (TTL)	3,600		3,600	Sec

DHCP

GPRS (2G&3G)	manual	used
Number of GPRS Subscribers		0

LTE/EPC	manual	used
Number of LTE Subscribers		0

Figure 16 Low Level Input for MBB in CANDI

— **AAA for GPRS**

Enter the number of GPRS subscribers and active ratio during busy hour for dimensioning.

— **AAA for EPC**

- **Number of AAA Subscribers**

  Enter the number of AAA subscribers who have SIM-based EPC subscription. It is mandatory input for every AAA service.

- **Percentage of Non-SIM Subscribers**

  Enter the percentage of subscribers who have non-SIM based subscription (Multi-Device). If Untrusted Wi-Fi Access (Multi-Device) service is selected, enter a number greater than 0%.

- **Avg. Number of Non-SIM Devices per Subscriber**

  Enter the average number of non-SIM devices per subscriber who have Multi-Device subscription. The max number is 5. If Untrusted Wi-Fi Access (Multi-Device) service is not selected, this parameter is ignored.

- **SAU Ratio During Busy Hour**

  Enter the SAU ratio of AAA subscribers during busy hour.

- **Use IMSI Masking**

  Enter 1 if customer wants to use IMSI masking feature. The default value is 0, which means the feature is not used.

— **AAA for Wi-Fi**

Enter the number of Wi-Fi subscribers, percentage of Non-SIM subscribers and active ratio during busy hour for dimensioning.

— **AAA for Fixed Access**

Enter the number of fixed access subscribers and the active ratio during busy hour for dimensioning.

— In MBB solution, **DNS** can be deployed in GPRS network or EPC network.

- **DNS GPRS**

  Enter the number of SGSN and the number of GPRS APN for DNS dimensioning.

- **DNS EPC**

  Enter the number of SGSN-MME, the number of EPC APN, the number of eNodeB, and the number of tracking areas for DNS dimensioning. DNS

Lookup Timer is internal in eNodeB, if unfamiliar with this parameter, use the default value.

— DHCP GPRS and/or EPC

Enter the number of GPRS and/or LTE subscriber to dimension DHCP.

3.4.2 IMS Input

IPWorks in IMS includes collocated DNS/ENUM/ERH services. Figure 17 shows the section `IPWorks_low` of `cand_inp` for IMS low level input. Besides the number of IMS subscribers, ENUM related low-level parameters can also be entered here.

In the section of IP Multimedia Subsystem (IMS), the following rules must apply:

— DNS is mandatory for selecting other services.

— ENUM is mandatory for selecting IMS Interconnect or ERH services.

— ERH service for number portability query is either over SS7 or LDAP, and SS7 and LDAP must not be selected together.

IP Multimedia Subsystem (IMS)

	manual	used
Number of IMS Subscribers	10000000	10,000,000

ENUM (Classic/Layered)

	default	manual	used	
Number of ENUMDNRANGE (number range) records			0	max. 10K
Avg. number of views per ENUMDNRANGE record	2		2	max. 20
Avg. number of NAPTR records per ENUMDNRANGE view	1.8		1.8	max. 5
Avg. number of NAPTR records per ENUMDNSCHED (individual number) view	1.8		1.8	max. 5
Number of LDAP requests to CUDB per sub. during BH (Layered only)	1.0224		1.0224	

Figure 17 Low-Level Input for IMS in CANDI

When DNS/ENUM is selected in IMS solution, following input is required for the dimensioning of IPWorks.

— **Number of IMS Subscribers**

Enter the number IMS subscribers if DNS/ENUM is selected in IMS solution

ENUM-specific input:

— **Number of ENUMDNRANGE (number range) records**

Enter the number of ENUMDNRANGE records. ENUMDNRANGE record represents a number range. The max supported number is `10000`.

— **Avg. number of views per ENUMDNRANGE record**

  Enter the average number of views per ENUMDNRANGE record. IPWorks uses view for client access control. The max number is 20. For more details of view control, refer to IPWorks ENUM Function Overview.

— **Avg. number of NAPTR records per ENUMDNRANGE view**

  Enter the average number of NAPTR records per ENUMDNRANGE view. NAPTR record is provisioned to IPWorks Storage Server or CUDB. It defines the type of service and URI of the associated number range. Max 5 NAPTR records are supported per number range.

— **Avg. number of NAPTR records per ENUMDNSCHED (individual number) view**

  Enter the average number of NAPTR records per ENUMDNSCHED view. ENUMDNSCHED represents an individual E.164 number. Only one view is supported by ENUMDNSCHED. NAPTR record is provisioned to IPWorks Storage Server or CUDB. It defines the type of service and URI of the associated E.164 number. Max 5 NAPTR records are supported per number.

— **Number of LDAP requests to CUDB per sub. during BH (Layered only)**

  This input impacts CUDB dimensioning. Do not change this value unless you know how to calculate it.

3.5 IPWorks Classic Output

This section describes CANDI output for IPWorks Classic.

`IPWorks_output` of `cand_out` gives dimensioning result of selected IPWorks service.

The output sheet for IPWorks includes two tables:

— The first table shows the dimensioned number of VNF and VM, VM size, and system resource usage per VM type.

— The second table shows the number of software licenses required.

Figure 18 shows the CANDI output for IPWorks Classic with Standard configuration.

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP5
Configuration: Standard

	Dimensioned Quantity	Size per VM			Resource Usage				
		vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks VNF	1	14	40	200	60.00%	-	-	-	-
IPWorks SC VM	2	14	8	0	60.00%	-	-	-	-
IPWorks PL VM	2	14	8	0	60.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	49	79	0	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	200,000	-	-

Figure 18 IPWorks Classic Output for Standard

Figure 19 shows the CANDI output for IPWorks Classic with Flexible configuration.

Note: If the vCPU or memory number is 0, this means that the required capacity exceeds the maximum capacity of one setting of flexible configuration. You can choose the Standard configuration in the input page.

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP5
Configuration: Flexible

	Dimensioned Quantity	Size per VM			Resource Usage				
		vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks VNF	1	3	5	75	60.00%	-	-	-	-
IPWorks SC VM	2	3	5	75	60.00%	-	-	-	-
IPWorks PL VM	2	3	8	0	60.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	73	112	0	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	300,000	-	-

Figure 19 IPWorks Classic Output for Flexible configuration

IPWorks Output

Date: 08/Jun/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP6
Configuration: Flexible

Warning: It exceed the max capacity of Flexible, please use the standard configuration.

	Dimensioned Quantity	Size per VM			Resource Usage				
		vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks VNF	0	0	0	75	80.00%	-	-	-	-
IPWorks SC VM	0	0	0	75	80.00%	-	-	-	-
IPWorks PL VM	0	0	8	0	80.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	728,446	881,618	0	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	3,000,000,000	-	-

Figure 20 IPWorks Classic Output for Flexible Configuration (Warning)

Figure 21 shows the CANDI output for IPWorks Classic with Compact configuration.

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP5
Configuration: Compact

	Dimensioned Quantity	Size per VM			Resource Usage				
IPWorks VNF	2	vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks SC VM	4	2	4	75	60.00%	-	-	-	-
IPWorks PL VM	4	2	6	0	60.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	49	79	0	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	200,000	-	-

Figure 21 IPWorks Classic Output for Compact

The following results are for the **IPWorks 2 Native**.

The output sheet for IPWorks includes two tables:

— The first table shows the number of software licenses required.

— The second table shows the dimensioned number of HW and VM.

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2 Native
Hardware Platform: HP ProLiant DL380 Gen9
Configuration: Basic

		MBB			IMS			FBB
Software License	Comment	AAA	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	73	112	0	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	300,000	-	-

	Dimensioned Quantity
HP ProLiant DL380 Gen9	2
IPWorks SC VM	2
IPWorks PL VM	2

Figure 22 IPWorks Classic Output for IPWorks 2 Native Basic

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2 Native
Hardware Platform: HP ProLiant DL380 Gen9
Configuration: SingleServer

		MBB			IMS			FBB
Software License	Comment	AAA	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	73	112	0	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	300,000	-	-

	Dimensioned Quantity
HP ProLiant DL380 Gen9	1
IPWorks SC VM	2
IPWorks PL VM	2

Figure 23 IPWorks Classic Output for IPWorks 2 Native Single Server

3.6 IPWorks Layered Output

This section describes CANDI output for IPWorks Layered.

For IPWorks Layered, CANDI output includes an additional table that displays TPS from AAA-FE/ENUM-FE to HSS-FE/CUDB.

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP5
Configuration: Standard

	Dimensioned Quantity	Size per VM			Resource Usage				
IPWorks VNF	1	vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks SC VM	2	14	40	280	60.00%	-	-	-	-
IPWorks PL VM	2	14	8	0	60.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA-FE	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	25	47	24	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	100,000	-	-

Interface	TPS
AAA-FE to CUDB (LDAP)	0
AAA to HSS-FE (Diameter)	0
AAA to HLR-FE (MAP)	0
ENUM-FE to CUDB (LDAP)	47

Figure 24 IPWorks Layered Output for Standard Configuration

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP5
Configuration: Standard

	Dimensioned Quantity	Size per VM			Resource Usage				
IPWorks VNF	1	vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks SC VM	2	14	40	280	60.00%	-	-	-	-
IPWorks PL VM	9	14	8	0	60.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA-FE	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	24,282	32,731	16,366	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	100,000,000	-	-

Interface	TPS
AAA-FE to CUDB (LDAP)	0
AAA to HSS-FE (Diameter)	0
AAA to HLR-FE (MAP)	0
ENUM-FE to CUDB (LDAP)	32731

Figure 25 IPWorks Layered Output for Standard Scaling Configuration

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP5
Configuration: Compact

	Dimensioned Quantity	Size per VM			Resource Usage				
IPWorks VNF	1	vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks SC VM	2	2	4	75	60.00%	-	-	-	-
IPWorks PL VM	2	2	6	0	60.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA-FE	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	25	47	24	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	100,000	-	-

Interface	TPS
AAA-FE to CUDB (LDAP)	0
AAA to HSS-FE (Diameter)	0
AAA to HLR-FE (MAP)	0
ENUM-FE to CUDB (LDAP)	47

Figure 26 IPWorks Layered Output for Compact Configuration

IPWorks Output

Date: 13/Mar/2018

Release: IPWorks 2
Cloud Software: CEE 6.4
Cloud Hardware: GEP5
Configuration: Flexible

	Dimensioned Quantity	Size per VM			Resource Usage				
IPWorks VNF	1	vCPU (#)	Mem (GB)	Disk (GB)	CPU	Mem	Disk	BW (Mbps)	IOPS
IPWorks SC VM	2	2	5	75	60.00%	-	-	-	-
IPWorks PL VM	2	2	8	0	60.00%	-	-	-	-

		MBB			IMS			FBB
Software License	Comment	AAA-FE	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	73	112	57	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	300,000	-	-

Interface	TPS
AAA-FE to CUDB (LDAP)	0
AAA to HSS-FE (Diameter)	0
AAA to HLR-FE (MAP)	0
ENUM-FE to CUDB (LDAP)	112

Figure 27 IPWorks Layered Output for Flexible Configuration

Note: If the vCPU or memory number is 0, this means that the required capacity exceeds the maximum capacity of one setting of flexible configuration. You can choose the Standard configuration in the input page.

The following results are for the **IPWorks 2 Native**:

IPWorks Output

Release: IPWorks 2 Native

Date: 13/Mar/2018

Hardware Platform: HP ProLiant DL380 Gen9

Configuration: Basic

		MBB			IMS			FBB
Software License	Comment	AAA-FE	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	49	79	40	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	200,000	-	-

Interface	TPS
AAA-FE to CUDB (LDAP)	0
AAA to HSS-FE (Diameter)	0
AAA to HLR-FE (MAP)	0
ENUM-FE to CUDB (LDAP)	79

	Dimensioned Quantity
HP ProLiant DL380 Gen9	2
IPWorks SC VM	2
IPWorks PL VM	2

Figure 28 IPWorks Layered Output for Basic

IPWorks Output

Release: IPWorks 2 Native

Date: 13/Mar/2018

Hardware Platform: HP ProLiant DL380 Gen9

Configuration: Basic

		MBB			IMS			FBB
Software License	Comment	AAA-FE	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	24,282	32,731	16,366	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	100,000,000	-	-

Interface	TPS
AAA-FE to CUDB (LDAP)	0
AAA to HSS-FE (Diameter)	0
AAA to HLR-FE (MAP)	0
ENUM-FE to CUDB (LDAP)	32731

	Dimensioned Quantity
HP ProLiant DL380 Gen9	6
IPWorks SC VM	2
IPWorks PL VM	9

Figure 29 IPWorks Layered Output for Basic Scaling

IPWorks Output

Release: IPWorks 2 Native

Date: 13/Mar/2018

Hardware Platform: HP ProLiant DL380 Gen9

Configuration: SingleServer

		MBB			IMS			FBB
Software License	Comment	AAA-FE	DNS	DHCP	DNS	ENUM	ERH	CLF
IP sessions		0	-	-	-	-	-	-
TPS		-	0	0	49	79	40	-
Connections		-	-	-	-	-	-	0
Records		-	-	-	-	200,000	-	-

Interface	TPS
AAA-FE to CUDB (LDAP)	0
AAA to HSS-FE (Diameter)	0
AAA to HLR-FE (MAP)	0
ENUM-FE to CUDB (LDAP)	79

	Dimensioned Quantity
HP ProLiant DL380 Gen9	1
IPWorks SC VM	2
IPWorks PL VM	2

Figure 30 IPWorks Layered Output for Single Server

Reference List

Ericsson Documents

[1] Trademark Information

[2] Typographic Conventions

[3] Glossary of Terms and Acronyms

[4] IPWorks ENUM Function Overview, 52/155 17-AVA 901 16 Uen

PCAT and Other Ericsson Document

[5] vUDC Dimensioning and Deployment Guideline, 4/192 02-HSC 113 08/8 Uen

[6] IPWorks 2 Characteristics

Standards

[7] The E.164 to URI Dynamic Delegation Discovery System Application (ENUM), RFC 3761, April 2004

Other Documents

[8] CANDI Tool

[9] Reference Traffic Model for Signaling Traffic in GSM, WCDMA, and Evolved Packet System, EAB-08:033765