# CPS vDRA Advanced Tuning Guide, Release 24.2.0

**First Published:** 2024-09-18

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# Preface

## About This Guide

**Note** The documentation set for this product strives to use bias-free language. For purposes of this documentation set, bias-free is defined as language that does not imply discrimination based on age, disability, gender, racial identity, ethnic identity, sexual orientation, socioeconomic status, and intersectionality. While any existing biased terms are being substituted, exceptions may be present in the documentation due to language that is hardcoded in the user interfaces of the product software, language used based on RFP documentation, or language that is used by a referenced third-party product.

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For information about available documentation, see the *CPS Documentation Map* for this release at Cisco.com.

**Note** The PATS/ATS, ANDSF, and MOG products have reached end of life and are not supported in this release. Any references to these products (specific or implied), their components or functions in this document are coincidental and are not supported. Full details on the end of life for these products are available at: https://www.cisco.com/c/en/us/products/wireless/policy-suite-mobile/eos-eol-notice-listing.html.

## Audience

This guide is best used by these readers:

- Network administrators

- Network engineers

- Network operators

- System administrators

This document assumes a general understanding of network architecture, configuration, and operations.

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- Contact your Cisco Systems, Inc. technical representative.

- Call the Cisco Systems, Inc. technical support number.

- Write to Cisco Systems, Inc. at support@cisco.com.

- Refer to support matrix at https://www.cisco.com/c/en/us/support/index.html and to other documents related to Cisco Policy Suite.

# Conventions (all documentation)

This document uses the following conventions.

| Conventions | Indication |
|---|---|
| **bold** font | Commands and keywords and user-entered text appear in **bold** font. |
| *italic* font | Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font. |
| [ ] | Elements in square brackets are optional. |
| {x | y | z } | Required alternative keywords are grouped in braces and separated by vertical bars. |
| [ x | y | z ] | Optional alternative keywords are grouped in brackets and separated by vertical bars. |
| string | A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks. |
| courier font | Terminal sessions and information the system displays appear in courier font. |
| < > | Nonprinting characters such as passwords are in angle brackets. |

| Conventions | Indication |
|---|---|
| [ ] | Default responses to system prompts are in square brackets. |
| !, # | An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line. |

**Note** Means reader take note. Notes contain helpful suggestions or references to material not covered in the manual.

**Caution** Means reader be careful. In this situation, you might perform an action that could result in equipment damage or loss of data.

**Warning** IMPORTANT SAFETY INSTRUCTIONS.

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SAVE THESE INSTRUCTIONS

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# Important Notes

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**Important**  Any feature or GUI functionality that is not documented may not be supported in this release or may be customer specific, and must not be used without consulting your Cisco Account representative.

**CHAPTER 1**

# vDRA Advanced Tuning

The configuration values in this document are based on the type and size of DRA deployment.

The deployment can be categorized into two sizes:

- Small Deployment - 2 Directors and 4 workers
- Large Deployment - 8 directors and 10 workers

**Note**  Recommended values are based on:

- Local Latency:
    - 20 ms for small deployments
    - 25 ms on large deployments

- Remote Latency:
    - 55 ms for small deployments
    - 50 ms for large deployments

In case the latency changes to a higher value, recommended values for all the configurations highlighted in this document needs to be re-characterized again.

# Threading Configuration

Thread pool configurations are applicable to java processes that run-in diameter-endpoint-s1xx on Director VM and binding-s1xx container on Worker VMs in DRA.

For more information on Threading Configuration, refer to the *CPS vDRA Configuration Guide*.

*Table 1: Thread Pool Names*

| Thread Pool Name | Description |
|---|---|
| bindings | This thread pool is used for IMSI_APN/MSISDN_APN AAR lookup (MOG) and binding audit updates. |
| bindings.lookup | This thread pool is used only if appsharding.reader thread pool is overloaded. This thread pool is applicable only for AAR VoLTE calls. |
| bindings.delete | This thread pool is used to query session database and enqueue session and all the binding for deletion. |
| bindings.response | This thread pool is used to receive database storage response and forwards it as bind store response. This is applicable for CCR-I requests. |
| msgtimeouts | This thread pool is used to process timed out requests. |
| qprocessor | This thread pool is used to send routed messages outside on the specific TCP connection. |
| receivers | Not Applicable |
| senders | Not Applicable |
| qprocessor.priority | This thread pool is used to send only priority routed messages outside on the specific TCP connection. |
| localcpPublishers | This thread pool is used to publish messages to local control plane. |
| globalcpPublishers | This thread pool is used to publish messages to global control plane. |
| cpSubscriberWorker | This Worker thread pool is used to process all the incoming control plane messages from local sites. |
| globalCPSubscriberWorker | This Worker thread pool is used to process all the incoming control plane messages from remote sites. |
| pcrfQuery | This thread pool is used for PCRF session queries used only for Rx AAR VoLTE calls. |
| pcrf.restapi | This thread pool is used to send request and receive response to/from pcrf endpoints and used only for RX AAR VoLTE calls.<br><br>**Note** **Scale By CPU Core** is not applicable for this thread pool. |

| Thread Pool Name | Description |
|---|---|
| stackStopHandler | This thread pool is used to gracefully disconnect diameter peers on process shutdown. |
| appsharding.reader | This thread pool is specific to Rx AAR VoLTE IPv6 binding lookup and processing. This thread pool is created for each shard. |

The following tables lists recommended values when single DRA installation TPS is above 200 K.

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**Important**    The highlighted values must be explicitly configured.

*Table 2: Recommended Values*

| Thread Pool Name | Default Values | | Recommended Values | |
|---|---|---|---|---|
| | Threads | Queue Size | Threads | Queue Size |
| bindings | 30 | 1000 | **130** | **30000** |
| bindings. lookup | 10 | 1000 | **30** | **5000** |
| bindings. delete | 10 | 1000 | **100** | **50000** |
| bindings. response | 10 | 1000 | 10 | 1000 |
| msgtimeouts | 3 | 1000 | 3 | 1000 |
| qprocessor | 30 | 5000 | **150** | **25000** |
| localcpPublishers | 15 | 2000 | 15 | 2000 |
| globalcpPublishers | 40 | 3000 | 40 | 3000 |
| cpSubscriberWorker | 15 | 10000 | 15 | 10000 |
| globalCPSubscriberWorker | 15 | 10000 | 30 | 20000 |
| pcrfQuery | 20 | 400 | 20 | 400 |
| pcrf.restapi | 10 | 2000 | 10 | 2000 |
| stackStopHandler | 50 | 0 | 50 | 0 |
| appsharding. reader | 1 | 1000 | **2** | **2000** |

# Database Capacity

> **Note** Rated database capacity has been arrived at after performing capacity tests.

The following table lists the database capacity for small and large deployments.

*Table 3: Database Capacity*

| Deployment | Cluster | No. of Primary Shards (dual DB enabled) | Network Latency (in ms) | Database Capacity (in k) | Database Capacity Per Shard | 85% Threshold Value |
|---|---|---|---|---|---|---|
| Small Deployment | Session_IPv6 | 8 | 20 | 30 | 30000/8 = 3750 | 3200 |
| | IMSI_MSISDN | 4 | 55 | 15 | 15000/4 = 3750 | 3200 |
| Large Deployment | Session_IPv6 | 48 | 25 | 180 | 180000/48 = 3750 | 3200 |
| | IMSI_MSISDN | 48 | 50 | 145 | 145000/48 = 3020 | 2600 |

The following is the test call model used to determine the capacity for each cluster:

1. CCR_I, CCR_T and AAR call model for Session-IPv6 database cluster capacity.

2. CCR-I and CCR_T call model for IMSI-APN/MSISDN-APN database cluster capacity.

3. Database capacity is based on network latency mentioned in the Table 3: Database Capacity, on page 4. If network latency is changed to higher value, then database capacity needs to be re-characterized.

# Database Alert Expressions

Database alerts refer to alerts that can be configured to be triggered if the capacity of the database exceeds beyond a certain threshold.

### IMSI_MSISDN Cluster

alert rule DRA_IMSI_MSISDN_DB_TPS_EXCEEDED

expression
"sum(rate(mongo_operation_total{state='primary',type='mongo',op=~'update|query|delete',cluster='IMSI_MSISDN'}[5m])) > (2500 * sum (mongo_node_state_primary {cluster='IMSI_MSISDN',type='mongo'}))"

event-host-label instance

message "{{ $labels.instance }} Persistence DB TPS exceeded , current value is {{ $value }} !"

snmp-severity critical

snmp-clear-message "{{ $labels.instance }} Persistence DB TPS in control, current value is {{ $value }} !"

**Session_IPv6 Cluster**

alert rule DRA_SESS_IPV6_DB_TPS_EXCEEDED

expression
"sum(rate(mongo_operation_total{state='primary',type='mongo',op=~'update|query|delete',cluster=~'SES_IPV6_.*'}[5m]))
> (3200 * sum(mongo_node_state_primary{cluster=~'SES_IPV6_.*',type='mongo'}))"

event-host-label instance

message "{{ $labels.instance }} Persistence DB TPS exceeded , current value is {{ $value }} !"

snmp-severity critical

snmp-clear-message "{{ $labels.instance }} Persistence DB TPS in control, current value is {{ $value }} !"

# Database Connection Settings

The following configurations vary based on deployment size (Small or Large) and should be configured accordingly. The worker VM java processes connect to the databases and create two database connection pools based on the database operation:

- Create/Update, and Delete

- Read

For more information on configuration syntax and examples, refer to the *CPS vDRA Operations Guide*.

**binding db-connection-settings**

The recommended values listed in the table are for write operations (Create/Update, Delete):

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**Important**   The highlighted values must be explicitly configured.

*Table 4: Recommended Value for Write Operations*

| Deployment | Bindings | connection-per-host | |
|---|---|---|---|
| | | **Default Values** | **Recommended Values** |
| Small Deployment | drasession | 10 | **14** |
| | ipv6 | 10 | 10 |
| | imsiapn | 10 | **35** |
| | msisdnapn | 10 | 10 |
| | ipv4 | 10 | 10 |

| Deployment | Bindings | connection-per-host | |
|---|---|---|---|
| | | **Default Values** | **Recommended Values** |
| Large Deployment | drasession | 10 | 10 |
| | ipv6 | 10 | 10 |
| | imsiapn | 10 | **20** |
| | msisdnapn | 10 | **20** |
| | ipv4 | 10 | **2** |

### binding db-read-connection-settings

The recommended values listed in the table are for read operations:

☞

**Important** The highlighted values must be explicitly configured.

*Table 5: Recommended Value for Read Operations*

| Deployment | Bindings | connections-per-host-for-read | |
|---|---|---|---|
| | | **Default Values** | **Recommended Values** |
| Small Deployment | drasession | 5 | 5 |
| | ipv6 | 5 | 5 |
| | imsiapn | 5 | **3** |
| | msisdnapn | 5 | 5 |
| | ipv4 | 5 | 5 |
| Large Deployment | drasession | 5 | **20** |
| | ipv6 | 5 | **20** |
| | imsiapn | 5 | **10** |
| | msisdnapn | 5 | **10** |
| | ipv4 | 5 | **1** |

#### binding cluster-binding-dbs imsiapn-msisdnapn

The following configuration is applicable only for large deployments. With this configuration IMSI-APN and MSISDN-APN bindings databases use the same connection pool for database transactions. This configuration helps in reducing the overall threads count in the worker VM.

*Table 6: Recommended Values*

| Deployment | Recommended Value |
|---|---|
| Small Deployment | Disable |
| Large Deployment | Enable |

# Audit Rate Limiter

Database Audit is an important functionality in DRA. To ensure that the database does not fill up with unnecessary entries or expired entries are cleared, a house keeping process is always functional. The following parameters should be used based on the deployment size and rated capacity of the system.

*Table 7: Audit Rate Limiter Recommended Values*

| Deployment | Rate Limiter | Stale Session Expiry Count | Binding DB Read Preference |
|---|---|---|---|
| Small Deployment | 100 | 6 | Nearest |
| Large Deployment | 51 | 6 | Nearest |

# Control Plane Tuning Configuration

Director nodes periodically advertise the status of all its peer connections over local and global control plane. All DRA nodes in the network use these peer status messages to keep their peer topology view updated. Peer topology is used to route the messages to appropriate director across different sites. When there are large number of peers connected across different sites, the load on control plane increases. This load increase can cause delay in processing peer status updates.

The following configurations are recommended to handle the increase in the control plane traffic process.

*Table 8: Control Plane Traffic Tuning Commands*

| Command | Parameters | Default Values | Recommended Value |
|---|---|---|---|
| `control-plane timers peer-status-update-interval <time-in-ms> peer-expiration-duration <duration-in-ms>`<br><br>**Note** To reflect the peer expiration duration change, application should be restarted in both director and worker nodes. | *time-in-ms*, *duration-in-ms* | 2000, 10000 | 4000, 12000 |
| `control-plane remote-peer-policy mated-system id <system-id>` | *system-id* (mated pair system ID) | NA | Mated Pair System ID |
| `control-plane remote-peer-policy global accept diameter-applications [Application Type]` | *Application Type* | All | Rx |
| `control-plane ipc-endpoint update-interval <time-in-milliseconds>` | *<time-in-milliseconds>* | 100 | 1000 |

# IPC Queue Send Thread Tuning Configuration

DRA maintains an IPC message queue where all the internal messages exchanged between Directors or Workers are stored. There are a set of IPC Queue processor threads that process these messages. During slow network conditions, when messages get delivered to one or a subset of peers, an IPC Queue processor thread that sends the message to these peers can eventually degrade the rate at which the IPC messages drop. These slow down conditions can cause message drops and 3002 errors not only to peers having degraded network but also to other peers.

The following configurations are recommended to handle the slow network peers.

*Table 9: IPC Queue - send thread Tuning Commands*

| Deployment | Command | Parameters | Default Values | Recommended Value |
|---|---|---|---|---|
| Large | `dra ipc-send-thread-limit <thread-limit> lock-sla-timeout <time-in-ms>message-throttle-duration <duration-in-ms> timeout-sample-to-throttle <max-samples>` | *thread-limit*<br><br>*time-in-ms*<br><br>*duration-in-ms*<br><br>*max-samples* | 50<br><br>200<br><br>30000<br><br>150 | 50 (1/3rd of IPC threads)<br><br>250<br><br>30000<br><br>150 |

| Deployment | Command | Parameters | Default Values | Recommended Value |
|---|---|---|---|---|
| Small | `dra ipc-send-thread-limit`<br>`<thread-limit> lock-sla-timeout`<br>`<time-in-ms>message-throttle-duration`<br>`<duration-in-ms>`<br>`timeout-sample-to-throttle`<br>`<max-samples>` | *thread-limit*<br><br>*time-in-ms*<br><br>*duration-in-ms*<br><br>*max-samples* | 50<br><br>200<br><br>30000<br><br>150 | 10 (1/3rd of IPC threads)<br><br>50<br><br>30000<br><br>30 |

> **Note**
> - To disable the SLA timeout, configure **lock-sla-timeout** to 2000 ms. Disabling SLA timeout leads to ipc message drop in slow network.
>
> - To disable throttling, configure **message-throttle-duration** to 0.
>
>   To disable thread throttling(limit), configure it to the value same as IPC Processor threads. Increasing **timeout-sample-to-throttle** reduces the chance of throttling the peer.

# IPC Queue Send Thread Priority Tuning Configuration

The enhancement of the slow peer handling logic is applicable for priority and nonpriority messages. Once a slow peer is identified, the application must be notified. The further messages towards that peer will be throttled for the configured duration (*message-throttle-duration*). Once the configured time elapsed, the peer will be marked as normal peer and all the messages towards that peer will be processed.

The following configurations are recommended to handle the slow network peers with extra optional parameters.

*Table 10: IPC Queue - send thread priority Tuning Commands*

| Deployment | Command | Parameters | Default Values | Recommended Value |
|---|---|---|---|---|
| Large | `dra ipc-send-thread-priority limit`<br>`<thread-limit> priority`<br>`lock-sla-timeout`<br>`<time-in-ms>priority`<br>`message-throttle-duration`<br>`<duration-in-ms>priority`<br>`timeout-sample-to-throttle`<br>`<max-samples>` | *thread-limit*<br><br>*time-in-ms*<br><br>*duration-in-ms*<br><br>*max-samples* | 5<br><br>200<br><br>30000<br><br>150 | 5 (1/2 of IPC threads)<br><br>250<br><br>30000<br><br>150 |
| Small | `dra ipc-send-thread-priority limit`<br>`<thread-limit> priority`<br>`lock-sla-timeout <time-in-ms>`<br>`priority message-throttle-duration`<br>`<duration-in-ms> priority`<br>`timeout-sample-to-throttle`<br>`<max-samples>` | *thread-limit*<br><br>*time-in-ms*<br><br>*duration-in-ms*<br><br>*max-samples* | 2<br><br>200<br><br>30000<br><br>150 | 2 (1/3rd of IPC threads)<br><br>50<br><br>30000<br><br>30 |