Configure Load Balancing on APs in CURWB Mode

Contents

Introduction

This document explains Degree of Preference and its crucial role in configuring vehicle handoff logic (load balancing) within a Fluidity network.

Background Information

In a Fluidity network, the default handoff logic is typically set to **standard**. However, advanced handoff logic settings allow for fine-tuning system performance based on specific environmental conditions.

In Load Balancing mode, mobile radios prioritize connections that offer the optimal balance between signal strength and traffic load.

This mode is primarily utilized in depot applications, where vehicles require high-speed data transfer while parked.

Prerequisite

Before implementing Load Balancing, radios must be set up in Fluidity Unit Role: Vehicle. In a Fluidity network, parameters such as Max Clients number, Handoff logic, Degree of Preference Limit, Degree of Preference Bias, Per Client DoP overhead, and Load Balancing can be customized to fine-tune the system. Note that the Max Clients number parameter is specific to the infrastructure unit role, while the Handoff logic parameter applies only to the vehicle unit role.

Understanding Degree of Preference (DoP)

The Degree of Preference (DoP) is a crucial adimensional metric in Fluidity network, used to assess the load level of each network units, whether mobile or infrastructure. DoP enables smart network management by using real-time load information to guide connection decisions.

Key Functions of DoP

Load Level Indicator: DoP quantifies how busy a unit is; updating every 5 seconds and during network events like handoffs or layout changes. Higher values indicate a unit is under heavier load; making it less ideal for new connections.

Network Coordination: Units advertise their DoP values across the network. Mobile units use infrastructure DoP data to choose optimal infrastructure unit to connect to; ensuring balanced load distribution. Infrastructure units use mobile DoP data to manage handoff requests; maintaining efficient operation.

Criteria for Infrastructure Handoff Eligibility

An Infrastructure unit can be selected for handoff by a Mobile unit under these conditions:

Handoff Eligibility by Vehicle Unit:

An Infrastructure unit is eligible for handoff by a Mobile unit if the mobile is already connected to it, or:

- The unit's RSSI (Received Signal Strength Indicator) is higher than the critical threshold.
- The advertised DoP of the unit is under the configured DoP limit.
- The unit is not black-listed, meaning it has not rejected a handoff request in the past 15 seconds and is not banned by the pole-proximity algorithm.

Handoff Eligibility by Infrastructure Unit:

Infrastructure unit X accepts a handoff request from a Mobile unit if:

- The mobile unit is already connected to Infrastructure unit X (within a 5-minute timeout), or X's current DoP is under the combined limit (DoP limit + DoP for client).
- The number of connected clients is under the configured maximum limit (max-clients).

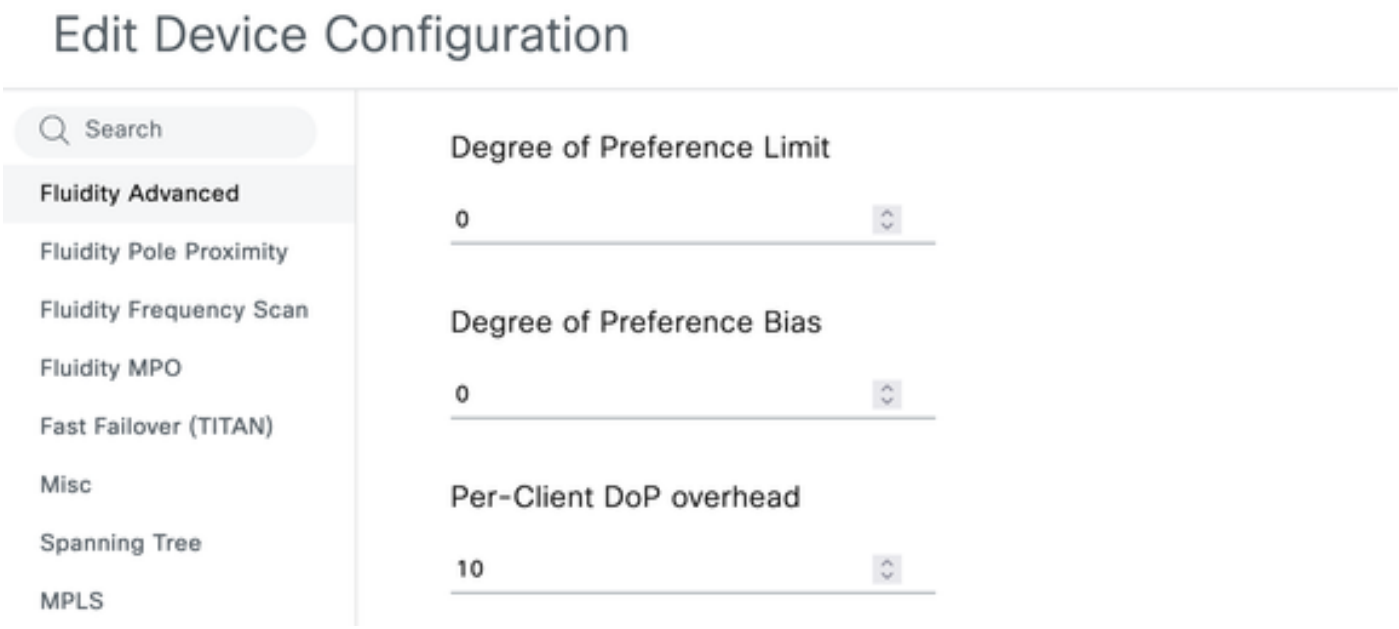
Load Balancing Handover Mechanism

- The Degree of Preference (DoP) value advertised by an Infrastructure unit is a function of the *current cumulative load carried by a unit expressed in Mbps, the number of clients connected, Per Client DoP Overhead, DoP Bias.*
- A Mobile unit selects the best eligible Infrastructure unit on the current frequency by prioritizing the strongest RSSI (within RSSI delta dBm from the strongest received) and the lowest DoP, with RSSI taking precedence over DoP when RSSI values differ by more than RSSI delta dBm.
- In a multi-frequency network design, a Mobile unit initiates a frequency scan from a pre-defined list and run the handoff decision algorithm if no eligible Infrastructure units are found on the current frequency within a specified interval.

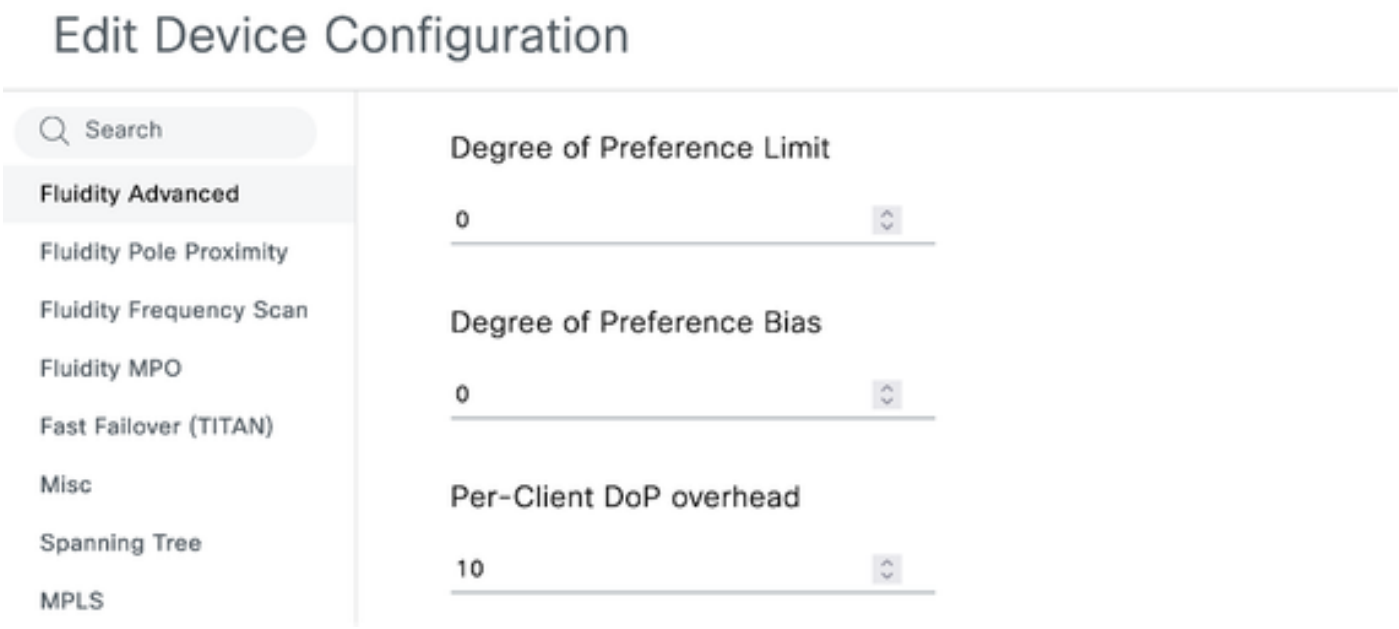
Configuration

Configuring Load Balancing using IW Service

1. To enable Degree of Preference settings, the Handoff Logic must be set to **Load Balancing** under Fluidity Settings.

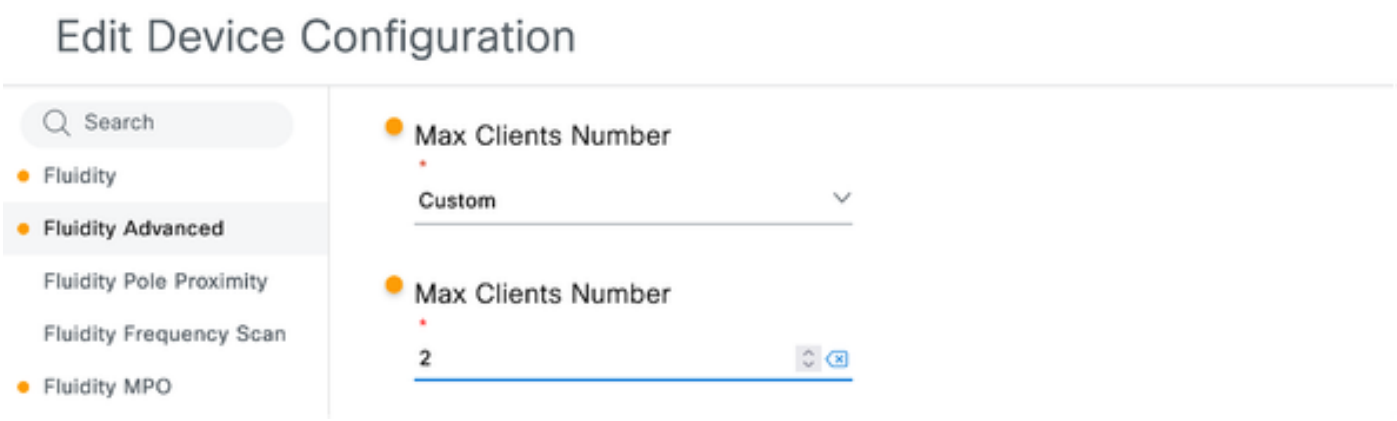


2. IW-Service or radio CLI provides these settings to fine tune the system.
    1. **Degree of Preferences (DoP) Limit:** This value sets the upper limit for the device DoP. The default value is 0, indicating unlimited DoP.
    2. **Degree of Preference Bias:** This value is added by each infrastructure unit to the computed DoP. Beyond the load, it is used to increase or decrease the likelihood of an infrastructure unit being selected by a mobile unit. The default value is 0, but it can be adjusted positively or negatively.
    3. **Per-Client DoP overhead:** This value is added by each client to the computed DoP, helping to fine-tune the system. The default value is 10.



3. **Max Clients Number** specifies the maximum number of vehicles allowed to connect to an

infrastructure unit simultaneously. The default value is **unlimited**.



Configuring Load Balancing using CLI

Configuring Layer2 Fluidity via CLI:

Trackside Configuration:

```
ME_TRK_IW9167EH#configure modeconfig mode meshend
Note: Tracksides other than mesh end needs to be configured as “meshpoint”

ME_TRK_IW9167EH#configure ap address ipv4 static IP NETMASK GATEWAY DNS1 DNS2
ME_TRK_IW9167EH#configure dot11Radio 1 frequency 5180
ME_TRK_IW9167EH#configure dot11Radio 1 bandwidth 20
ME_TRK_IW9167EH#configure wireless passphrase URWB
ME_TRK_IW9167EH#configure dot11Radio 1 mode fluidity
ME_TRK_IW9167EH#configure fluidity id infrastructure
ME_TRK_IW9167EH#configure fluidity dop bias 0
ME_TRK_IW9167EH#configure fluidity dop limit 0
ME_TRK_IW9167EH#configure fluidity dop client 10
ME_TRK_IW9167EH#configure fluidity max-clients 2
ME_TRK_IW9167EH#write
ME_TRK_IW9167EH#reload
```

Vehicle configuration:

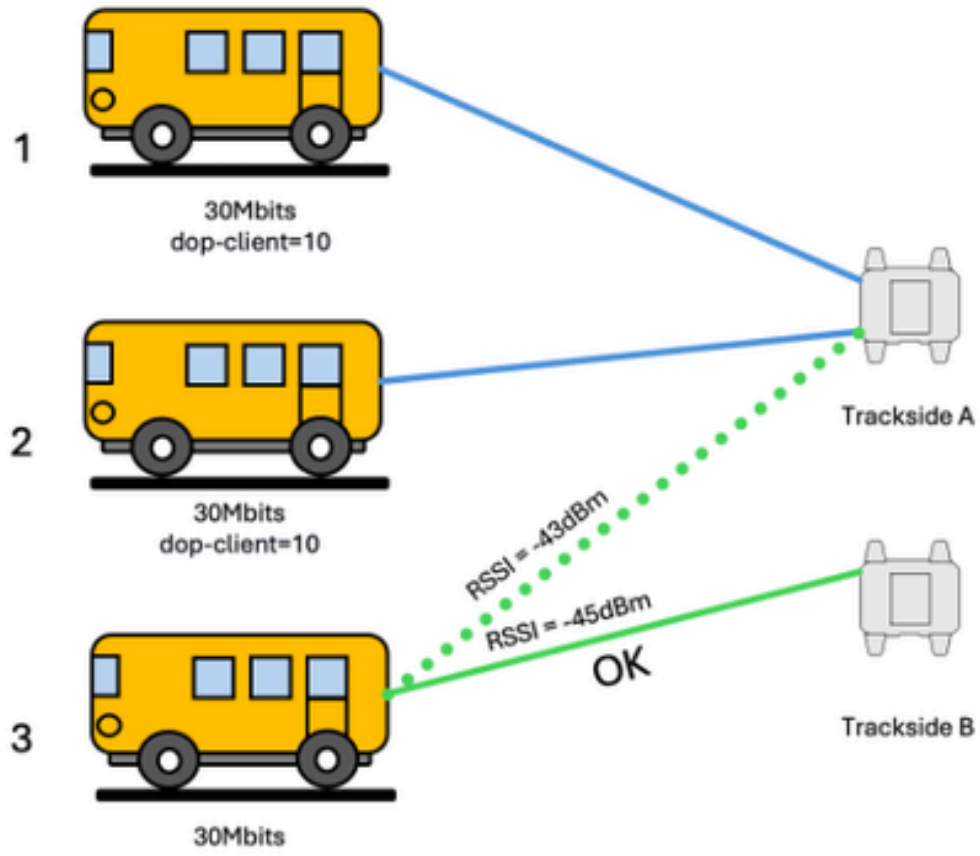
```
MP_V_IW9165E#configure modeconfig mode meshpoint
MP_V_IW9165E#configure ap address ipv4 static IP NETMASK GATEWAY DNS1 DNS2
MP_V_IW9165E#configure dot11Radio 1 frequency 5180
MP_V_IW9165E#configure dot11Radio 1 bandwidth 20
MP_V_IW9165E#configure wireless passphrase URWB
MP_V_IW9165E#configure dot11Radio 1 mode fluidity
MP_V_IW9165E#configure fluidity id vehicle-auto
MP_V_IW9165E#configure fluidity handoff load-balancing
MP_V_IW9165E #configure fluidity dop bias 0
MP_V_IW9165E #configure fluidity dop limit 0
MP_V_IW9165E #configure fluidity dop client 10
MP_V _IW9165E#write
MP_V _IW9165E#reload
```

Load Balancing Examples

Example 1:

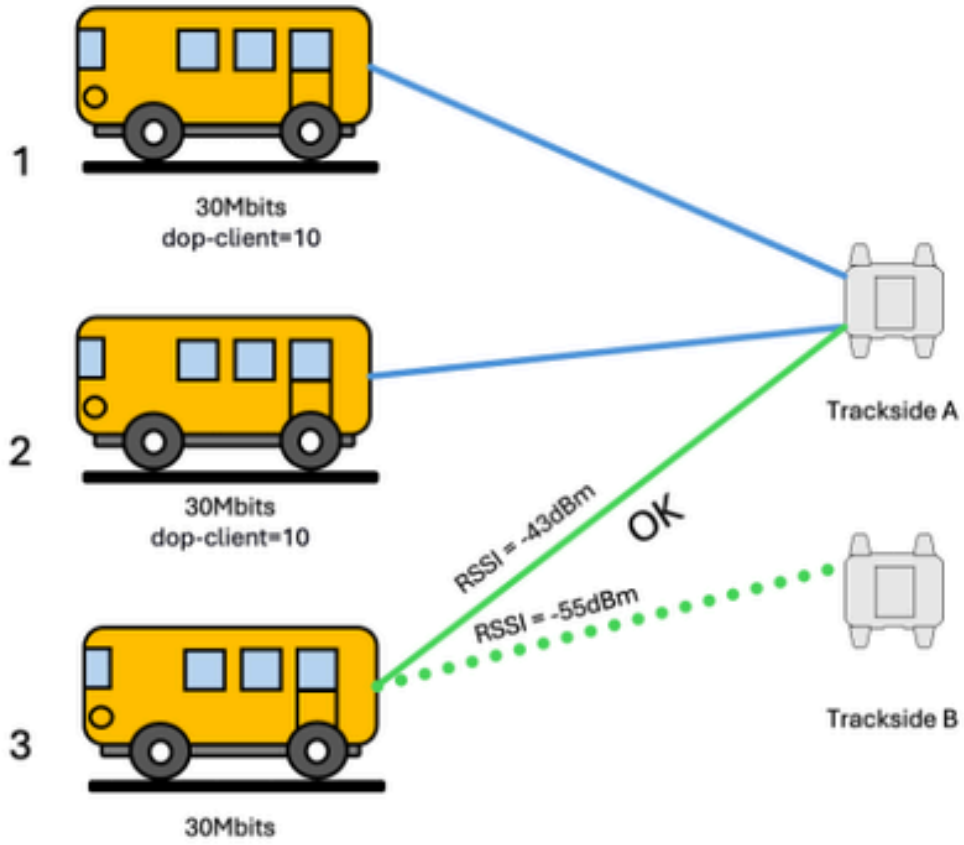
1. Trackside-A and Trackside-B infrastructure units are operating on the same frequency, with RSSI values of [-43 dBm vs -45 dBm] as perceived by Train 3, not exceeding the RSSI delta (as default Δ = 6 dB).

1. Train 3 connects to Trackside-B because the DoP advertised by Trackside-A is higher than that of Trackside-B. The presence of multiple connected vehicles increases the DoP of Trackside-A.



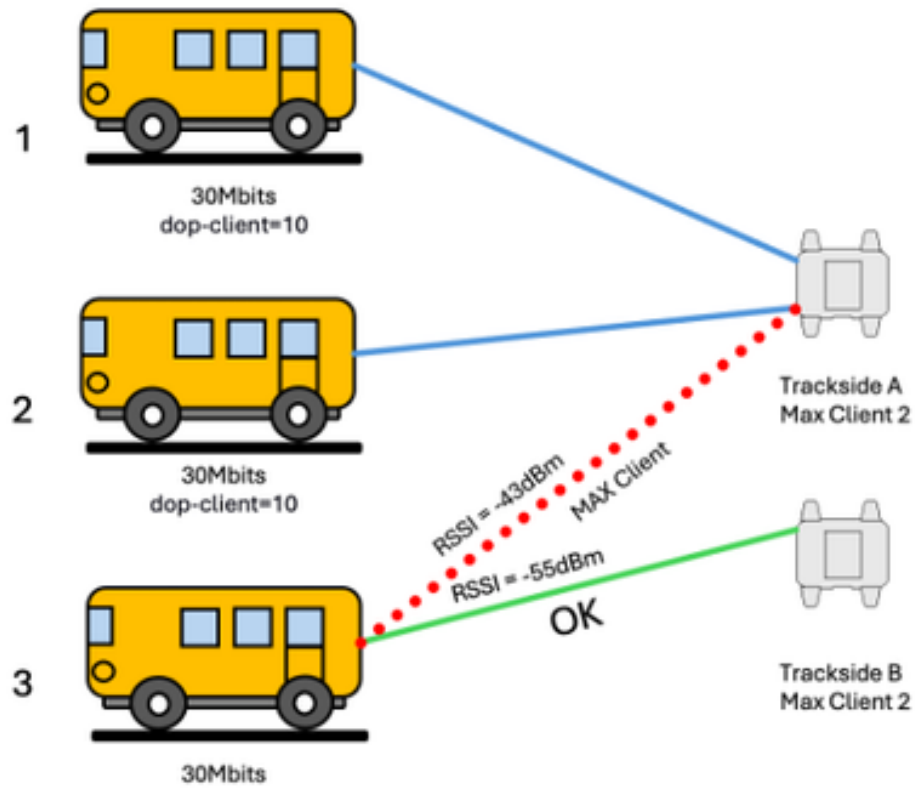
Example 2:

1. Trackside-A and Trackside-B infrastructure units are operating on the same frequency, with RSSI values of [-43 dBm vs -55 dBm] as perceived by Train 3, exceeding the RSSI delta (Δ = 6 dB).
2. Train 3 connects to Trackside-A because the RSSI values differ by more than the RSSI delta (Δ = 6 dB). In such cases, RSSI always takes priority over DoP when selecting the optimal infrastructure unit.



Example 3:

1. Train 3 attempts to connect to the infrastructure unit Trackside-A because it offers a higher RSSI level.
2. Trackside-A evaluates whether accepting the connection from Train 3 exceeds the configured DoP limit. Additionally, Trackside-A checks if accepting another vehicle would surpass the maximum client threshold.
3. Even if the DoP does not exceed the limit by accepting Train 3, Trackside-A refuses the connection if the number of clients would exceed the maximum clients threshold.
4. Train 3 then assesses other options and attempt to connect to Trackside-B.
5. Train 3 successfully connects to Trackside-B, as there are no threshold violations in accepting Train 3.


1
30Mbits
dop-client=10
2
30Mbits
dop-client=10
3
30Mbits
RSSI = -43dBm
MAX Client
RSSI = -55dBm
OK
Trackside A
Max Client 2
Trackside B
Max Client 2