ALLSEEN ALLIANCE

Core WG Technical Meeting

December 2, 2014

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Reminder:

This call is being recorded

Agenda

1. QCE AllJoyn Router Selection for TCL Proposal

QCE AllJoyn Router Selection for TCL Proposal

TCL Router Selection

- An algorithm is desired for TCL to select a preferred AJ Router

- Router characteristics which are important from TCL router selection perspective
  - Mobility
  - Power Source
  - Availability
  - WiFi Traffic Overhead
  - Number of available connections

- Proposed approach:
  - Generate a router ranking based on these characteristics and use the ranking at the TCL for selecting a desired router

Router Characteristics

- Static characteristics
  - Mobility:
    - Indicates how mobile the router is
    - Values:
      - Always Stationary (e.g. WiFi Access Point, TV)
      - Low mobility (mostly stationary & proximal e.g. wireless speaker)
      - Intermediate mobility (e.g. tablets, laptops)
      - High mobility (e.g. smartphone)
  - Power source:
    - Indicates how the router device is powered
    - Values:
      - Always AC powered
      - Battery powered and chargeable
      - Battery powered and not chargeable

Router Characteristics

- Static characteristics
  - Availability
    - Indicates average uptime for the AJ Router device over a 24hr period, independent of proximal/remote location.
      - Examples: WiFi Access Point availability: 24hr, TV availability: 5hr, Smartphone availability: 3hr
    - Values range in [1, 8] with each value representing a 3 hr granularity.
  - Node Type
    - It is desirable to select a router such that WiFi traffic overhead is minimized
    - Selecting a router on the WiFi Access Point or on a hardwired device is preferred
    - 'Node type' indicates type of the node router is deployed on
    - Values:
      - Access Point
      - Wired (e.g. NAS Server)
      - Wireless
- Static characteristics values are set as part of the router config file by the OEM/App Developer

Router Characteristics

- Dynamic characteristics
  - Some dynamic characteristics are AJ specific while others are platform fetched
  - Only AJ specific dynamic characteristics considered in current design

- AJ Specific dynamic characteristics
  - Following characteristics are considered which provide a measure of available connections
    1. Number of Available TCP connections (out of max_completed_connections_tcp)
    2. Number of Available UDP connections (out of max_completed_connections_udp)
    3. Number of Available TCL connections over TCP (out of max_remote_clients_tcp)
    - max_remote_clients_tcp was formerly known as max_untrusted_clients

- Platform based dynamic characteristics (not considered in current design)
  - Available Battery time
  - CPU load

Router Ranking

- Calculate separate rank for static and dynamic characteristics

- Static Rank (SRNK)
  - Normalize value for each static characteristics in [0,1] range
  - Calculate SRNK as weighted average of normalized values with these weights
    - Mobility weight = 3/10
    - Availability weight = 3/10
    - Node Type weight = 3/10
    - Power source weight = 1/10
  - SRKN is in [0,1] range

Static Characteristics

Mobility	**Enumeration**	**Normalized Value**
Always Stationary	4	1
Low mobility	3	3/4
Intermediate mobility	2	1/2
High mobility	1	1/4
Power Source		
Always AC powered	3	1
Battery powered and chargeable	2	2/3
Battery powered and not chargeable	1	1/3
Availability		
Low (0-3 hr)	1	1/8
:	2	1/4
:	3	3/8
:	4	1/2
:	5	5/8
:	6	3/4
:	7	7/8
High (21-24 hr)	8	1
Node Type		
Access Point	1	1
Wired	2	1
Wireless	3	1/2

Router Ranking

- Dynamic Rank (DRNK)
  - DRNK is based on absolute values of the available connections
    - Example: Device1 with 20 available TCP conn
  - Define a common base (max) across devices for normalizing absolute connection values
    - Available TCP connections max - [500]
    - Available UDP connections max – [5000]
    - Available remote clients connections max – [100]
  - Common base is coded in
    - If future devices support more than max conn, then rank contribution will be ‘1’
  - Normalize conn values in [0, 1] range using the respective common base
    - Normalization done using a log scale
    - Log scale ensures that values at lower range are more granular than values at higher range
  - Account for loading - scale normalized value with the available capacity ratio
    - Example: capacity ratio = 50/100 for a device with 50 available TCP conns out of 100
    - Higher the capacity (implying lower the load), higher will be the rank contribution
  - Calculate DRNK as weighted average of (normalized+scaled) values for three types of conns
    - Each conn gets same weight (1/3)
  - DRNK is in [0, 1] range

Router Ranking

- Overall Router Rank (RRNK)
  - Compute an overall RRNK as weighted average of SRNK and DRNK with these weights
    - SRNK weight = 0.6
    - DRNK weight = 0.4
  - RRNK is in [0,1] range.

- Router rank generation algorithm behaves as follows:
  - Typically the router with higher static rank will get higher overall rank
  - If multiple routers have same/close enough static ranks, router with the higher available connections (defined by dynamic rank) will get higher overall rank
    - DRNK used as a way to break tie
  - If routers with high SRNKs have really small DRNKs, still high SRNK routers will get slightly higher overall rank. Router with a lower SRNK but much higher DRNK will typically not get higher overall rank.

Router Logic

- Router replies to mDNS query only if configured with matching BusNode WKN
- Router also ensures that following connections criteria are met for sending mDNS response
  - At least one available TCL connection over TCP (out of max_remote_clients_tcp)
  - At least one additional TCP and UDP connections available (besides the TCL one)
- Router computes RRNK only if connections criteria are met
- Send RRNK in the mDNS response message to TCL
- Send router AJ Protocol version in mDNS response (already planned n 14.12)

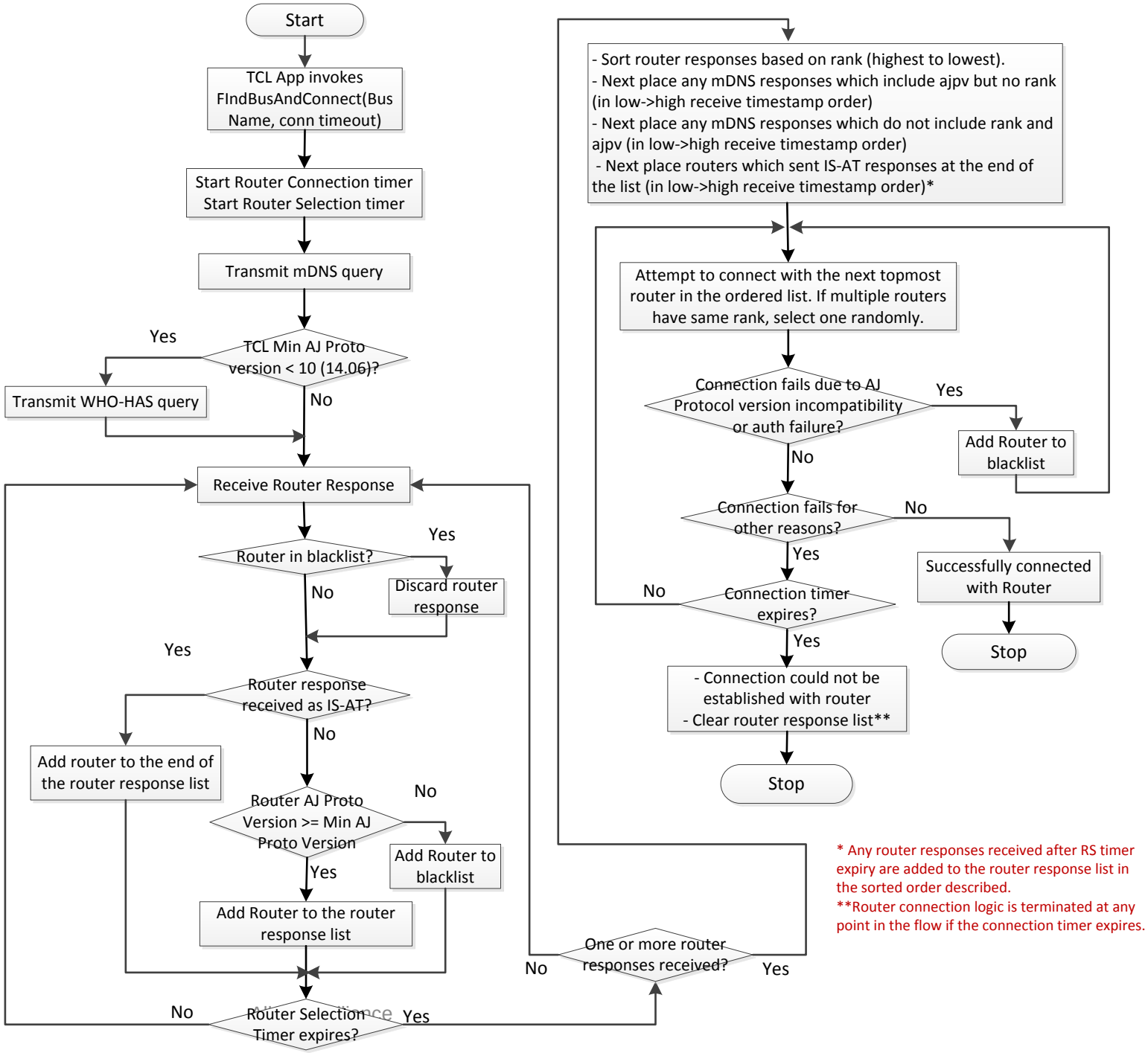
TCL Logic – Summary (1/2)

- Send a WHO-HAS message for router discovery only if TCL Min AJ Protocol Version < 10 (14.06).
  - A 14.06 router will be sending an mDNS response for TCL query
- Maintain a router response list. Router response will be sorted as below:
  - New routers with mDNS response including rank will be listed on the top, shorted based on rank (high to low)
  - 14.12 routers with mDNS response including ajpv but no rank will be listed next in low->high receive timestamp order
  - 14.06 routers with mDNS response without rank and ajpv will be listed next in low->high receive timestamp order
  - 14.02 routers with IS-AT responses will be listed at the end of the list in low->high receive timestamp order

TCL Logic – Summary (2/2)

- Support an overall router connection (RC) timer for connecting to a router (specified by the app)
  - Enforce [min, max] range for the RC timer
- Wait for router selection (RS) timer to collect router responses before attempting to connect with a router
  - RS time < min of RC timer
- If no responses received in RS timer, continue to wait and connect immediately when a response received
- Add router response received after the RS timer has to the router response list in sorted order
- Add router to the blacklist based on AJ protocol version incompatibility or auth failure
- Terminate router connection logic whenever RC timer expires.

TCL Logic - Flowchart



* Any router responses received after RS timer expiry are added to the router response list in the sorted order described.
**Router connection logic is terminated at any point in the flow if the connection timer expires.

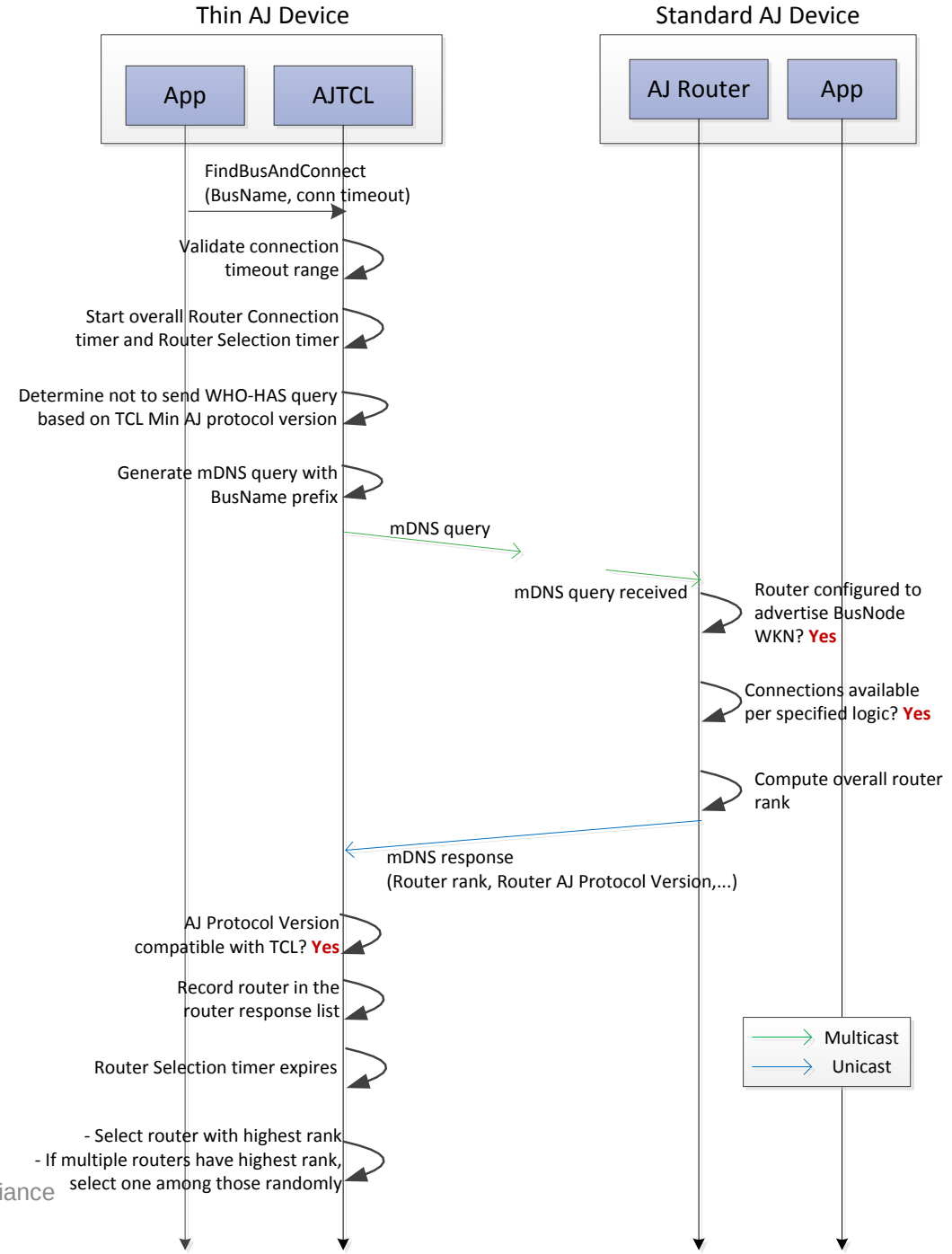
mDNS Updates

- No changes to mDNS query

- mDNS Response
  - Includes two new keys under sender-info TXT record
    - rank: indicates the overall router rank
    - ajpv: indicates the AJ protocol version of the router. This is already planned to be added in 14.12.

Router Selection Call Flow

- **Use Case:** TCL looking for a router supporting NGNS
  - TCL Min AJ Protocol Version = 10



Use Cases

- UC 1: Static and mobile devices have similar # of connections available.

Devices	Static Characteristics				Dynamic Parameters			SRNK	DRNK	Overall RRNK
	Power Source	Mobility	Availability*	Node Type	Available TCP Conn (total configured)	Available UDP Conn (total configured)	Available TCL Conn (total configured)			
WiFi Access Point	3	4	8	1 (AP)	40 (100)	500 (2000)	10 (50)	1	0.17	0.66
TV	3	4	2	2 (Wired)	60 (80)	300 (1000)	20 (20)	0.77	0.44	0.63
Wireless Speaker	2	3	8	3 (Wireless)	10 (20)	80 (200)	5 (10)	0.74	0.18	0.51
Tablet	2	2	1	3	80 (100)	600 (2000)	10 (30)	0.4	0.31	0.36
Smartphone	2	1	1	3	60 (100)	800 (2000)	15 (30)	0.32	0.33	0.32
Laptop	2	2	2	3	60 (100)	800 (2000)	15 (30)	0.44	0.33	0.39

*Availability numbers are based on average usage reports for these devices

Use Cases

- UC 2: Static devices have minimal available conn, mobile devices have higher available conn

Devices	Static Characteristics				Dynamic Parameters			SRNK	DRNK	Overall RRNK
	Power Source	Mobility	Availability	Node Type	Available TCP Conn (total configured)	Available UDP Conn (total configured)	Available TCL Conn (total configured)			
WiFi Access Point	3	4	8	1 (AP)	5 (100)	10 (2000)	2 (50)	1	0	0.6
TV	3	4	2	2 (Wired)	5 (80)	10 (1000)	2 (20)	0.77	0.01	0.46
Wireless Speaker	2	3	8	3 (Wireless)	10 (20)	80 (200)	5 (10)	0.74	0.18	0.51
Tablet	2	2	1	3	80 (100)	600 (2000)	10 (30)	0.4	0.31	0.36
Smartphone	2	1	1	3	80 (100)	1800 (2000)	20 (30)	0.32	0.59	0.42
Laptop	2	2	2	3	60 (100)	800 (2000)	15 (30)	0.44	0.33	0.39

Use Cases

- UC 3: Multiple static devices with same availability (AP and NAS Server)

Devices	Static Characteristics				Dynamic Parameters			SRNK	DRNK	Overall RRNK
	Power Source	Mobility	Availability*	Node Type	Available TCP Conn (total configured)	Available UDP Conn (total configured)	Available TCL Conn (total configured)			
WiFi Access Point	3	4	8	1 (AP)	40 (100)	500 (2000)	10 (50)	1	0.17	0.66
NAS Server	3	4	8	2 (Wired)	60 (100)	500 (2000)	20 (50)	1	0.27	0.7
TV	3	4	2	2	60 (80)	300 (1000)	15 (20)	0.77	0.37	0.61
Tablet	2	2	1	3 (Wireless)	80 (100)	600 (2000)	10 (30)	0.4	0.31	0.36
Smartphone	2	1	1	3	60 (100)	800 (2000)	15 (30)	0.32	0.33	0.32
Laptop	2	2	2	3	60 (100)	800 (2000)	15 (30)	0.44	0.33	0.39

Use Cases

- UC 4: NAS Server connected wirelessly

Devices	Static Characteristics				Dynamic Parameters			SRNK	DRNK	Overall RRNK
	Power Source	Mobility	Availability*	Node Type	Available TCP Conn (total configured)	Available UDP Conn (total configured)	Available TCL Conn (total configured)			
WiFi Access Point	3	4	8	1 (AP)	40 (100)	500 (2000)	10 (50)	1	0.17	0.66
NAS Server	3	4	8	3	60 (100)	500 (2000)	20 (50)	0.85	0.27	0.61
TV	3	4	2	2 (Wired)	60 (80)	300 (1000)	15 (20)	0.77	0.37	0.61
Tablet	2	2	1	3 (Wireless)	80 (100)	600 (2000)	10 (30)	0.4	0.31	0.36
Smartphone	2	1	1	3	60 (100)	800 (2000)	15 (30)	0.32	0.33	0.32
Laptop	2	2	2	3	60 (100)	800 (2000)	15 (30)	0.44	0.33	0.39

Use Case Analysis

Router ranking use cases

- Use Case 1
  - Represents a typical use case
  - With routers on static and mobile devices having similar # of available conn, a static router gets selected.
- Use Case 2
  - Represents a non-typical but quite plausible scenario
  - With router on static devices having minimal # of available conn, still a static router gets selected
- Use Case 3
  - With multiple static routers with same SRNK, the router with higher available connections get selected
- Use Case 4
  - If NAS Server is connected wirelessly, its SRNK drops and AP gets selected

List of Applicable Config Parameters

- Algorithm parameters (on Router) - should be same on all devices
  - Weight assignment among static characteristics
  - Common base for TCP, UDP and TCL connections
  - Weight assignment between SRNK and DRNK

- Router Config Parameters (device specific)
  - Total allowed connections for TCP, UDP and TCL
  - Values for static characteristics
    - Mobility, Availability, Node Type

- TCL Parameters
  - [min, max] range for router connection timeout
    - Suggested default: min=10sec, max=60sec
  - Router Selection Timer
    - Suggested default = 5sec

Backup Slides

Router Ranking

- Static Rank computation
  - Assign weights to each static characteristics based on importance
    - Mobility weight (w_m) = 3/10
    - Availability weight (w_a) = 3/10
    - Node Type weight (w_{nt}) $= 3/10$
    - Power source (w_{ps}) = 1/10
  - Calculate Static Rank (SRNK) as weighted average
    - $SRNK = (w_m * x_m + w_a * x_a + w_{nt} * x_{nt} + w_{ps} * x_{ps})$,
      - where x represents the normalized value for the corresponding static characteristic

Router Ranking

- Dynamic Rank computation
  - Normalize each absolute connection value in [0,1] range using the associated [0, max] range
  - Normalizing conn values using log scale
    - $Normalized\ avail\ conn\ (x_i')\ is\ computed\ as$:
    - $x'_i = \frac{\log(x_i)}{\log(\max(x_i))}$
    - If $x_i > \max(x_i)$, $then\ x'_i = 1$
    - Log scale ensures that values at lower range are more granular than values at higher range
  - Determine available capacity ratio (A) = (avail/total) for each type of connection
    - Total for TCP = (num_completed_connections_tcp – num_remote_clients_tcp)
  - Assign same weight (1/N) to all types of connections
  - Calculate Dynamic Rank (DRNK) as weighted average
    - $DRNK = 1/N(x'_{tcp}A_{tcp} + x'_{udp}A_{udp} + x'_{tcl}A_{tcl})$
      - where N=3,
      - A is available capacity ratio for corresponding connection type

Router Ranking

- Overall Rank computation
  - Suggested weights for SRNK and DRNK
    - SRNK weight (w_{srnk})= 0.6
    - DRNK weight (w_{drnk})= 0.4
  - Calculate overall Router Rank (RRNK) as weighted average of SRNK and DRNK
    - $RRNK = (w_{srnk} * SRNK + w_{drnk} DRNK)$

Thank You

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