IETF 97 ROLL

Routing over Low-Power And Lossy Networks

Chairs:
Peter van der Stok
Ines Robles

Secretary:
Michael Richardson

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Source: https://www.ietf.org/about/note-well.html

Meeting Materials

- 11:10-12:10 Wednesday Morning session II
- Remote Participation
  - Jabber Room: roll@jabber.ietf.org
  - Meetecho: http://www.meetecho.com/ietf97/roll
- Etherpad:
  - http://tools.ietf.org/wg/roll/minutes
- Audio Streaming:
- Minutes taker: xxxx (in etherpad)
- Jabber Scribe:
- **Please sign blue sheets :-)**

Agenda

11:10 - 12:10 Wednesday Morning session II

Item	Time	Presenter
Status of the working group	11:10 - 11:18 (8mins)	Peter/Ines
Use of rpl info draft - draft-ietf-roll-useofrplinfo-09	11:18 - 11:26 (8 min.)	Michael Richardson
AODV-RPL draft - draft-satish-roll-aodv-rpl-02	11:26 - 11:41 (15 min.)	Charles Perkins
DAO projection: draft-thubert-roll-dao-projection-03	11:41 - 11:55 (14 min.)	Pascal Thubert
Mpl Forwarder select - draft-vanderstok-roll-mpl-forw-select-02	11:55 - 12:08 (13 min.)	Peter van der Stok
Q&A	12:08 - 12:10 (2 min.)	Peter/Ines

Milestones

May 2016	Submit draft about how to compress RFC6553, RFC6554, and IP headers in the 6LoWPAN adaptation layer context to the IESG. draft-ietf-6lo-routing-dispatch	Done
April 2016	Submit draft about when to use RFC6553, RFC6554, and IPv6-in-IPv6 encapsulation to the IESG. draft-robles-roll-useofrplinfo	In WGLC
Jan 2016	Evaluate WG progress, recharter or close	Done

State of Active Internet-Drafts

Draft	Status
draft-ietf-roll-applicability-ami-15	Ed Queue
draft-ietf-roll-applicability-template-09	Fade away
draft-ietf-roll-routing-dispatch-05	To IANA
draft-ietf-roll-useofrplinfo-09	WGLC

No Open Tickets

Related Internet-Drafts

draft-jadhav-roll-no-path-dao-ps-01 **No-Path DAO Problem Statement**
draft-satish-roll-aodv-rpl-02 **Asymmetric AODV-P2P-RPL in Low-Power and Lossy Networks (LLNs)**
draft-thubert-roll-dao-projection-03 **Root initiated routing state in RPL**
draft-vanderstok-roll-mpl-forw-select-01 **MPL Forwarder Select (MPLFS)**
draft-vanderstok-roll-mpl-yang-02 **A YANG model for Multicast Protocol for Low power and lossy Networks (MPL)**

Charter modifications

- Added “**We focus only in IPv6 work.**”
- Work Items are:
  - Guidance in using RFC6553, RFC6554, and IPv6-in-IPv6 encapsulation.
  - Additional protocol elements to reduce packet size and the amount of required routing states
  - Automatic selection of MPL forwarders to reduce message replication.
  - Data models for RPL and MPL management
  - Multicast **enhancements** algorithms.

draft-ietf-roll-useofrplinfo: Status

Update: WG Last Call. Please comment.

Draft Update RFC 6550

"The related document updates [RFC6550]. In general, any packet that leaves the RPL domain of an LLN (or leaves the LLN entirely) will NOT be discarded, when it has the [RFC6553] RPL Option Header known as the RPI or [RFC6554] SRH3 Extension Header (S)RH3. Due to changes to [I-D.ietf-6man-rfc2460bis] the RPI Hop-by-Hop option MAY be left in place even if the end host does not understand it. "

Asymmetric AODV-P2P-RPL in Low-Power and Lossy Networks (LLNs)

draft-satish-roll-aodv-rpl-02

Satish Anamalamudi
Mingui Zhang
AR. Sangi
Charlie Perkins
S.V.R Anand
Dongxin Liu
satish.anamalamudi@huawei.com

Overview

- Extension of P2P-RPL [RFC6997]
  - Support for purely storing mode(hop-by-hop routing).
  - Support both Symmetrical and Asymmetrical bi-directional links.
  - Avoid address vector in “P2P-RDO” and “P2P-DRO” messages.

- AODV-RPL Mode of Operation (MoP)
  - RREQ Message.
  - RREP Message.

AODV-RPL Control messages

- Paired DODAGs.
  - DODAG RREQ-Instance
  - DODAG RREP-Instance

- DODAG RREQ-Instance
  - DIO + RREQ Option
  - Control transmission from OrigNode to TargNode.
  - Data transmission from TargNode to OrigNode.

- DODAG RREP-Instance
  - DIO + RREP Option
  - Control transmission from TargNode to OrigNode.
  - Data transmission from OrigNode to TargNode.

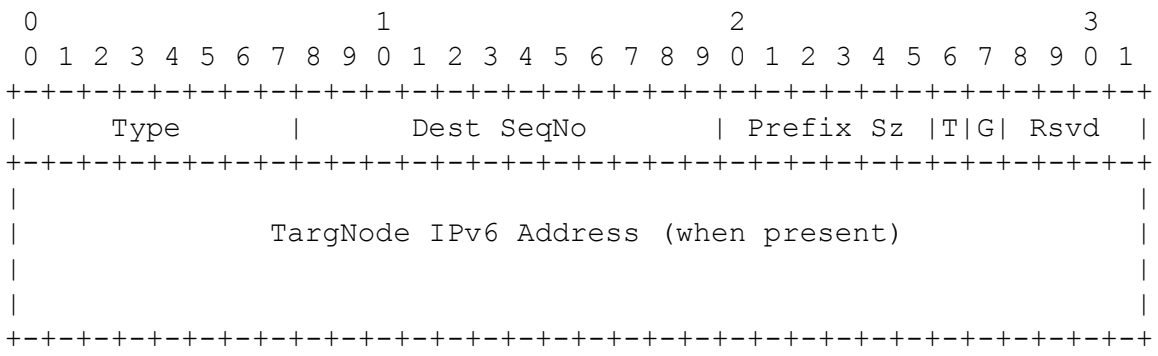
Changes from “01” to “02”

- Draft update
  - DODAG Pairing.
  - Avoids Destination IP in “RREP message”.
- Implementation Update
  - Works on Contiki with Cooja simulator
  - Supports both symmetric and Asymmetric AODV-RPL
  - Initial comparisons with RPL storing mode [RFC6550]
  - Comparisons with both symmetric and asymmetric operations.

DODAG Pairing

- DODAG Pairing for Instance IDs
- Upstream Instance ID
  - RREQ-Instance ID must be an odd number.
  - Intermediate routers store the Instance-ID.
- Down-stream Instance ID
  - RREP-Instance ID must be “RREQ-InstanceID+1”.
  - RREP-Instance ID is therefore an even number

Gratuitous RREP(G-RREP)



- “G=0” represents RREP is from TragNode.
- “G=1” represents RREP is from Intermediate node.
- “G” is set to “1” when Intermediate node has path towards destination.
  - Unicast G-RREP towards OrgNode.
  - Unicast RREQ-Instance towards TargNode.
- 'T' is set to true to indicate that the TargNode IPv6 Address field is present.

AODV-RPL Implementation

- Software Implementation on Contiki 3.0
  - Supports Symmetric and Asymmetric cases
  - Will be available on GitHub soon
- Currently being tested and simulated on Cooja simulator
  - Experimentation under different network scenarios underway
- Expect to demonstrate during IETF 98

Next Steps

- Comments and Questions

Thanks!

Root initiated routing state in RPL

draft-thubert-dao-projection

Pascal Thubert

IETF 97

Seoul Nov. 2016

Highlights

- Adds Centralized routing (Traffic Engineering) to RPL
  - E.g. Root coordinates with PCE
- Add limited Storing in Non storing mode
  - Enough topology info in non-storing route optimization at the root
  - Local compression; RPL source route header becomes loose
- Also support for transversal route in Storing Mode
  - Works for storing and non storing routes
- Need topological information and / or device constraints
  - e.g. how many routes can a given RPL router store?
  - Can leverage TEAS / DETNET work

What’s new with DAO projection 03

Nothing Much;

Fixed abstract

Clarified capabilities for transversal routes in storing more

Justification the need of reducing packet size

What’s next for DAO projection ?

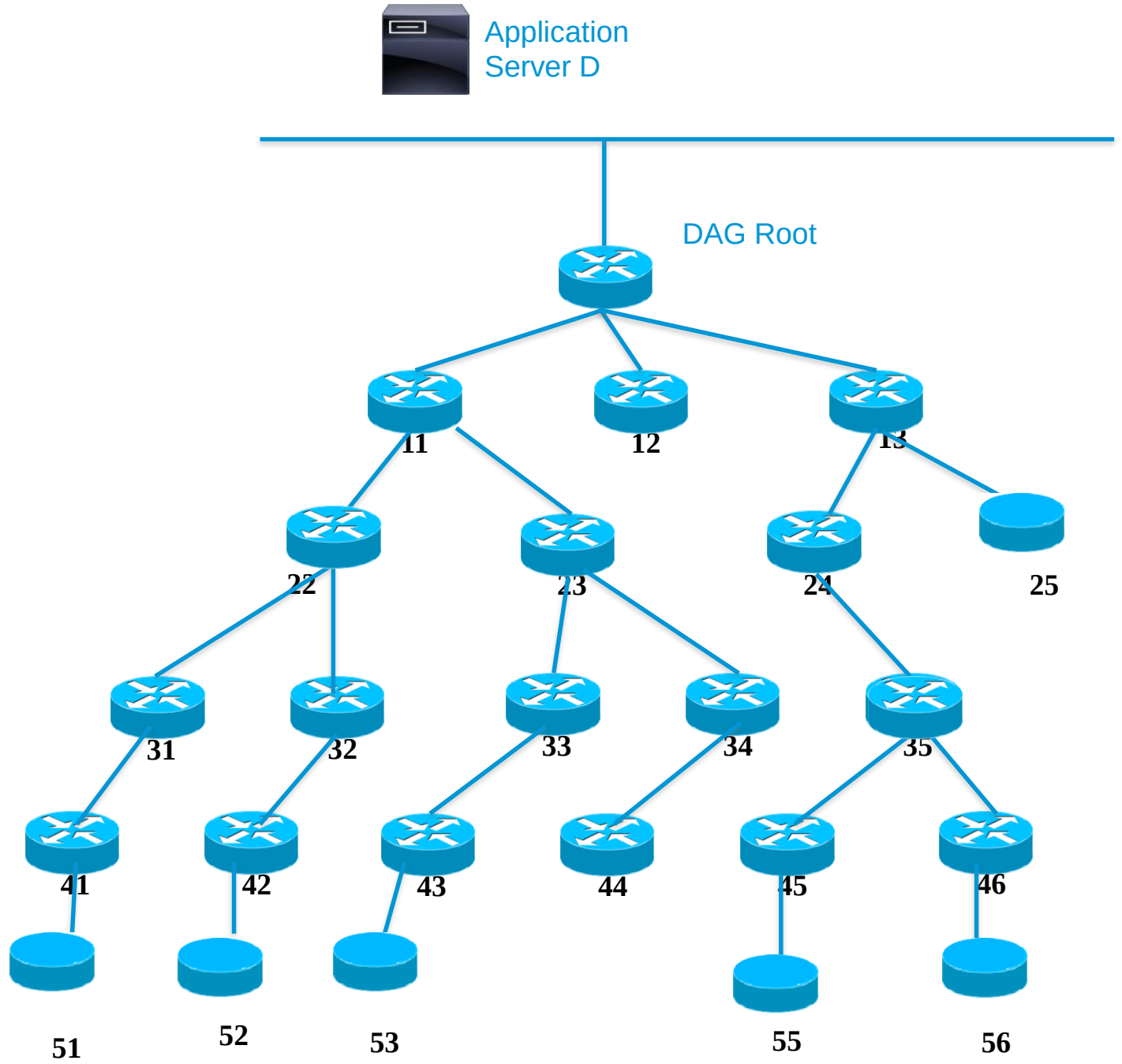
Do we agree on need?

- https://tools.ietf.org/html/draft-ietf-roll-rpl-industrial-applicability

Anyone considering implementation?

Call for Adoption?

Detailed operation


Application
Server D
DAG Root
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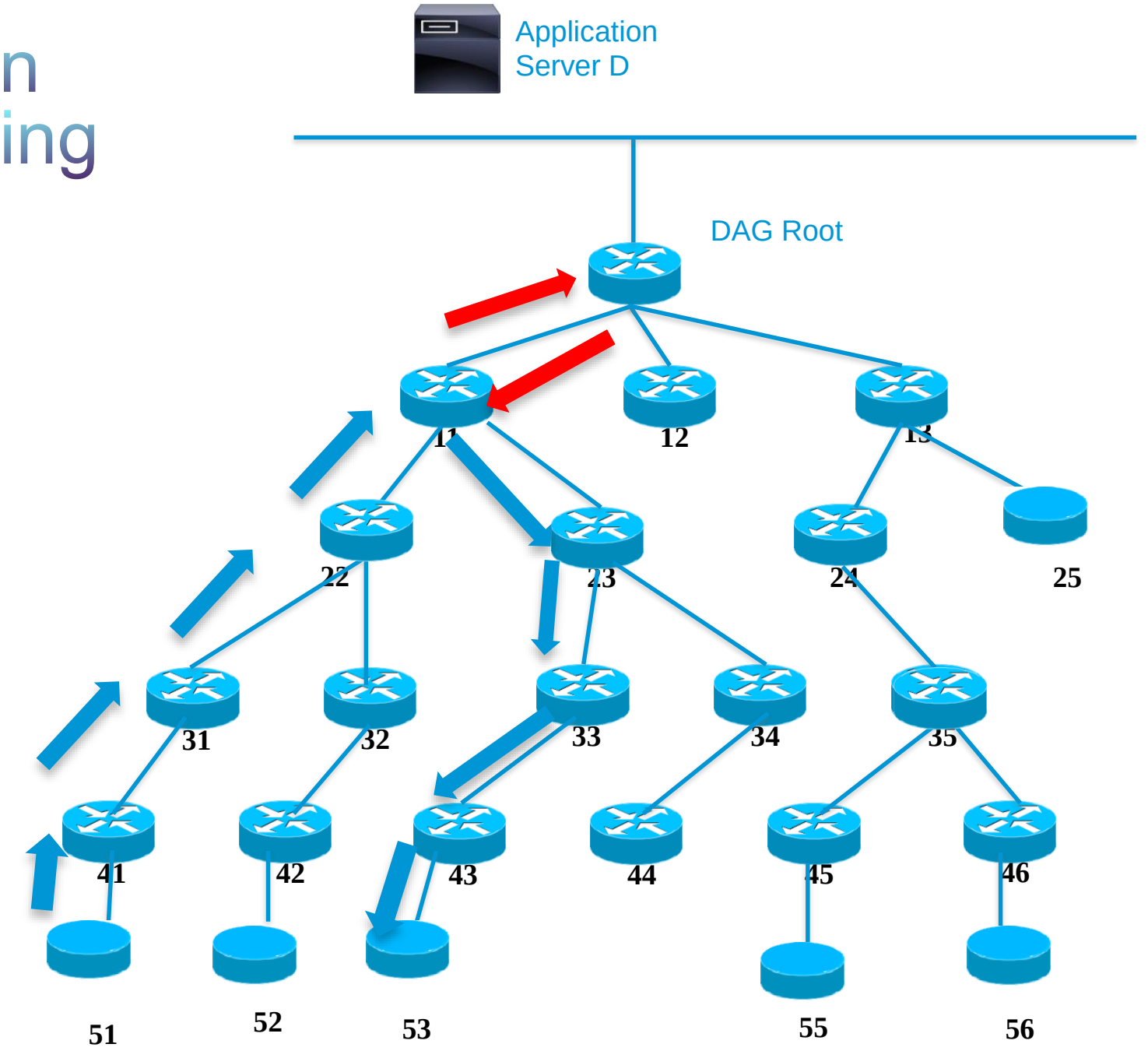
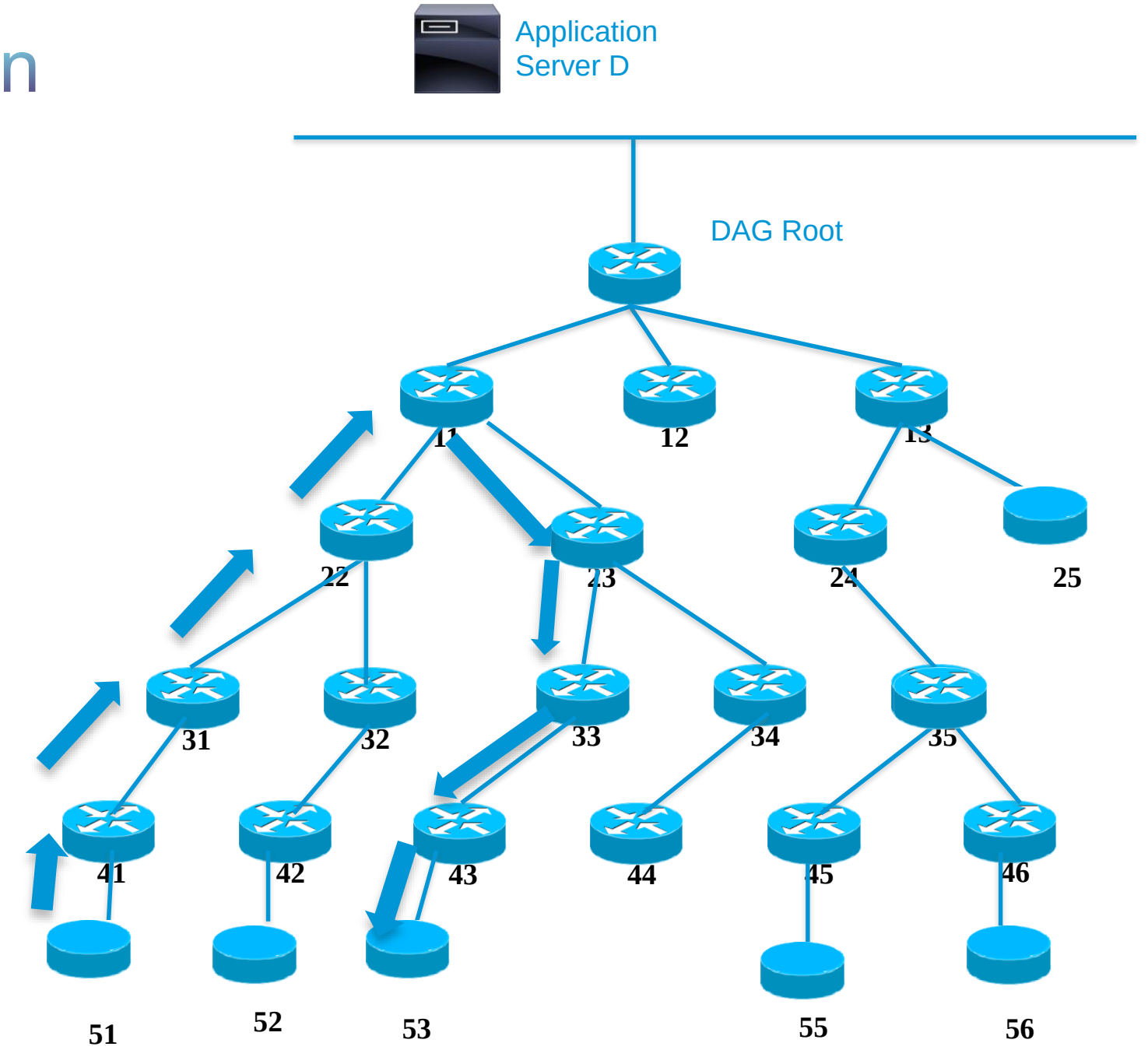
Stretch in non-storing mode



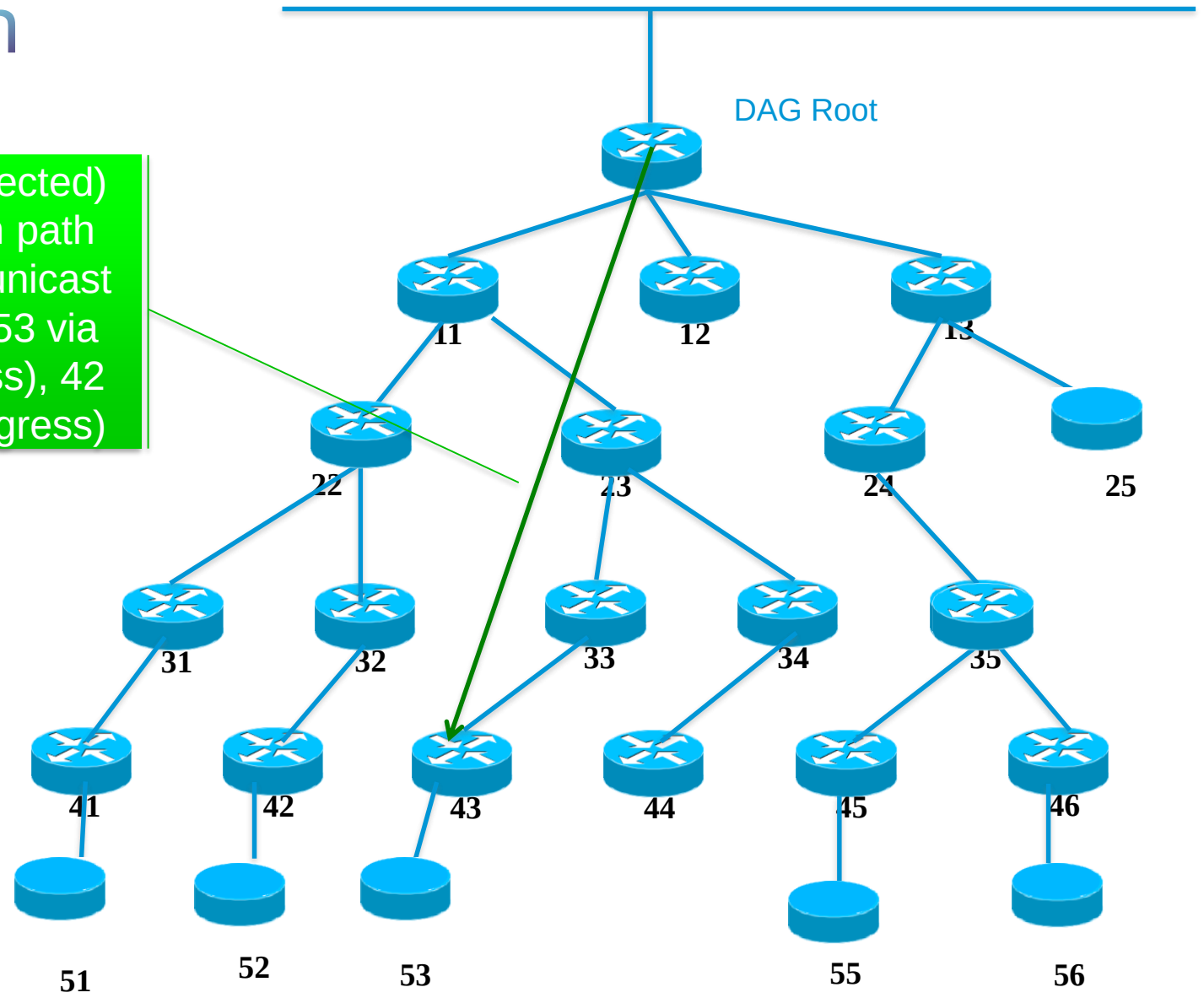
Stretch in storing mode



DAO projection

Application Server D

New (projected) DAO with path segment unicast to target 53 via 41 (ingress), 42 and 43 (egress)

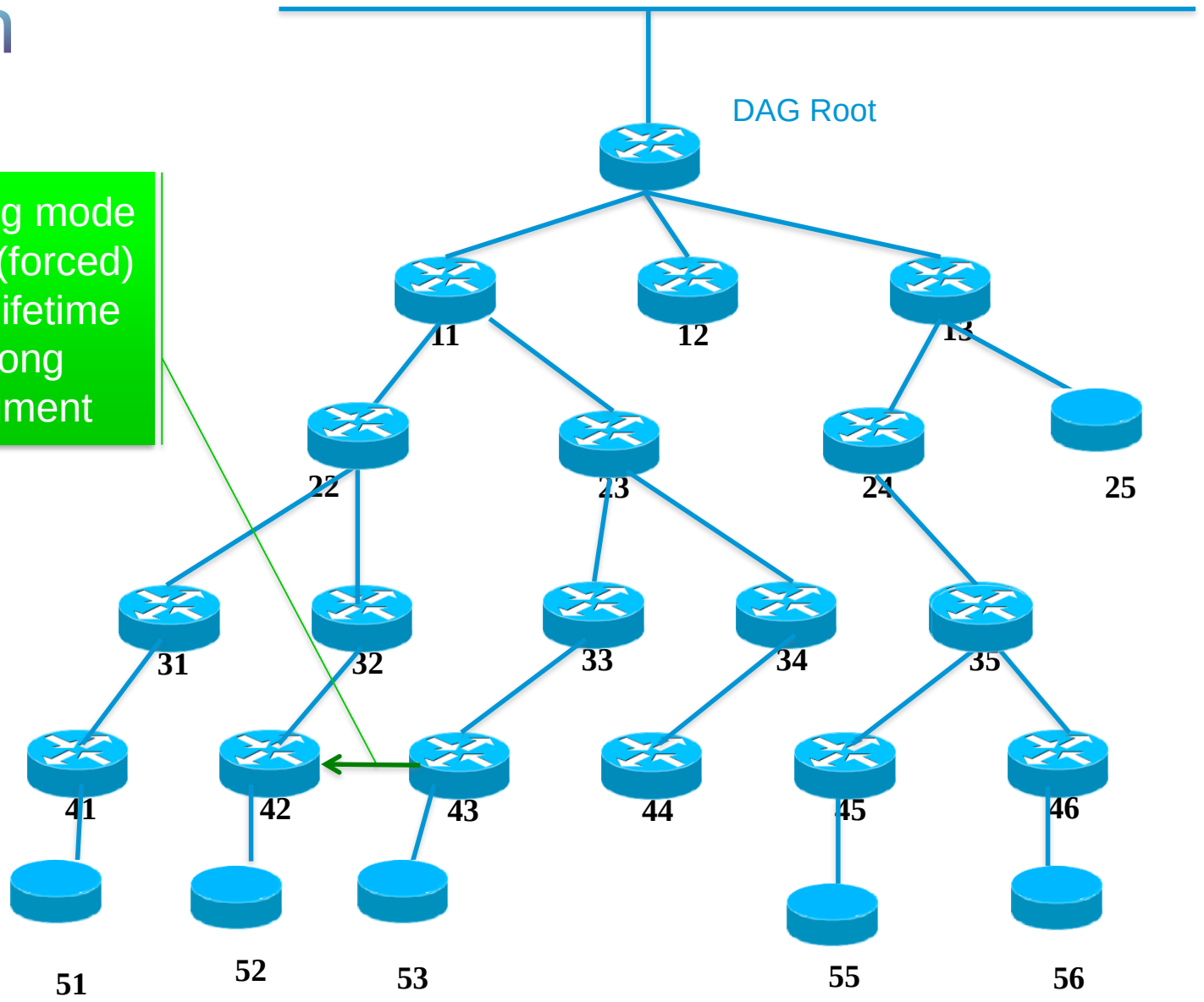


DAO projection

Application Server D

DAG Root

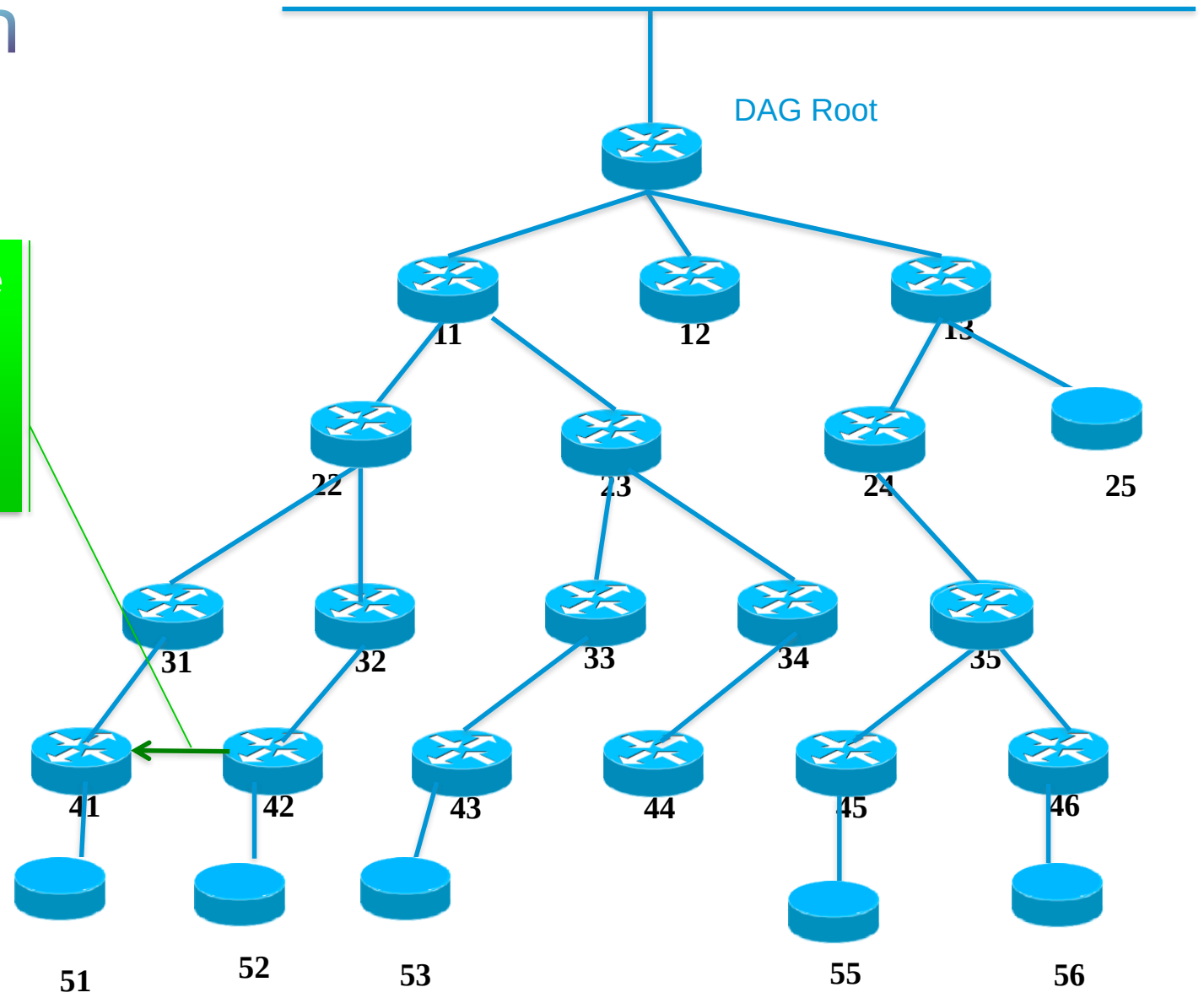
Storing mode DAO (forced) with lifetime along segment



DAO projection

Application Server D

Storing mode DAO (forced) with lifetime along segment

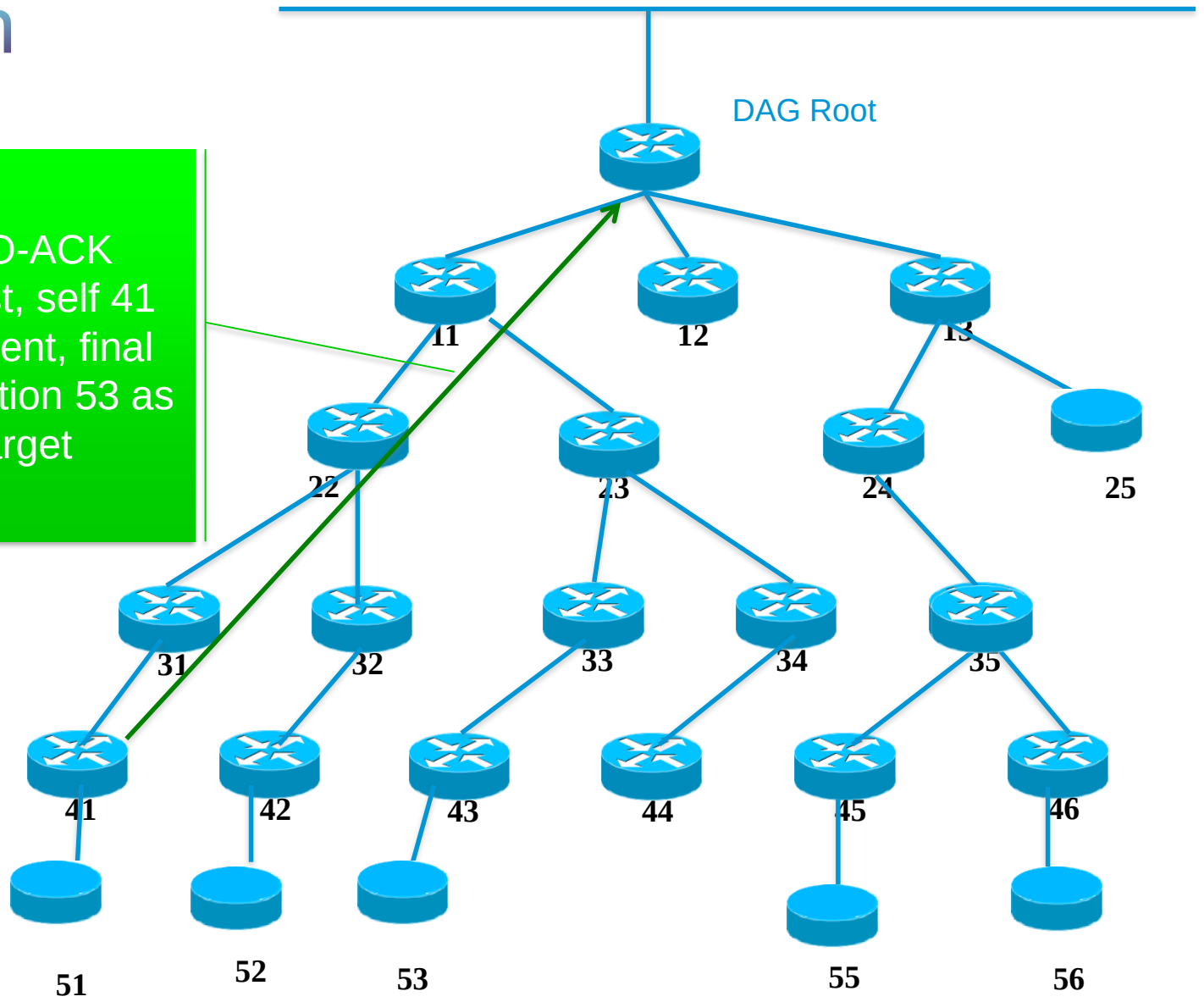


DAO projection

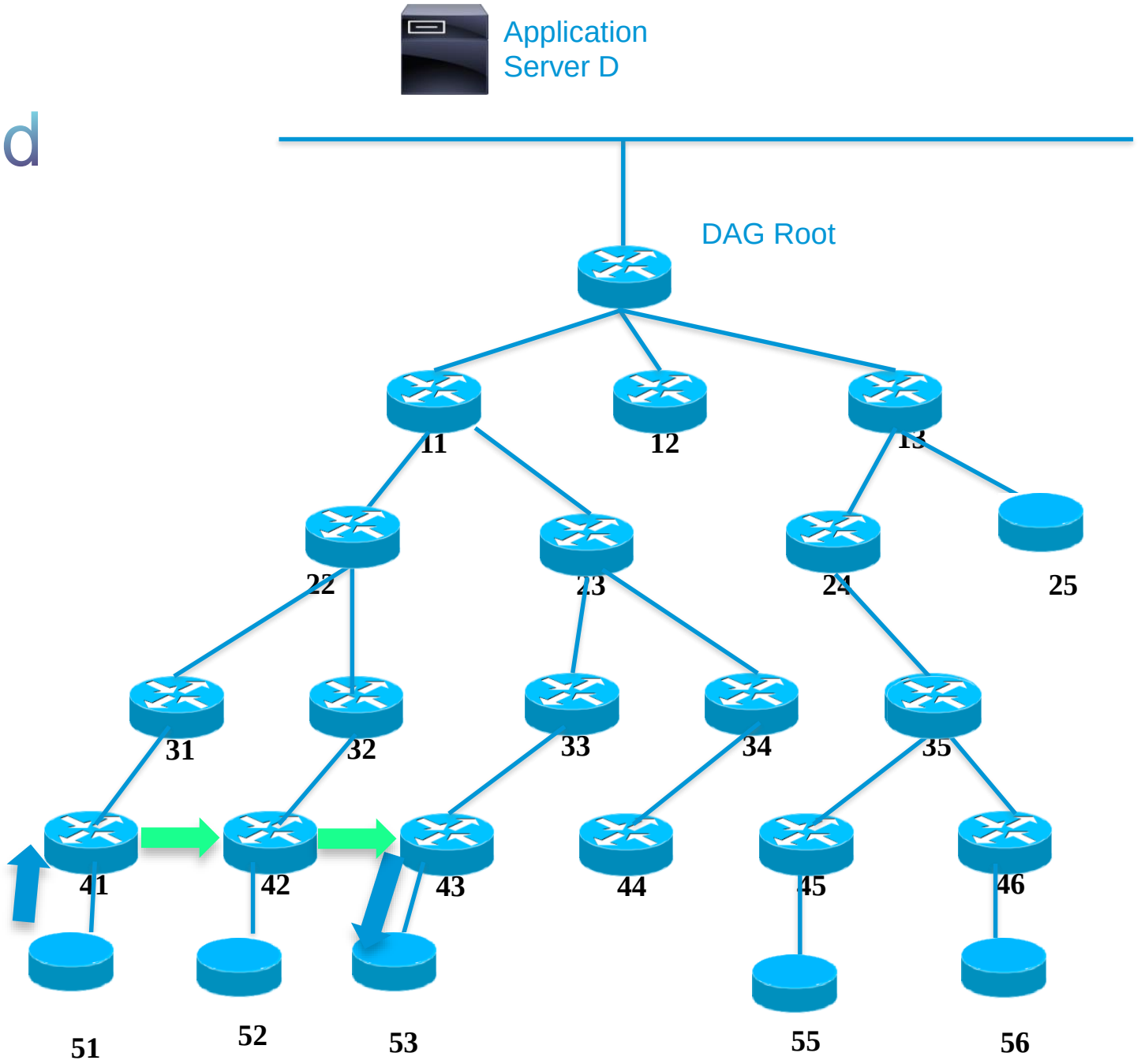
Application Server D

DAG Root

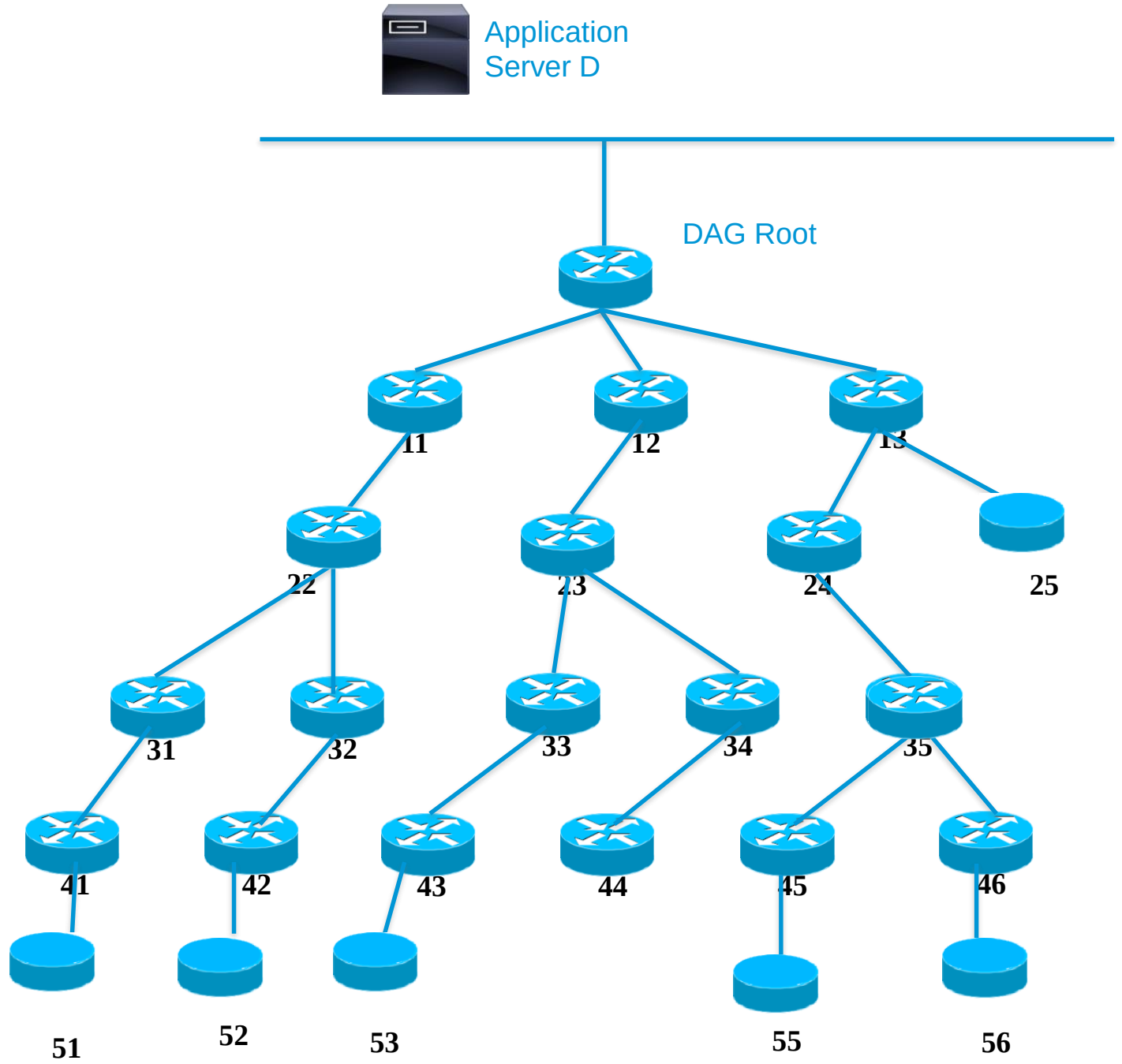
DAO-ACK unicast, self 41 as parent, final destination 53 as target



Optimized Path



Existing non storing optimization


Application
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DAG Root
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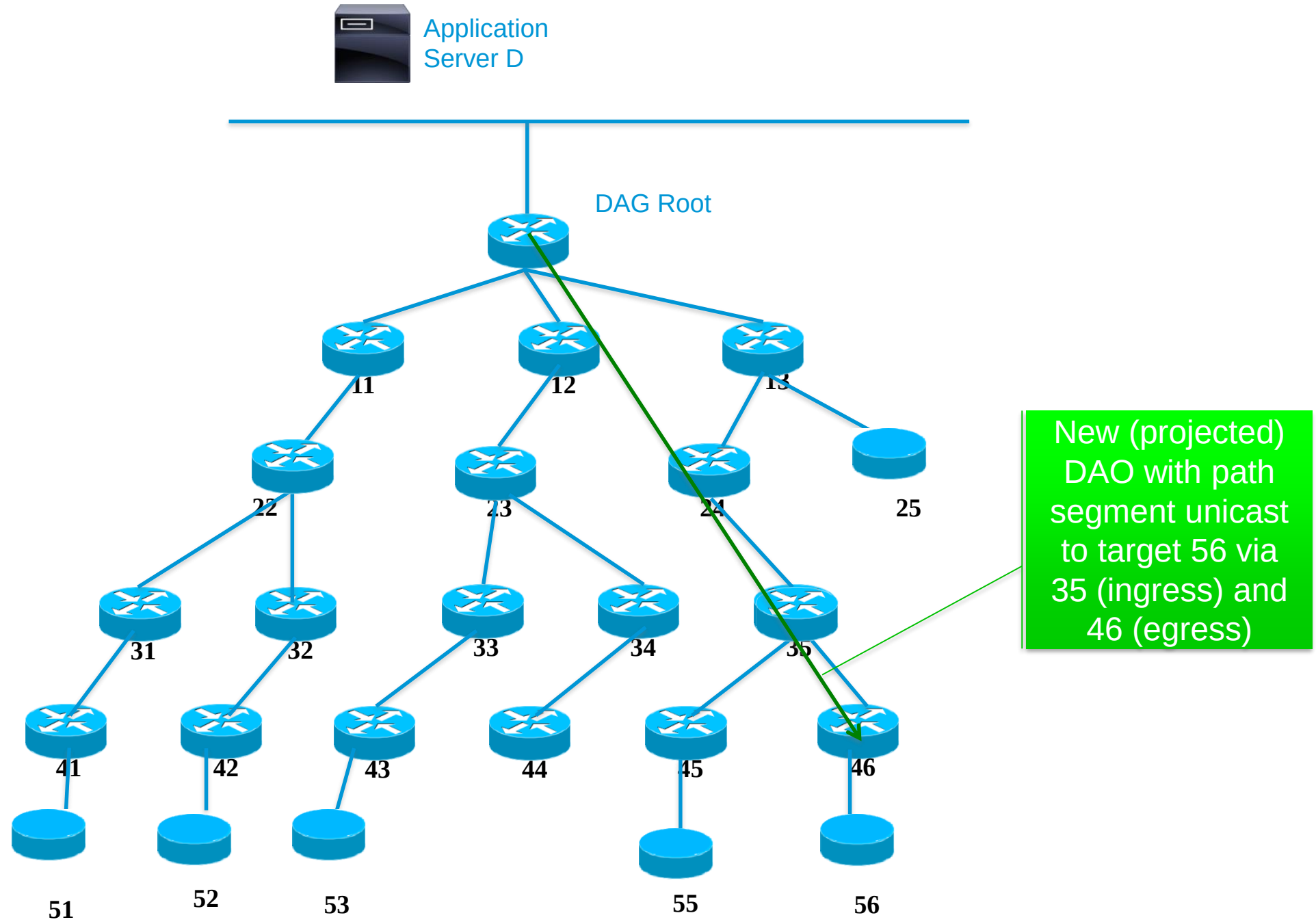
Application
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DAG Root
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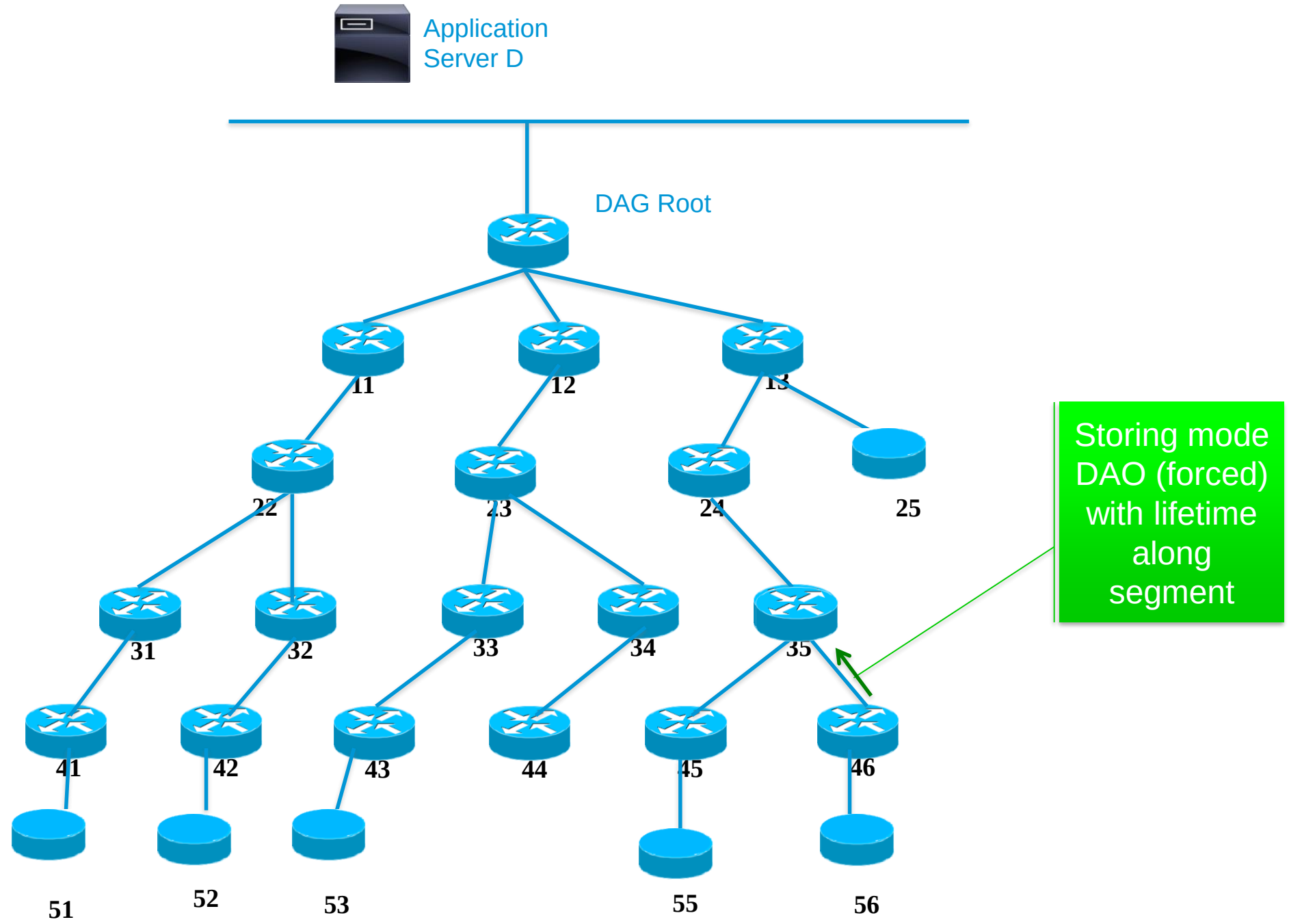
New (projected) DAO with path segment unicast to target 56 via 35 (ingress) and 46 (egress)


Application
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DAG Root
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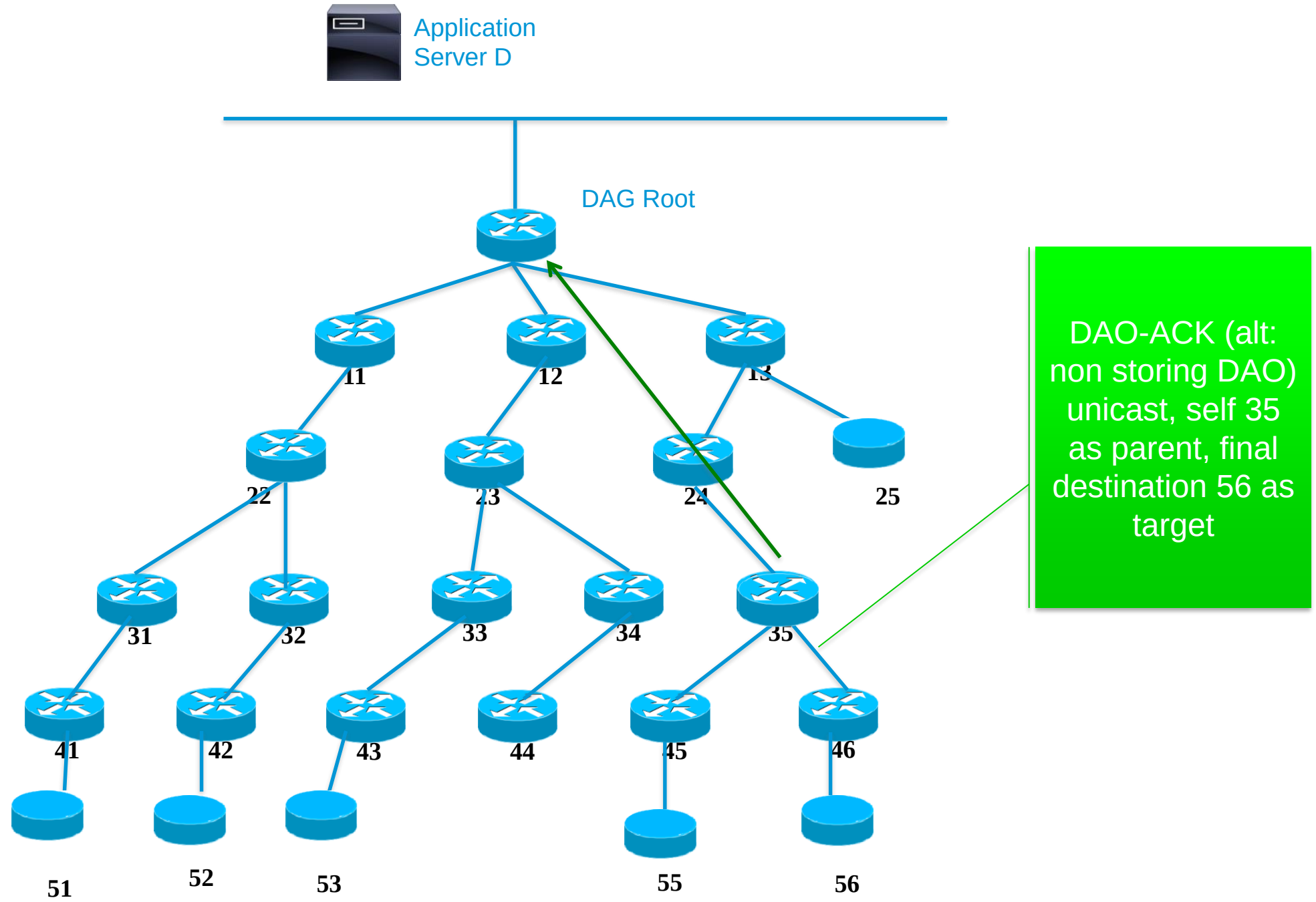
Storing mode
DAO (forced)
with lifetime
along
segment


Application
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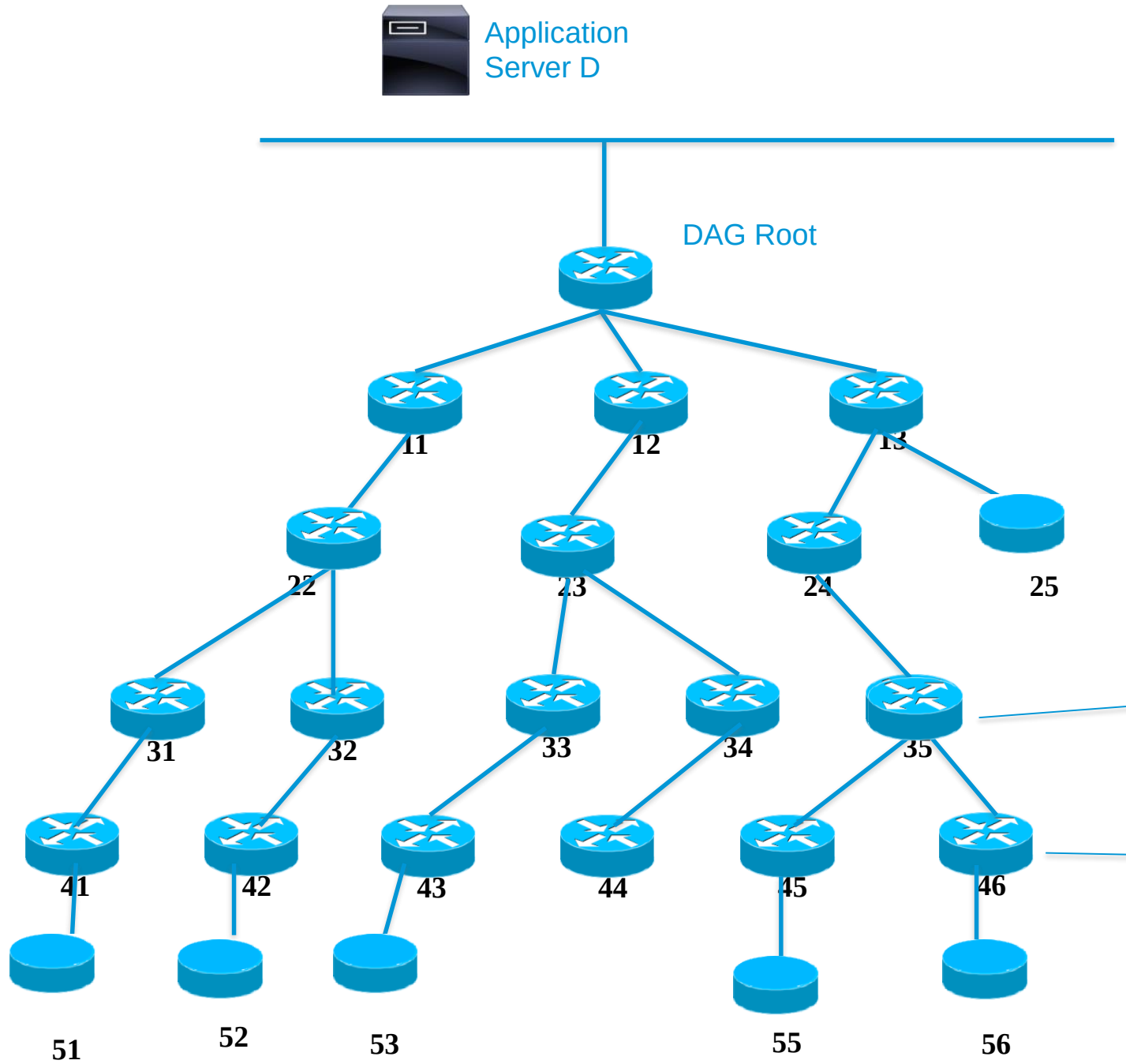
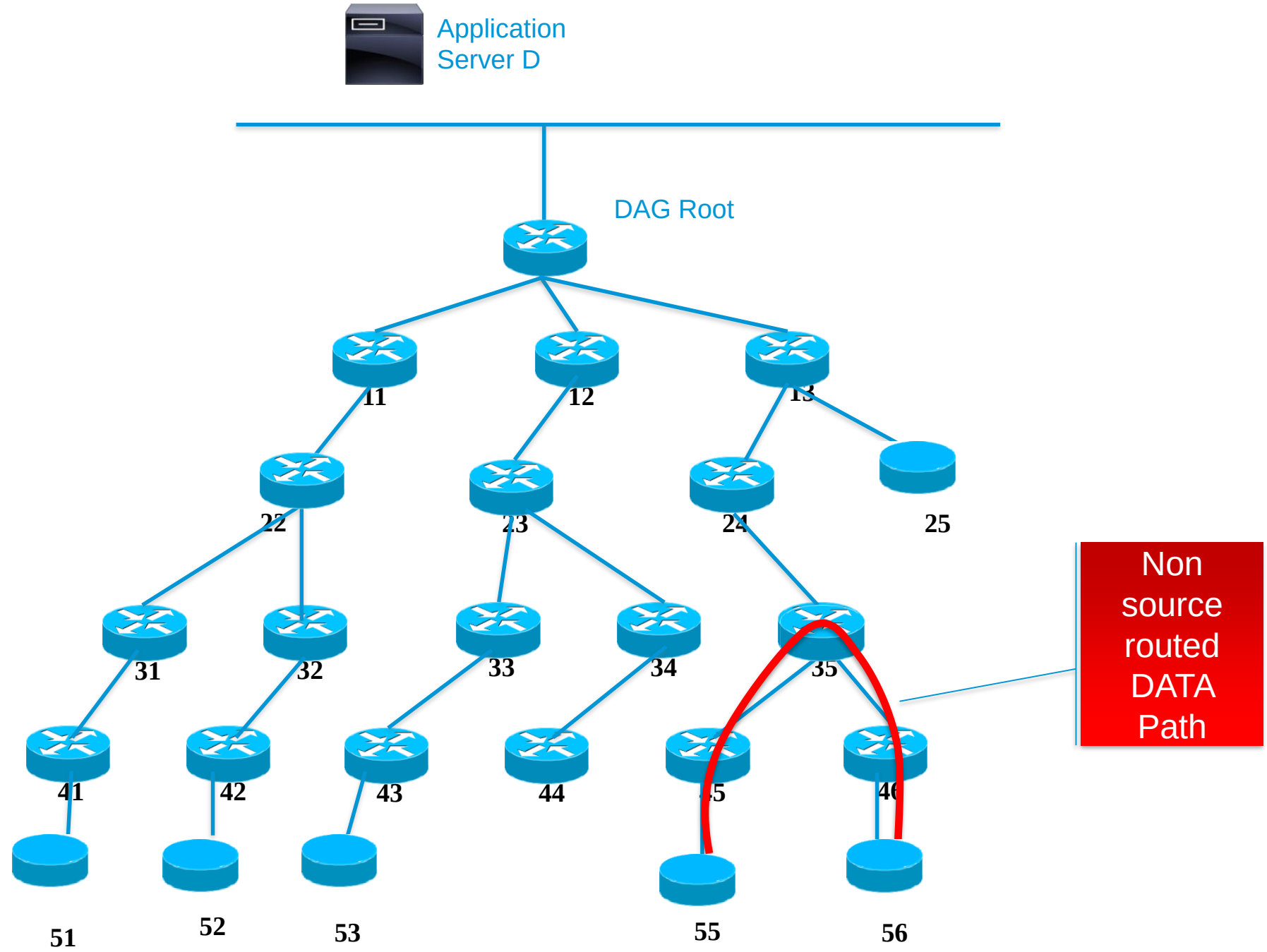
DAO-ACK (alt: non storing DAO) unicast, self 35 as parent, final destination 56 as target



DAO from 46 installs a route to 56 in 35
(all nodes in projected route from ingress included to egress excluded)
=> egress should already have a route to target

56 via 46

Preexisting connected route to 56


Application
Server D
DAG Root
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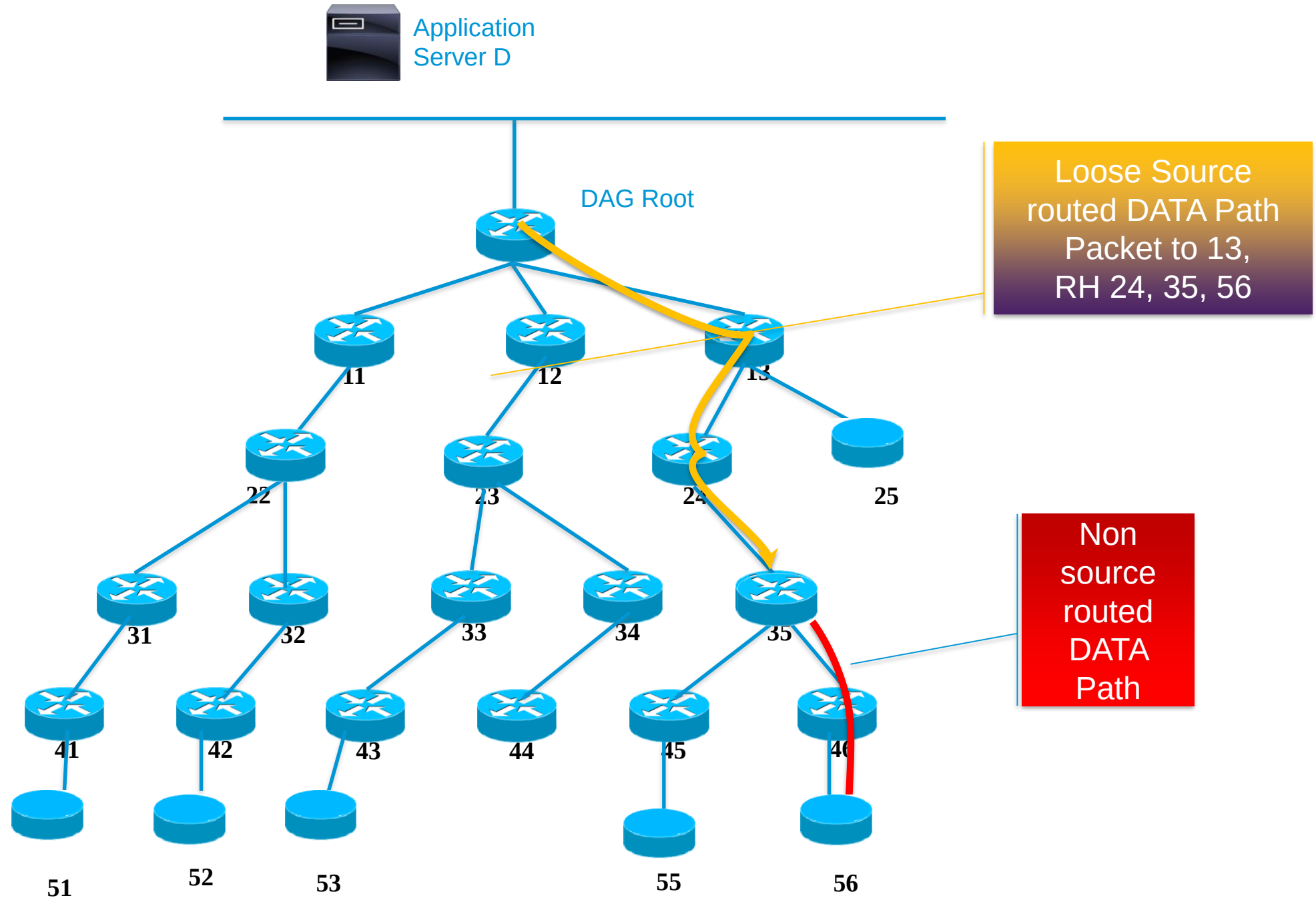
Non source routed DATA Path


Application
Server D
DAG Root
Loose Source routed DATA Path Packet to 13, RH 24, 35, 56
Non source routed DATA Path
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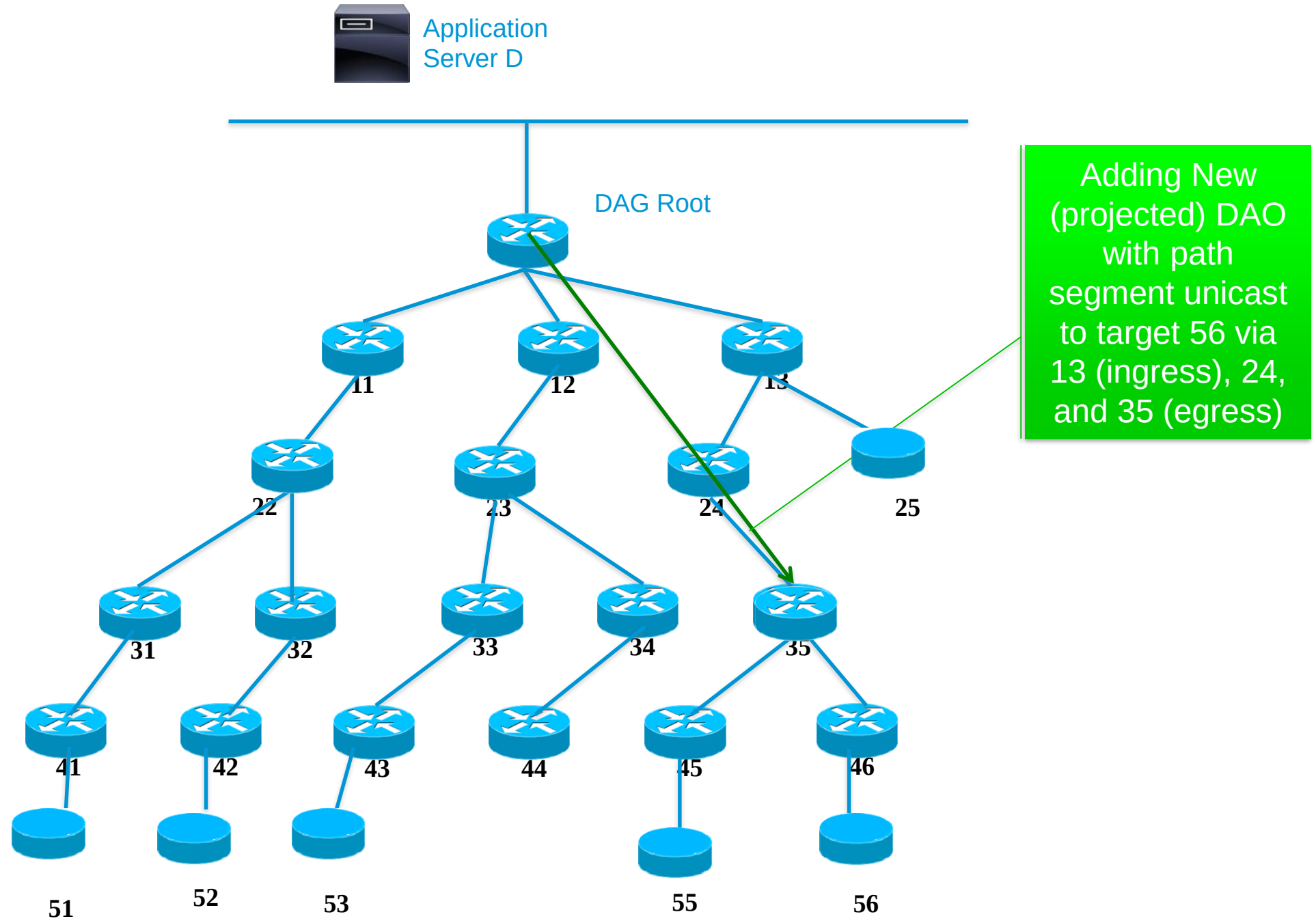
Application
Server D
DAG Root
Adding New (projected) DAO with path segment unicast to target 56 via 13 (ingress), 24, and 35 (egress)
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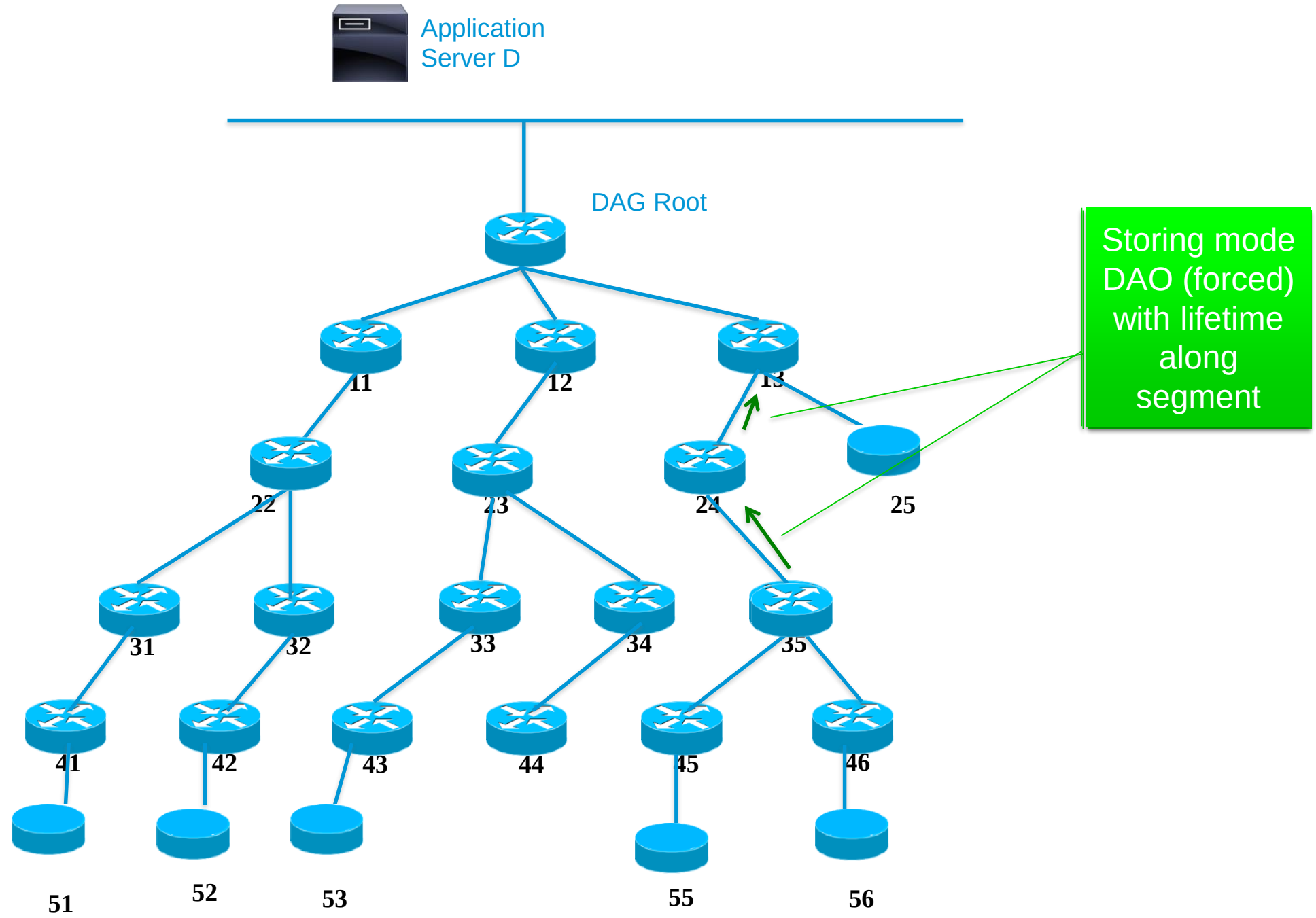
Application
Server D
DAG Root
Storing mode
DAO (forced)
with lifetime
along
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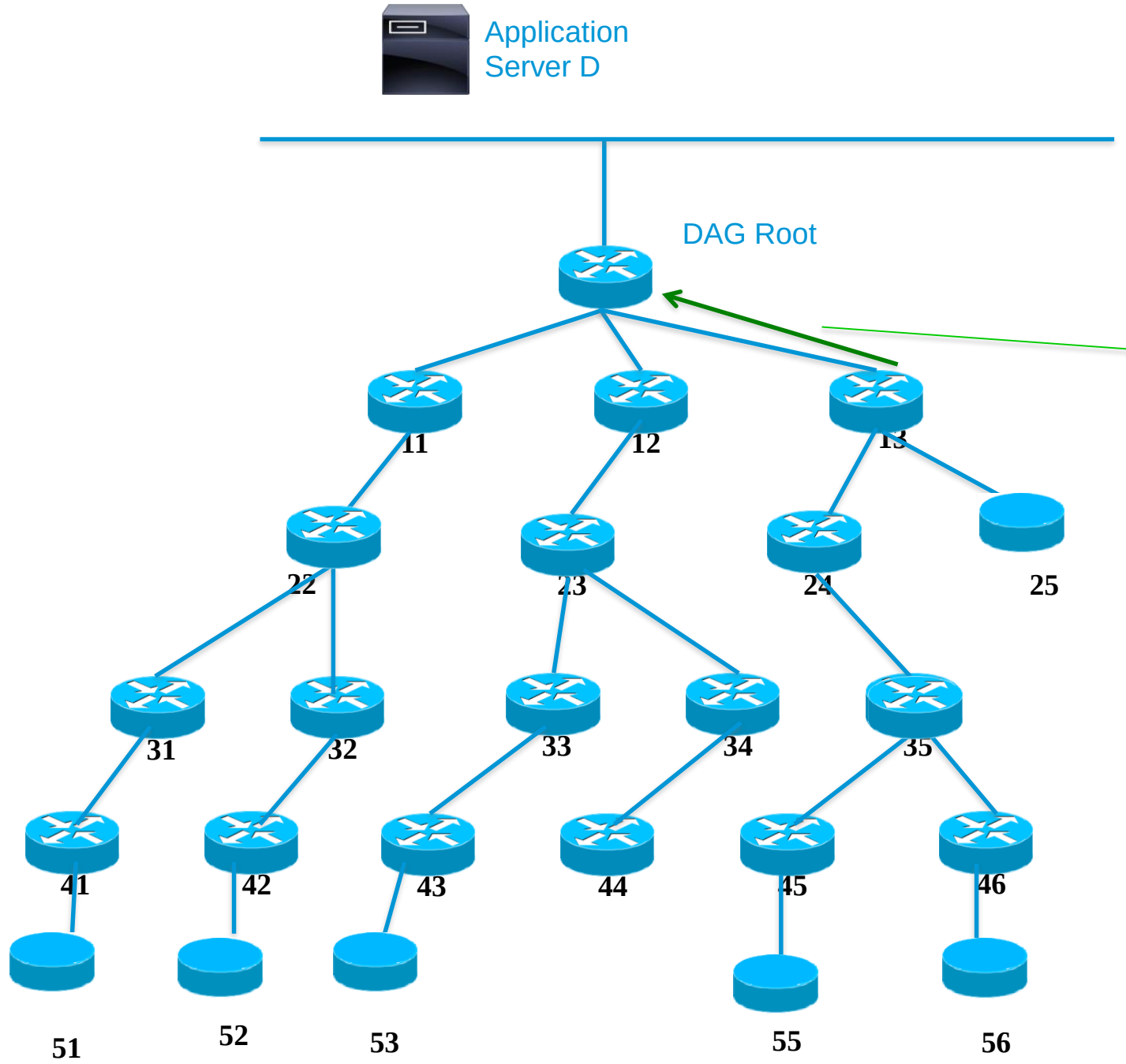
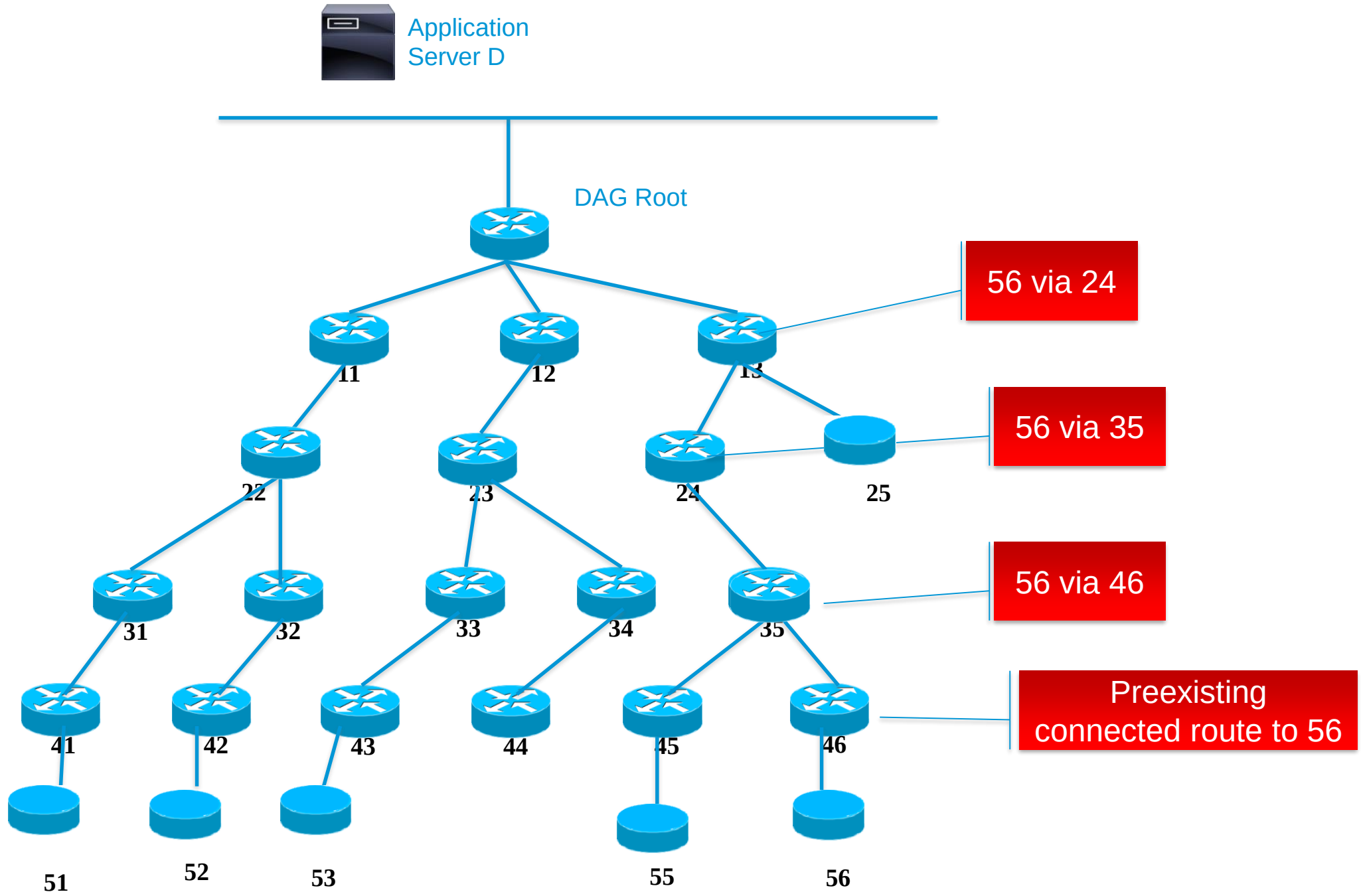


DAO-ACK (alt: non storing DAO) unicast, self 13 as parent, final destination 56 as target


Application
Server D
DAG Root
56 via 24
56 via 35
56 via 46
Preexisting
connected route to 56
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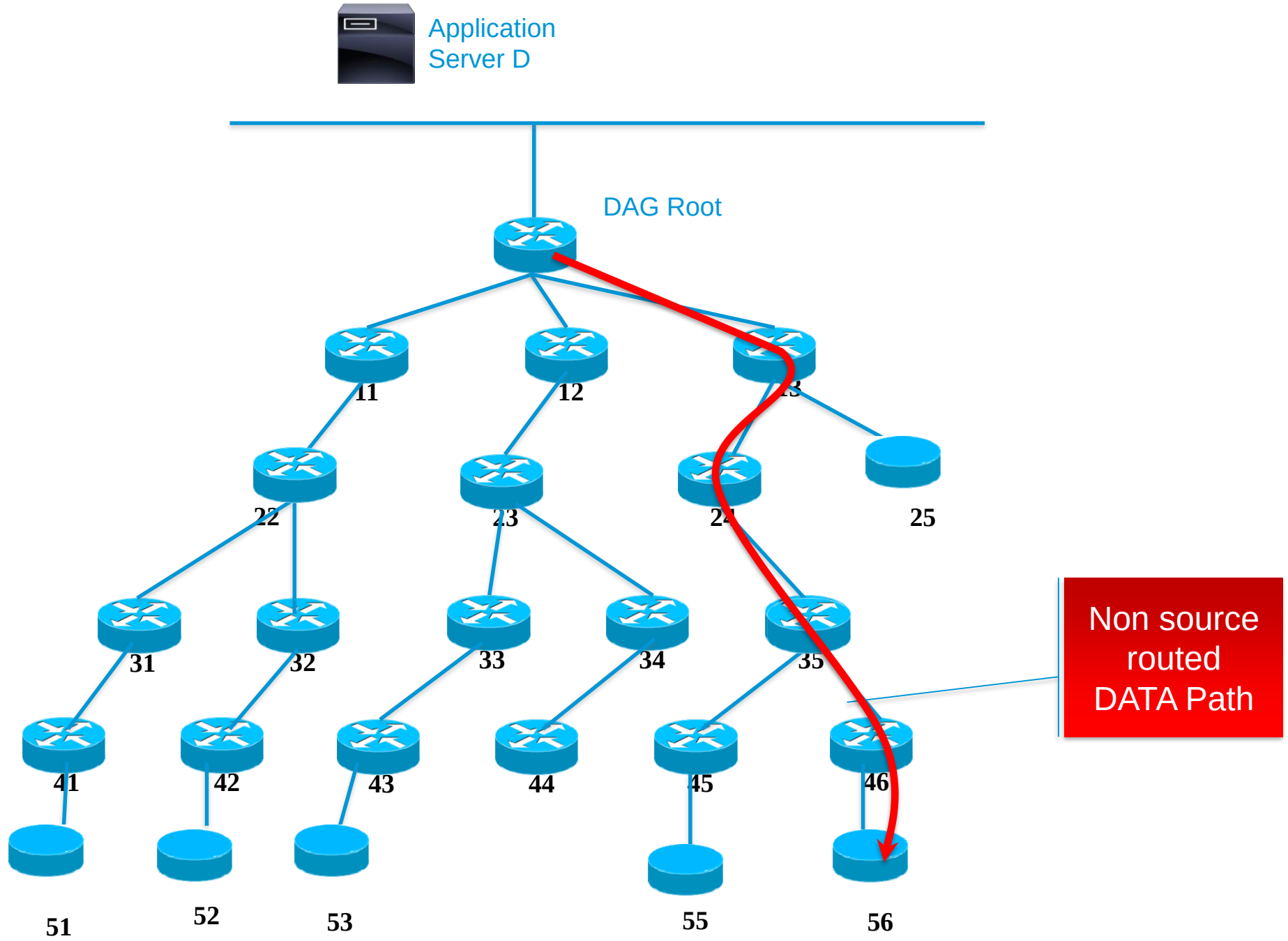
Application
Server D
DAG Root
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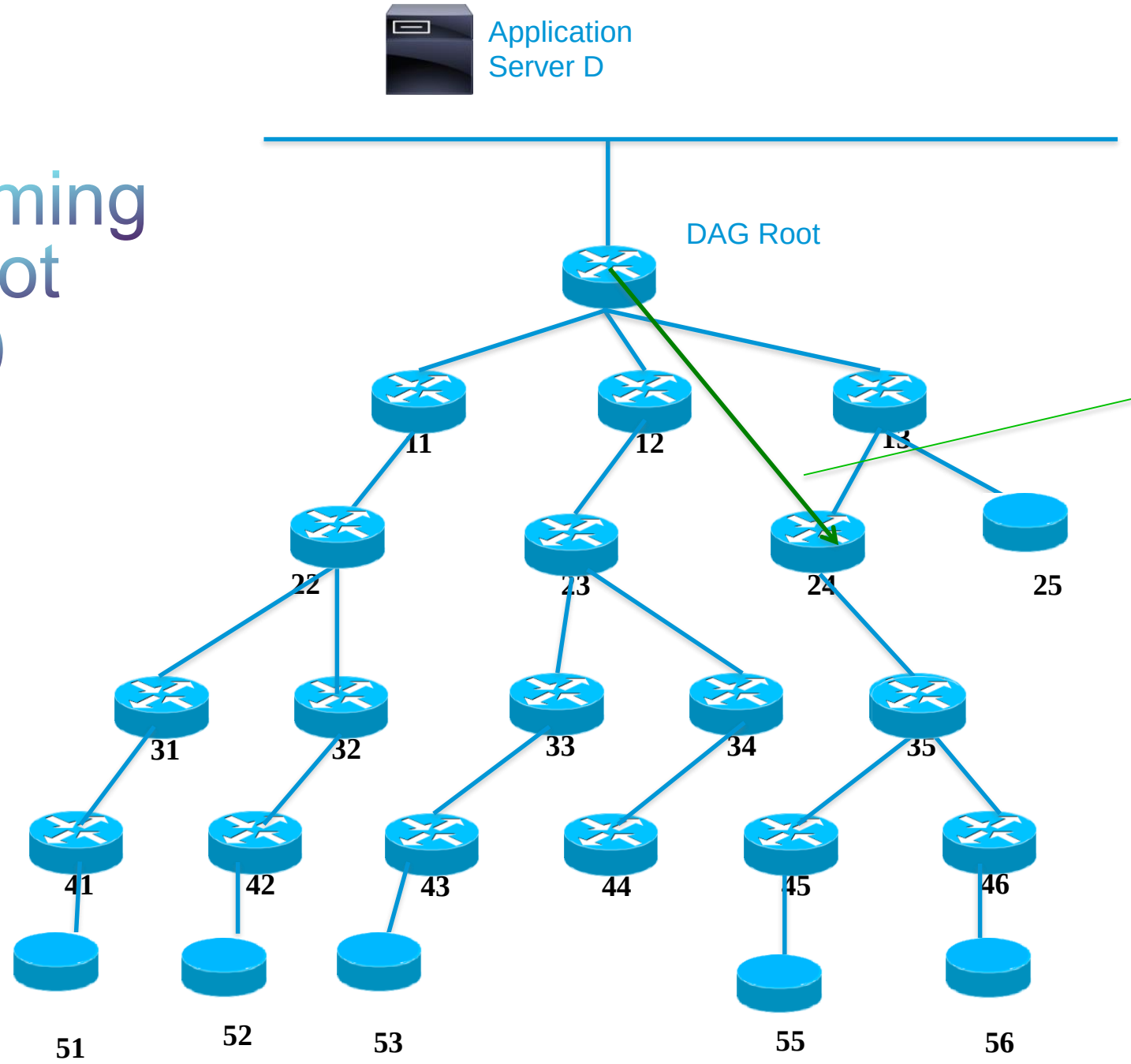
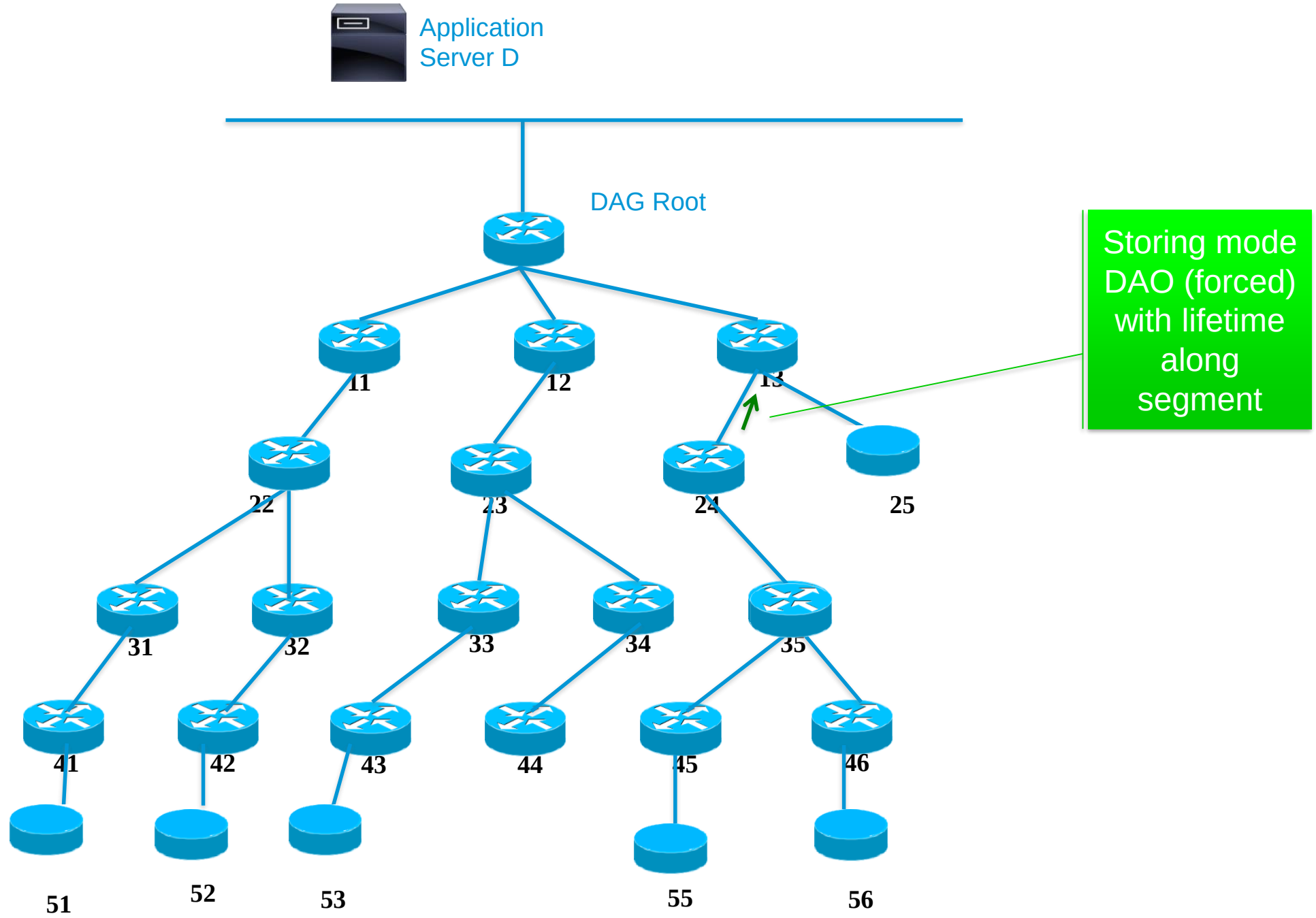
Non source
routed
DATA Path

Alternate Programming By the root (Michael)



ALT: Adding New (projected) DAO with path segment unicast to target 35 via 13 (ingress) and 24 (egress)


Application
Server D
DAG Root
Storing mode
DAO (forced)
with lifetime
along
segment
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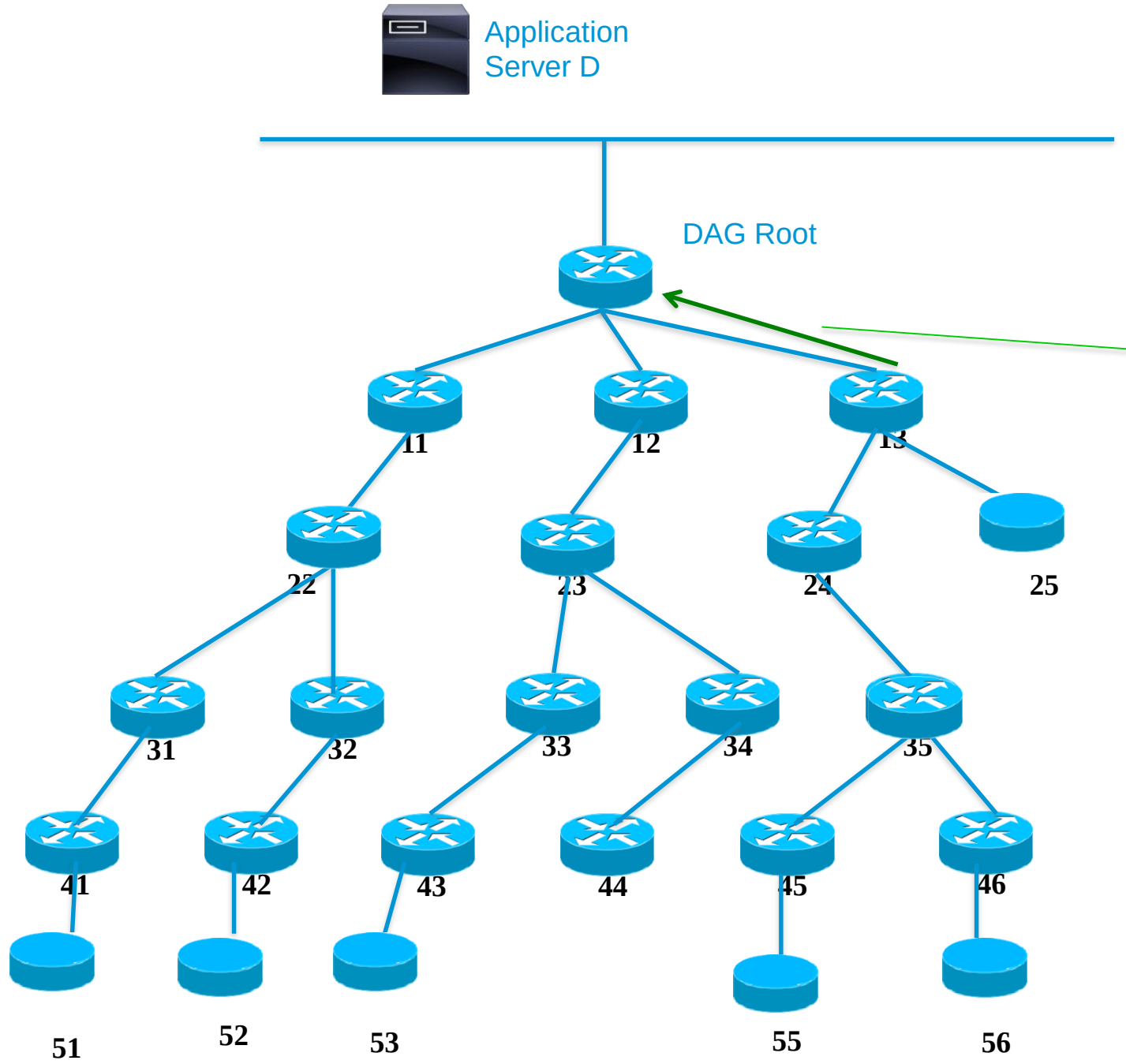
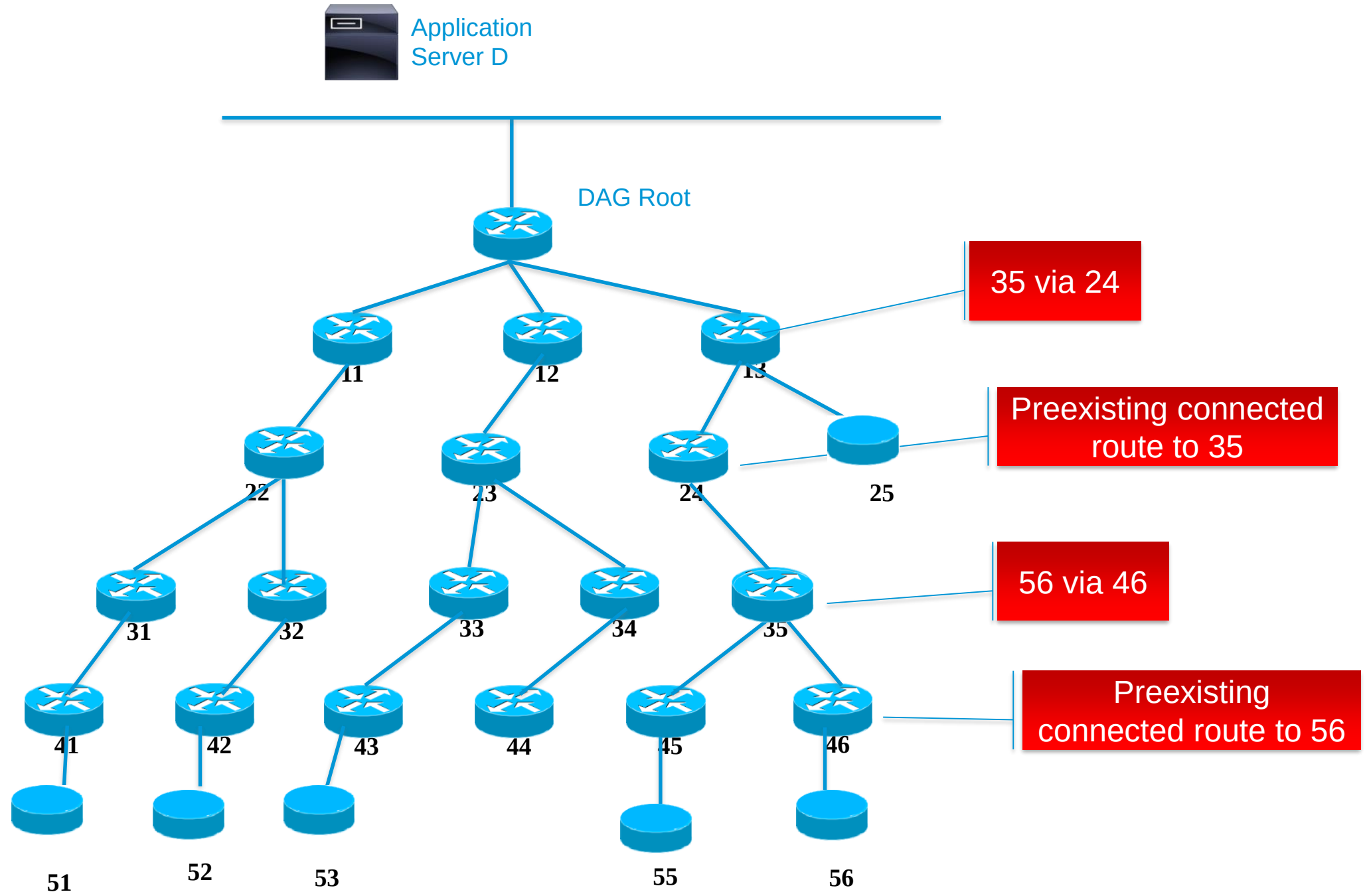


DAO-ACK (alt: non storing DAO) unicast, self 13 as parent, final destination 56 as target


Application
Server D
DAG Root
35 via 24
Preexisting connected
route to 35
56 via 46
Preexisting
connected route to 56
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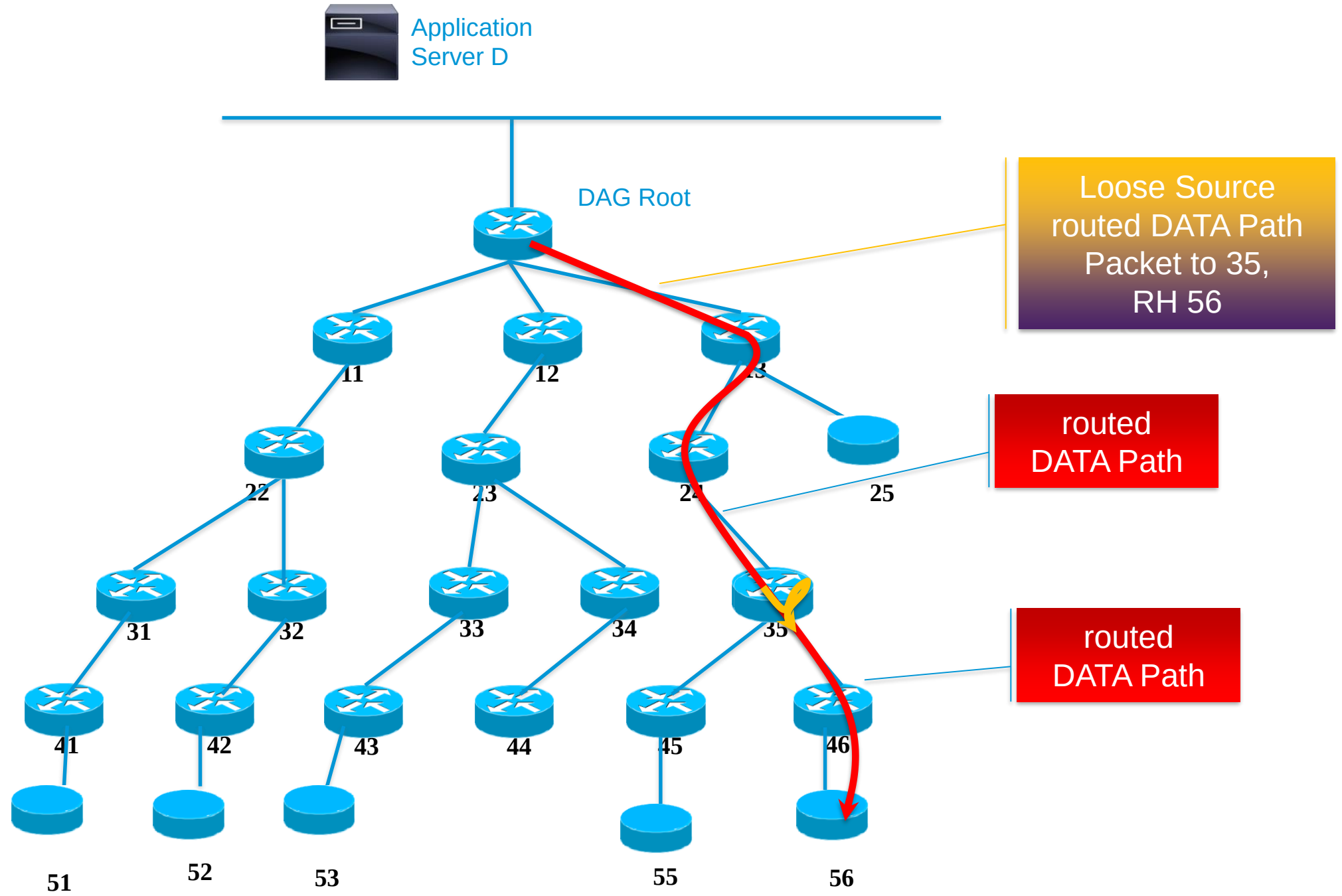
Application
Server D
DAG Root
Loose Source
routed DATA Path
Packet to 35,
RH 56
routed
DATA Path
routed
DATA Path
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ROLL working group

MPL Forwarder Select (MPLFS)
draft-vanderstok-roll-mpl-forw-select-00

P. van der Stok, AR. Sangi

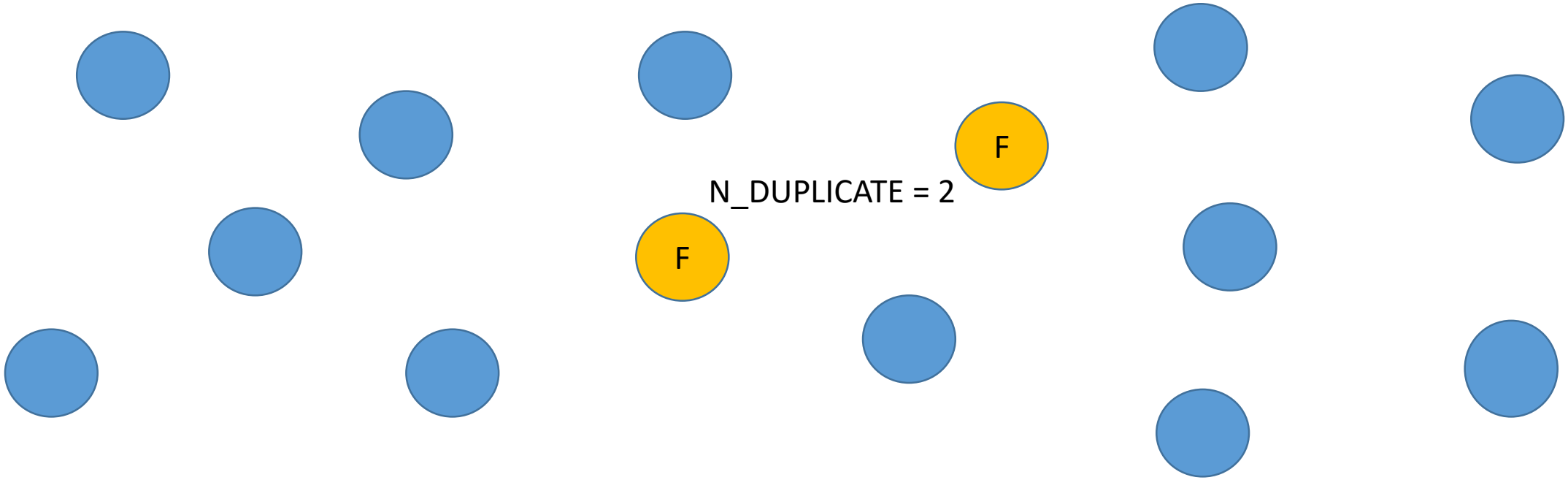
Introduction

MPL uses forwarders to forward multicast messages in a multi-hop network

Minimizing the number of forwarders/routers and selecting them automatically is required

PURPOSE

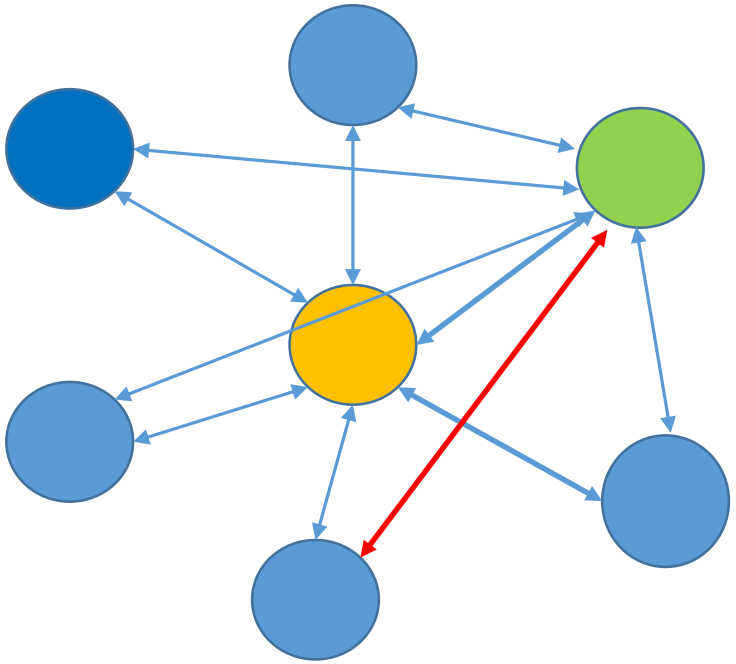
All nodes are connected to a minimum number, N_DUPLICATE, of forwarders (routers).
There is a path between any 2 forwarders.



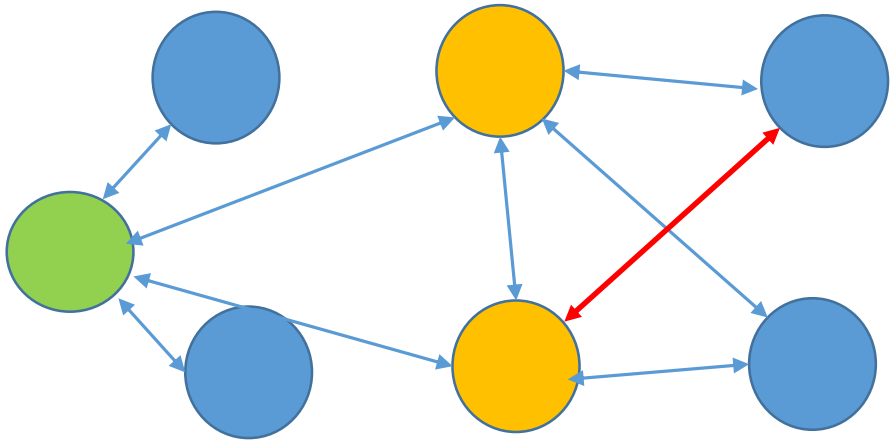
Inspired by:
NeighbourHood Discovery (NHDP) [RFC6130],
and Simple Multicast Forwarding (SMF) [RFC6621].

1-2 Forwarders for reliability

Single hop network



2 hop network



Forwarder

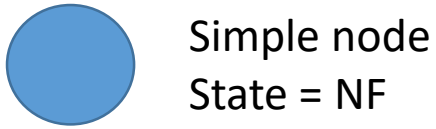
Broadcaster

1=hop link

Crashed 1=hop link

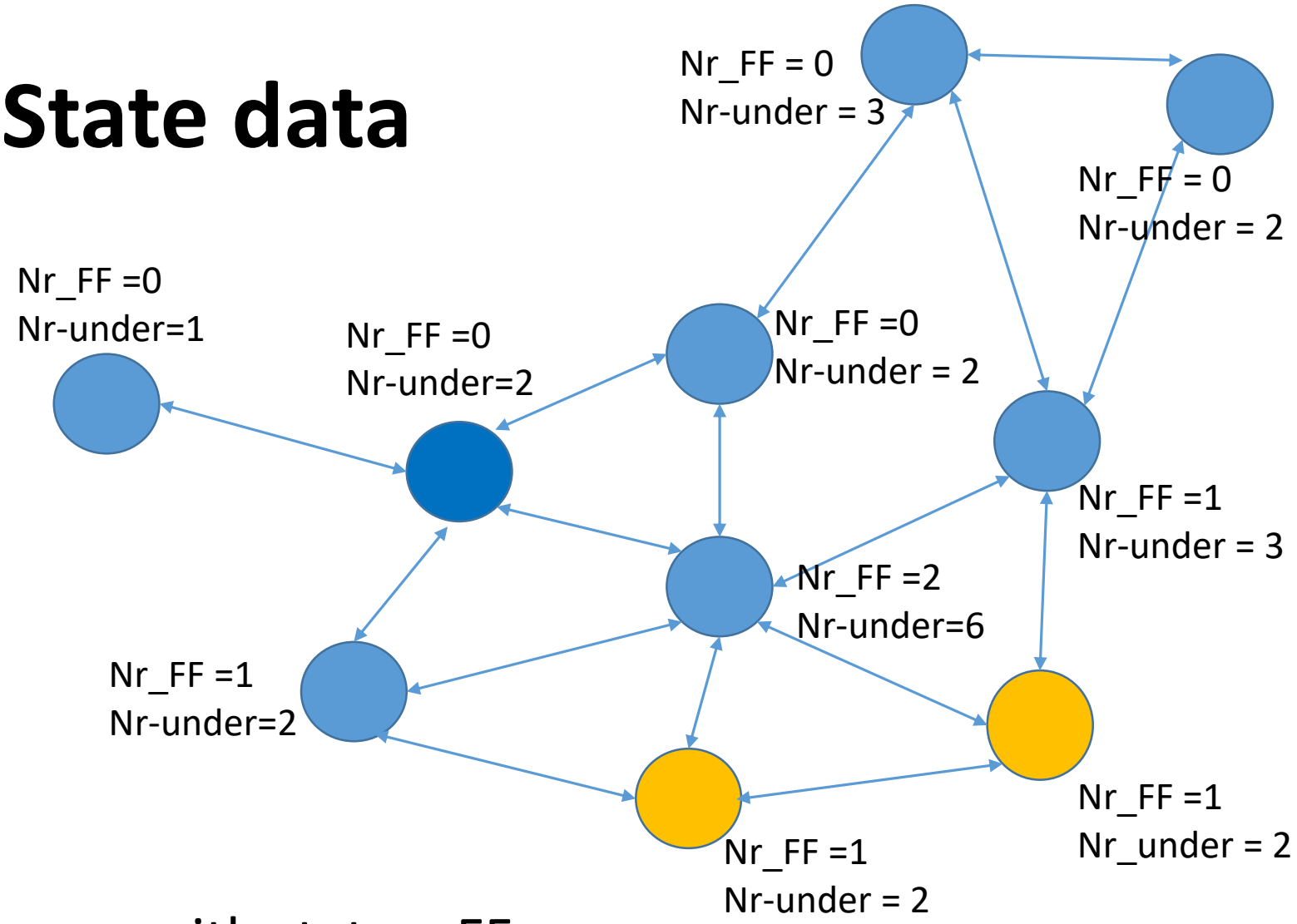
State data

Forwarder
State = FF



Simple node
State = NF

N_DUPLICATE = 2



- Node maintains:
  - Nr_FF is number of neighbours with state = FF
  - Nr-under is number of neighbours with nr_FF < N_DUPLICATE
  - Nr-above: Number of neighbours with nr_FF > N_DUPLICATE

Protocol

- Nodes link-local multicast (Trickle) info about their 1-hop neighbours
  - Address
  - RSSI of link to neighbour (includes receiver)
  - nr_FF: number of Forwarder neighbours
  - Nr-under: Number of neighbours with nr_FF < N_DUPLICATE
  - Nr-above: Number of neighbours with nr_FF > N_DUPLICATE
  - State
- CBOR format used in message
- Only messages from valid neighbours with rssi_in and rssi_out < 4
- On message reception:
  - Update node data and execute selection algorithm

Selection algorithm

Node selects itself

Intended for stable networks (e.g. fixed installations with rare failures)

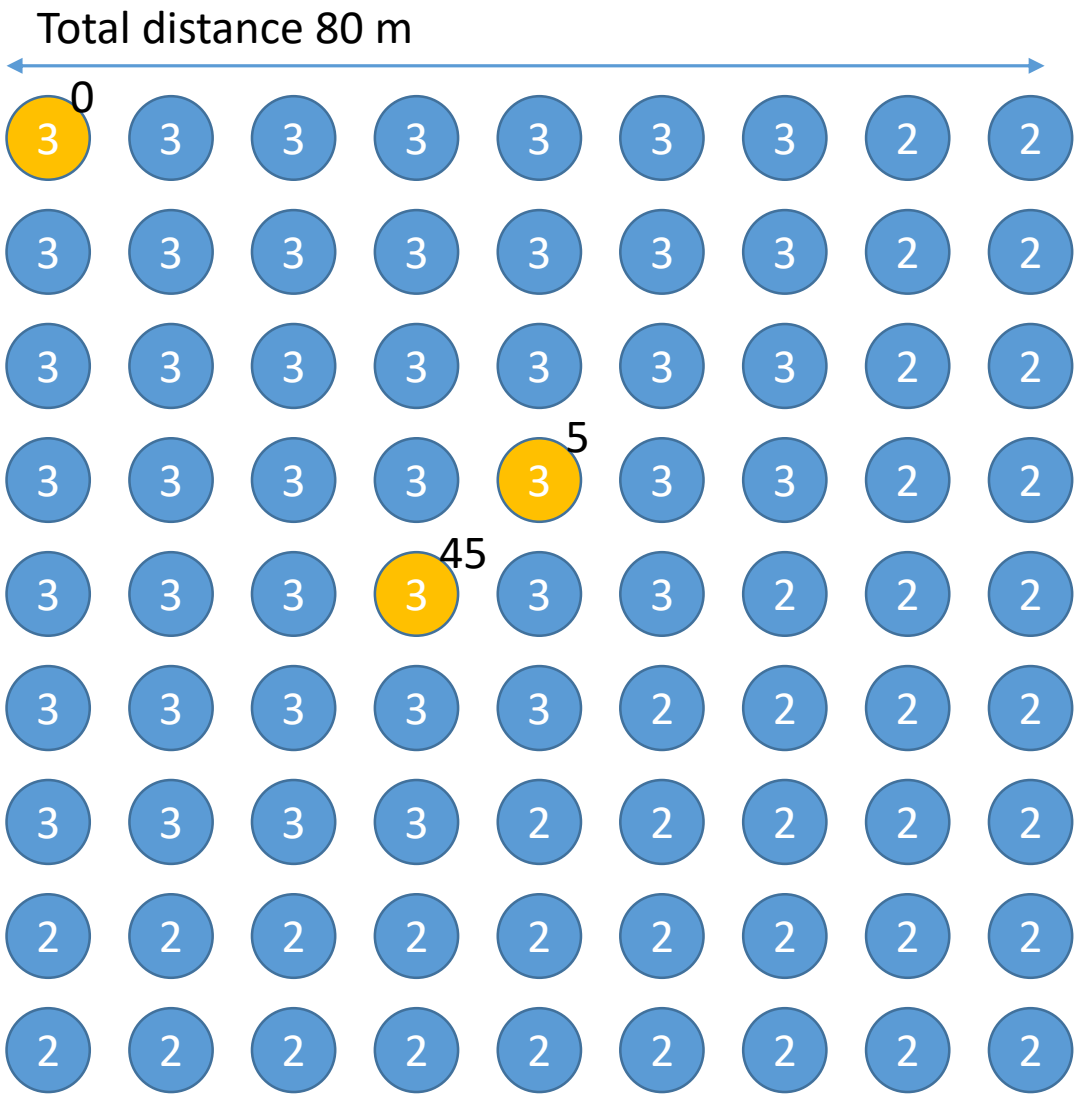
- Order neighbours and itself on nr-under and address
- IF first and nr-under > 0 and nr_FF > 0
    - then set State to FF
- IF first* and nr-above == nr of valid neighbours
    - then set State to NF

Timing aspect to observe “stable” network configuration

- Condition for state change:
    - During nr-of-neighbour messages nr-Under has not changed

Example 1

9x9



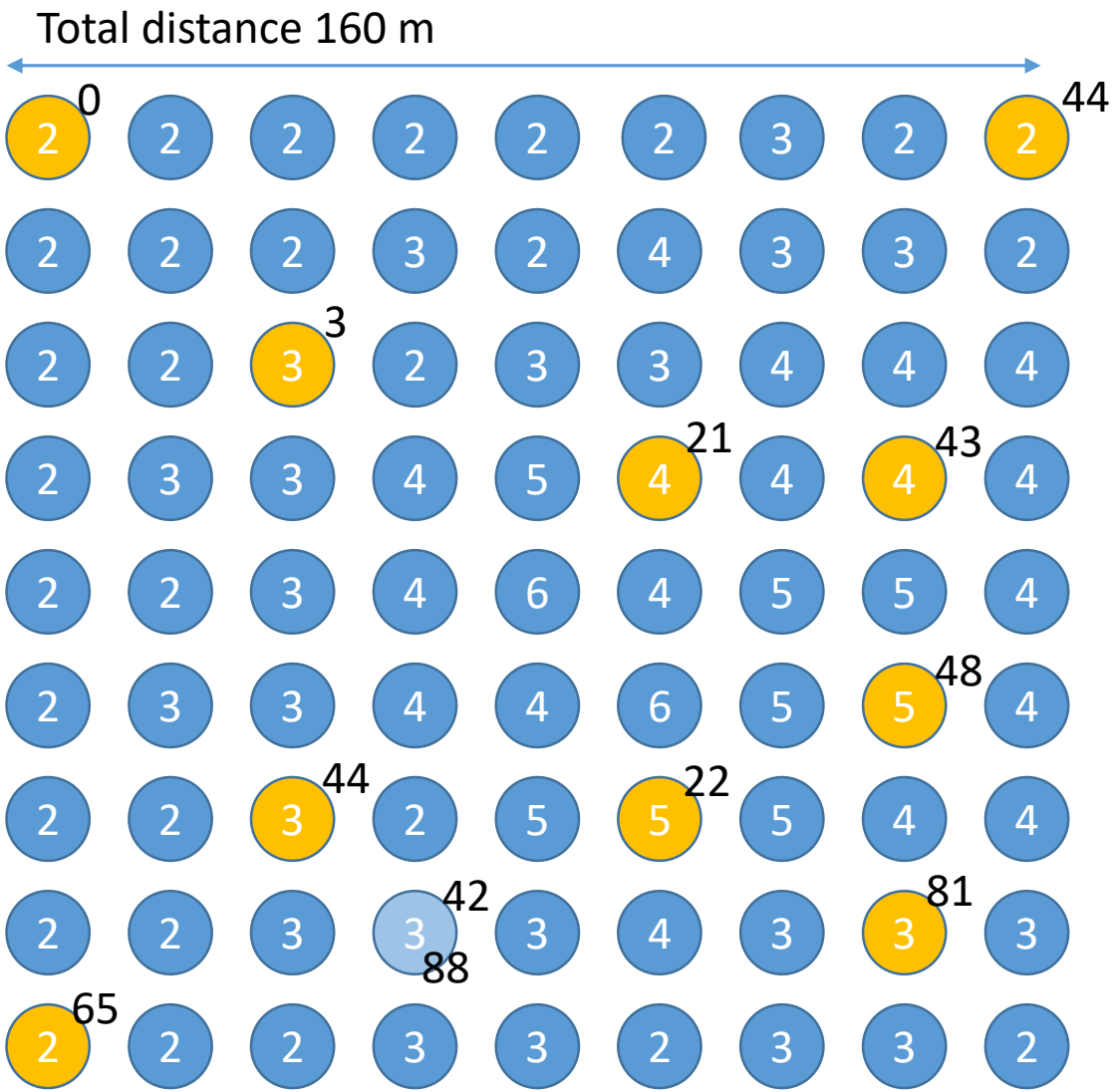
Distance between node **10 m**
Random addresses
N_DUPLICATE = 2

x — Non forwarder sees x forwarders

x (y) — Forwarder sees x forwarders, became forwarder after y seconds

Example 2

9x9



Distance between node **20 m**
Random addresses
N_DUPLICATE = 2

x (y / z) — Removed forwarder after z seconds, became forwarder after y seconds, and sees x forwarders

x — Non forwarder sees x forwarders

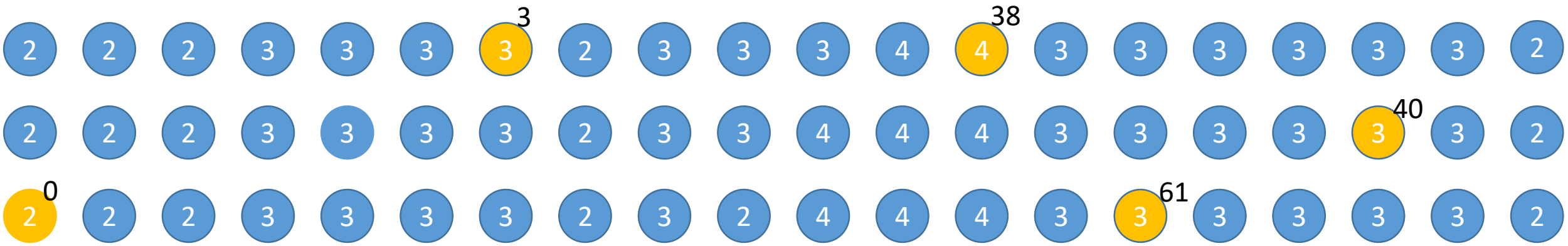
x (y) — Forwarder sees x forwarders, became forwarder after y seconds

Example 3

20x3

Distance between node **10 m**
Random addresses
N_DULICATE = 2

Total distance 190 m



x — Non forwarder sees x forwarders

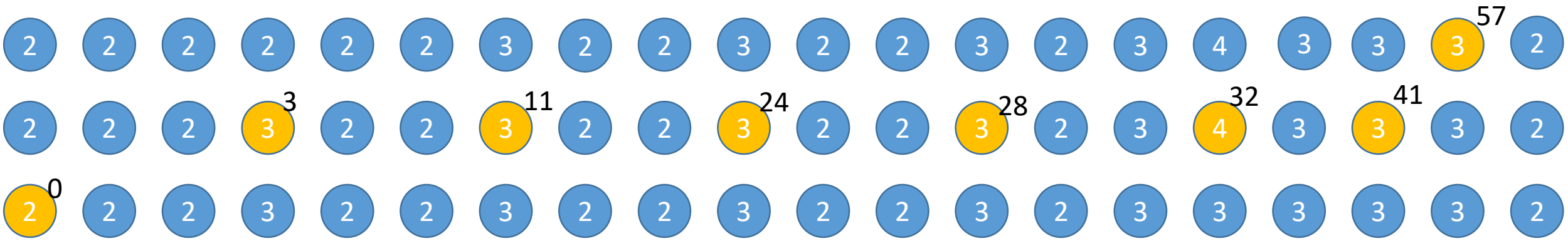
x (y) — Forwarder sees x forwarders, became forwarder after y seconds

Example 4

20x3

Distance between node **20 m**
Random addresses
N_DUPLICATE = 2

Total distance 380 m



x — Non forwarder sees x forwarders

x (y) — Forwarder sees x forwarders, became forwarder after y seconds

Q&A

Thanks!