

On-time Forwarding with Push-In First-Out (PIFO) Queue

draft-ryoo-detnet-ontime-forwarding-04

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Update of On-time Forwarding

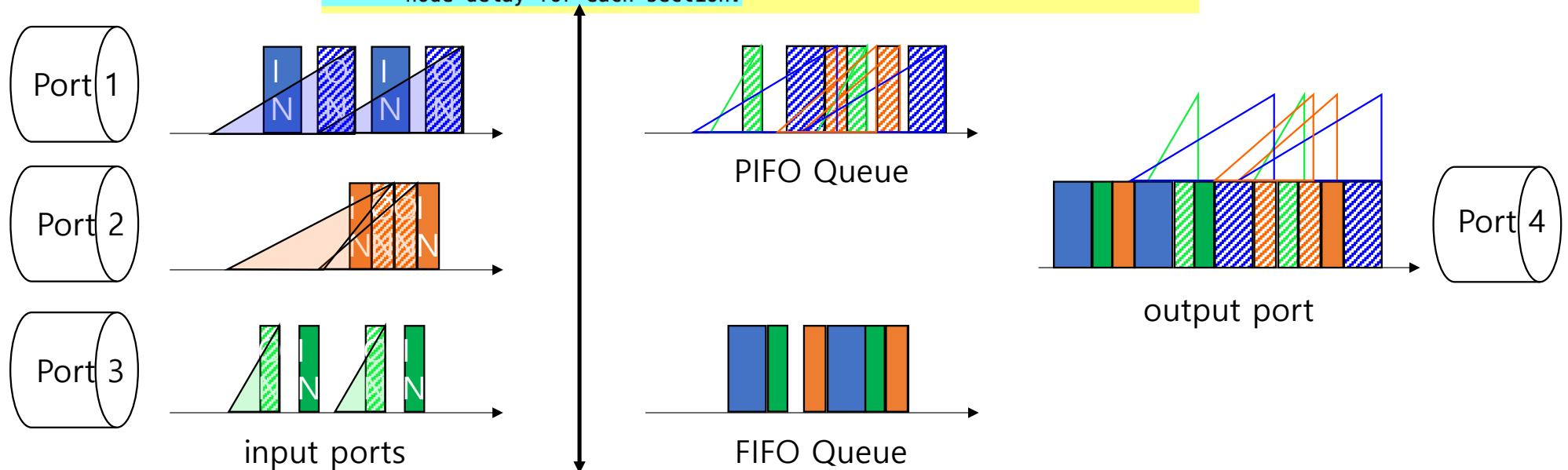
- The original Chapter 7 referred only to the Scaling Requirement Draft, but it has now been divided into two sub-sections and referred to both the Scaling Requirement Draft and the Taxonomy Draft.

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Update of On-time Forwarding

- Reflecting the updates from the Scaling Requirement Draft, Section 7.1 added the content on Support Multiple Mechanisms in Single and Multiple Domains.

8. The solution described in this document uses a dedicated PIFO queue and clearly distinguishes the algorithm applied to it from that used for the existing FIFO queue. It supports multiple mechanisms by appropriately mapping each flow to a queue based on its SLA. Furthermore, it can support multiple algorithms across multiple domains by compartmentalizing the end-to-end delay requirements according to sections divided by differences in domain or link speed, and applying the upper and lower bounds of node delay for each section.



Update of On-time Forwarding

- Section 7.2 has been added to include the Functional Characteristics and Suitable Category parts from the Taxonomy Draft.

7.2. Taxonomy

Based on the draft of the taxonomy, latency-bound solutions are classified according to functional characteristics such as

- * periodicity (periodic, non-periodic)
- * network synchronization (phase and frequency synchronous, asynchronous)

- * traffic granularity (flow level, flow aggregate level, class level)

- * time bound (bounded, left-bounded, right-bounded, unbounded)

- * service order (rate-based, time-based, arrival-based, priority-based)

The solution described in this document is a non-periodic, asynchronous, flow level, bounded, time-based solution.

The draft of the taxonomy also defines seven suitable categories for deterministic networking as follows.

- * Right-bounded category

- * Flow level periodic bounded category

- * Class level periodic bounded category

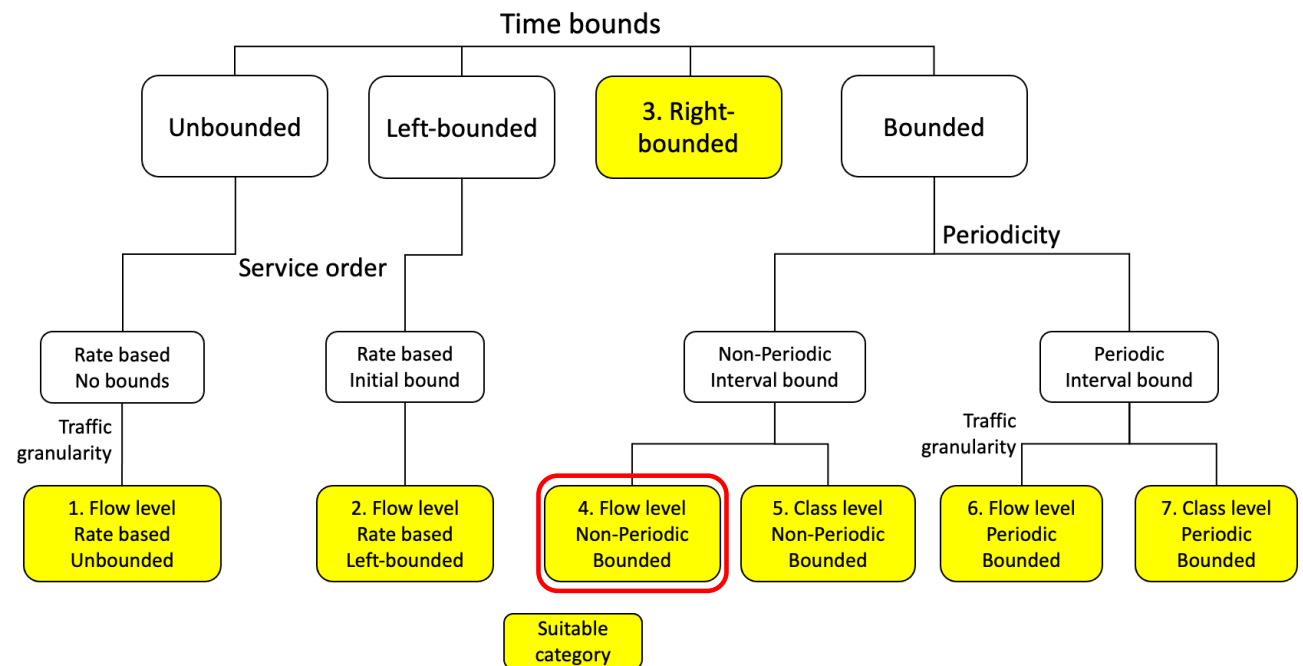
- * Flow level non-periodic bounded category

- * Class level non-periodic bounded category

- * Flow level rate based unbounded category

- * Flow level rate based left-bounded category

The solution described in this document belongs to the "Flow level non-periodic bounded category", which is an on-time solution with a time-based service order characteristic that can adjust very low jitter and delay according to the user's requirements.



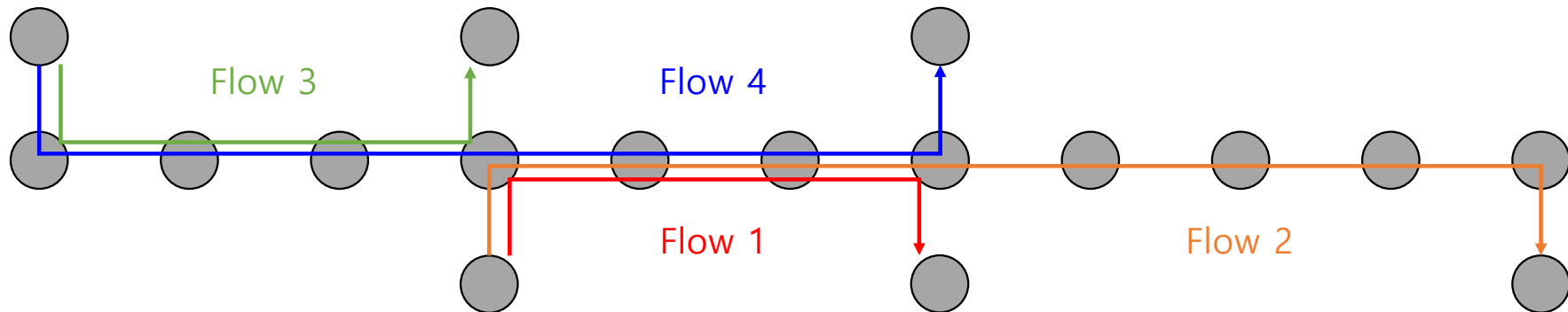
On-time forwarding is the only solution currently being suggested in the 4th suitable category.

Implement state of On-time Forwarding

- **The On-time Forwarding solution implemented by FPGA**
 - It was implemented to transmit metadata to the next node based on post-stack MPLS network action (MNA), and is planned to implement in-stack MNA.
- **The solution is currently being tested on the actual KOREN network.**
 1. Four nodes in the KOREN network over a 500 km section between Seoul and Daejeon (64~1518byte random size test packets)
 2. Eight nodes in the KOREN network over a 1000 km section between Seoul and Daejeon (64~1518byte random size test packets)
 3. Four nodes in the KOREN network over a 690 km section between Daejeon and Busan with an OTN sub-layer (64~1518byte random size test packets)
 4. Seven nodes in the KOREN network over a 1190 km section between Seoul, Daejeon and Busan with an OTN sub-layer (64~1518byte random size test packets)

Implement state of On-time Forwarding

- We tested the on-time service (with the same 6.5 ms latency requirement) on multi-path segments of 500 km (Flow 1), 1000 km (Flow 2), 690 km (Flow 3), and 1190 km (Flow 4) between Seoul, Daejeon, and Busan over the actual KOREN network.



Implement state of On-time Forwarding

- Verify that four flows, each with different paths and lengths, satisfy the same maximum and minimum delay requirements.

Packet Group Statistic View - 09														
	B	C	T	AK	BB	BS	BT	CK	DT	DU	DV	DW	EE	EV
	PGID	Total # Frames Rec.	Latency Min (μs)	Latency Max (μs)	Latency Max-Min (μs)	Latency Avg (μs)	Bit Rate (/sec)	Byte Count	Small Error	Big Error	Reverse Error	Total Error	First Timestamp	Last Timestamp
1														
2														
3														
4	1	1,124,252,383	2,482.642	2,694.757	212.115	2,558.741	5,895,847,942	1,439,043,050,240	1,353,025	264,363,376	0	265,716,401	00:00:00.0000000	00:32:34.6100093
24														
25														
26														
32	6	11,393,439,912	6,136.850	6,153.135	16.285	6,146.911	35,054,582,407	8,567,856,513,742	0	0	0	0	00:00:00.0000000	00:32:34.6078275
33	7	11,589,838,961	3,645.300	3,668.265	22.965	3,646.115	8,808,271,875,958	8,808,271,875,958	0	0	0	0	00:00:00.0000000	00:32:34.6105121
37	11	2,215,391,515	6,501.387	6,514.490	13.103	6,505.940	1,665,997,916,055	1,665,997,916,055	0	0	0	0	00:00:00.0000000	00:32:34.6082608
44	18	2,505,909,953	6,499.847	6,511.657	11.810	6,505.940	1,904,465,620,540	1,904,465,620,540	0	0	0	0	00:00:00.0000000	00:32:34.6097666
48														
49														
50														
56	6	11,589,755,070	2,487.622	2,494.410	6.788	2,490.781	36,052,350,985	8,808,198,408,901	0	0	0	0	00:00:00.0000000	00:32:34.6354440
57	7	11,902,977,743	4,977.755	4,986.175	8.420	4,980.781	9,046,243,376,265	9,046,243,376,265	0	0	0	0	00:00:00.0000000	00:32:34.6331165
64	14	2,192,653,180	6,500.720	6,507.100	6.380	6,503.998	1,666,427,252,964	1,666,427,252,964	0	0	0	0	00:00:00.0000000	00:32:34.6327495
67	17	2,505,889,925	6,499.965	6,509.117	9.152	6,503.998	1,904,487,855,257	1,904,487,855,257	0	0	0	0	00:00:00.0000000	00:32:34.6332382
72														
73														
74														
78	4	1,303,202,701	2,484.162	2,678.802	194.640	2,552.716	6,846,565,914	1,668,099,457,280	1,831,467	285,173,473	0	287,004,940	00:00:00.0000000	00:32:34.6383934

Thank you