

Design and Implementation of Automatic System for Network Testing with Quality Degradation

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1. Introduction

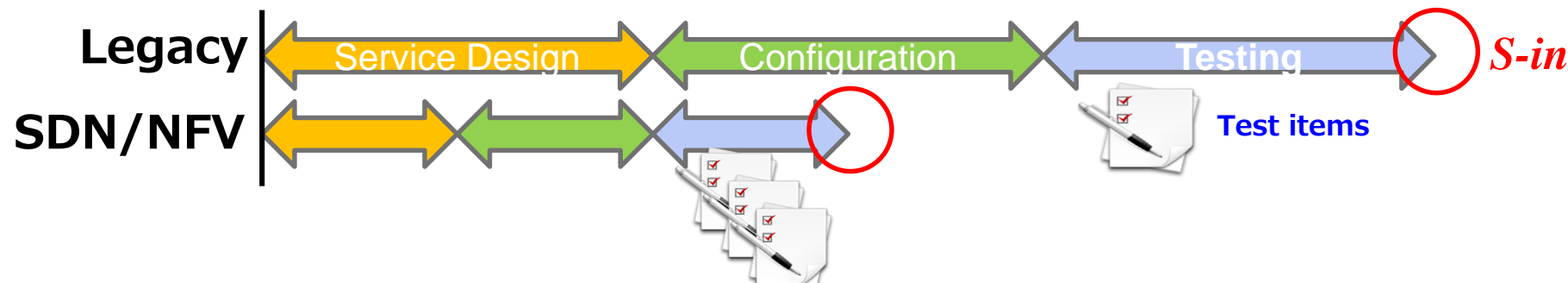
Network Testing

- To maintain SLA between customers and carriers
- When devices are added, removed, upgraded
- Over hundreds of test items

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SDN/NFV

- Virtualized: **More components to be tested**
- Diversified services: **More patterns to be tested**
- Agile implementation: **Shorter time for testing**



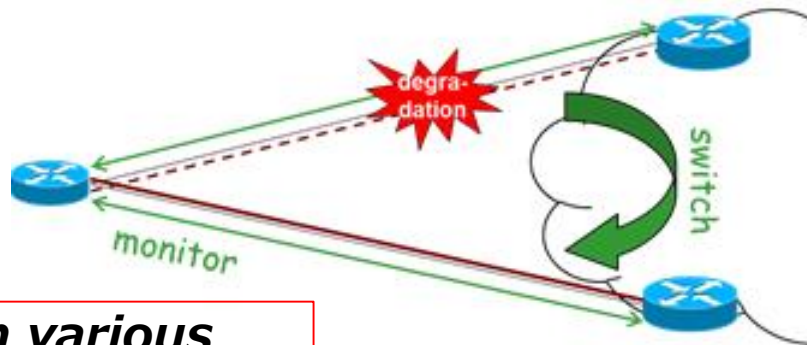
Manual-based approach

- cannot cover all items
- human error risk

2. Our target and proposal

■ Policy-based path control

- Becoming widely used
(e.g., hybrid WAN)
- Monitor and switch paths
in responding to network
conditions



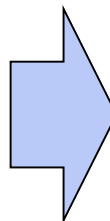
*Testing with various
quality patterns is needed*

■ Testing automation

● CloudShell/TestShell

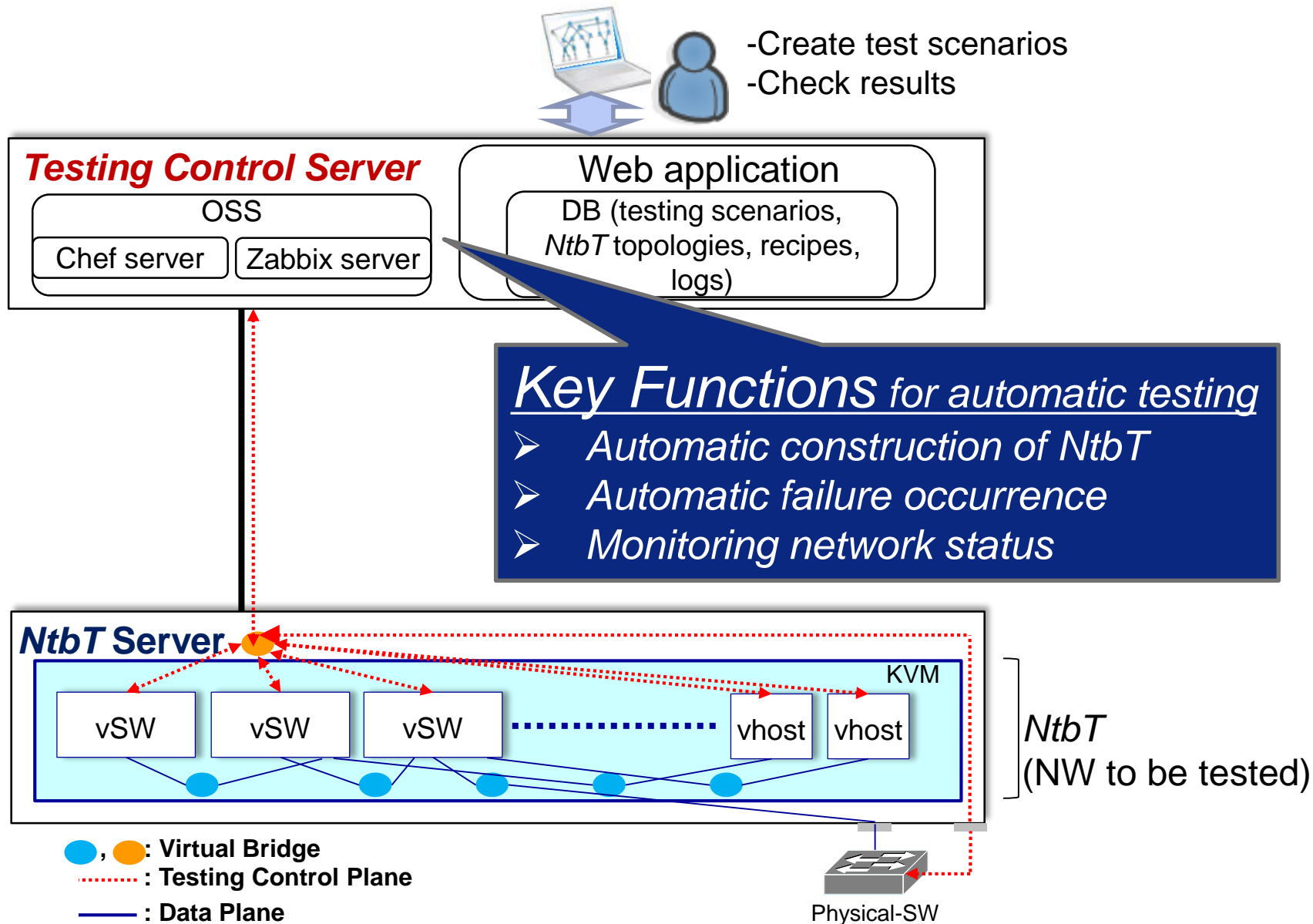
- Protocol testing
- Protocol: BGP/OSPF

*Does not support testing
in degradation cases*



**Automatic System
for Network
Testing with
Quality
Degradation**

3. Automatic system for network testing



3.1 Testing scenario

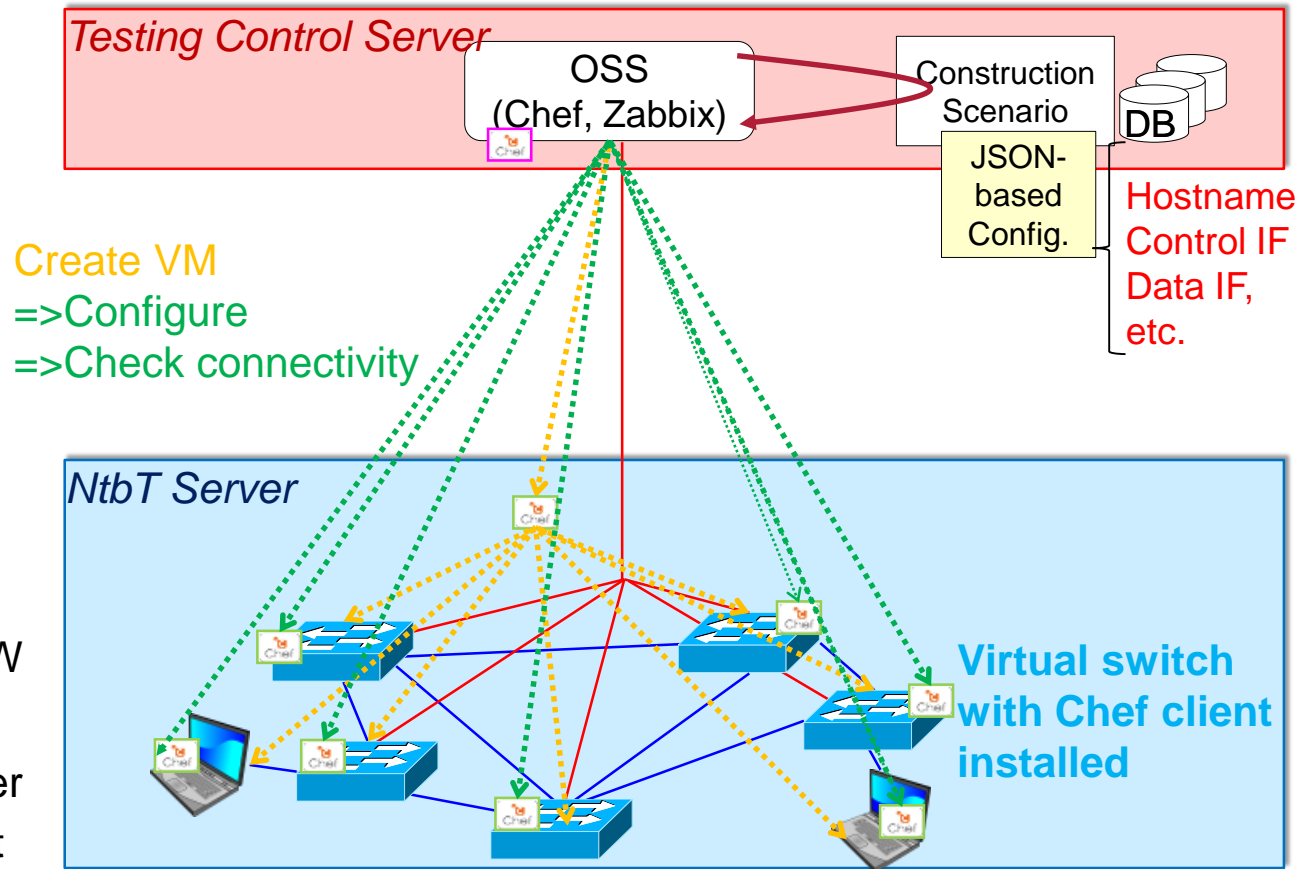
Testing Scenario	No.	Scenario Step
<i>NtbT</i> construction scenario	1	Selection of <i>NtbT</i> topology from DB
	2	Construction of <i>NtbT</i>
	3	Initialization of network equipment
	4	Checking of connectivity
Failure scenario	5	Selection of recipes from DB with execution time Traffic recipes : traffic sending/receiving { IP version Failure recipes: interface down/up { Bandwidth, etc. latency start/stop { Node : Interface, etc.

●Procedure:

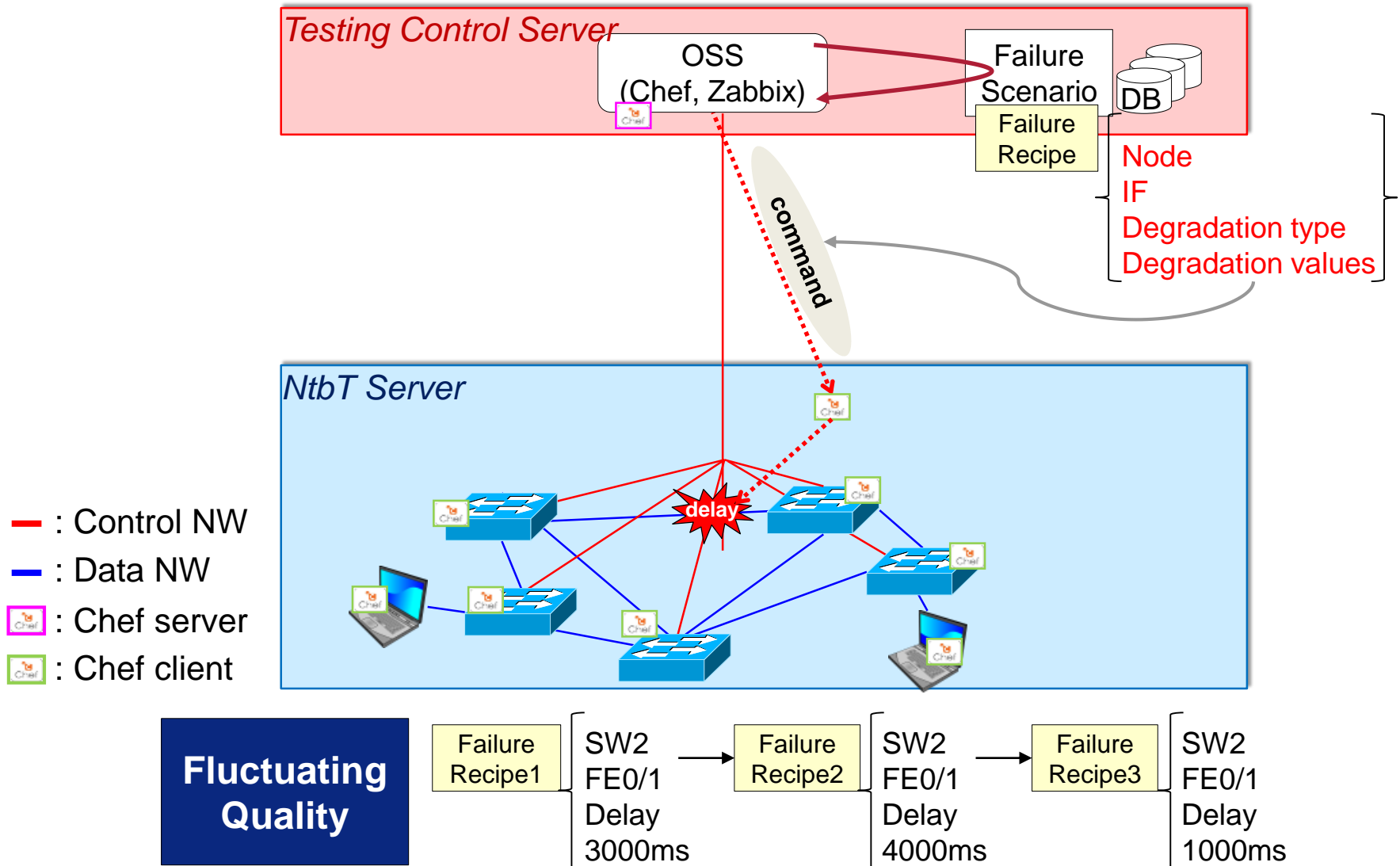
- I. Create a testing scenario with start time
- II. Scenario runs automatically
- III. Check the monitoring result

*Monitor network
status during testing*

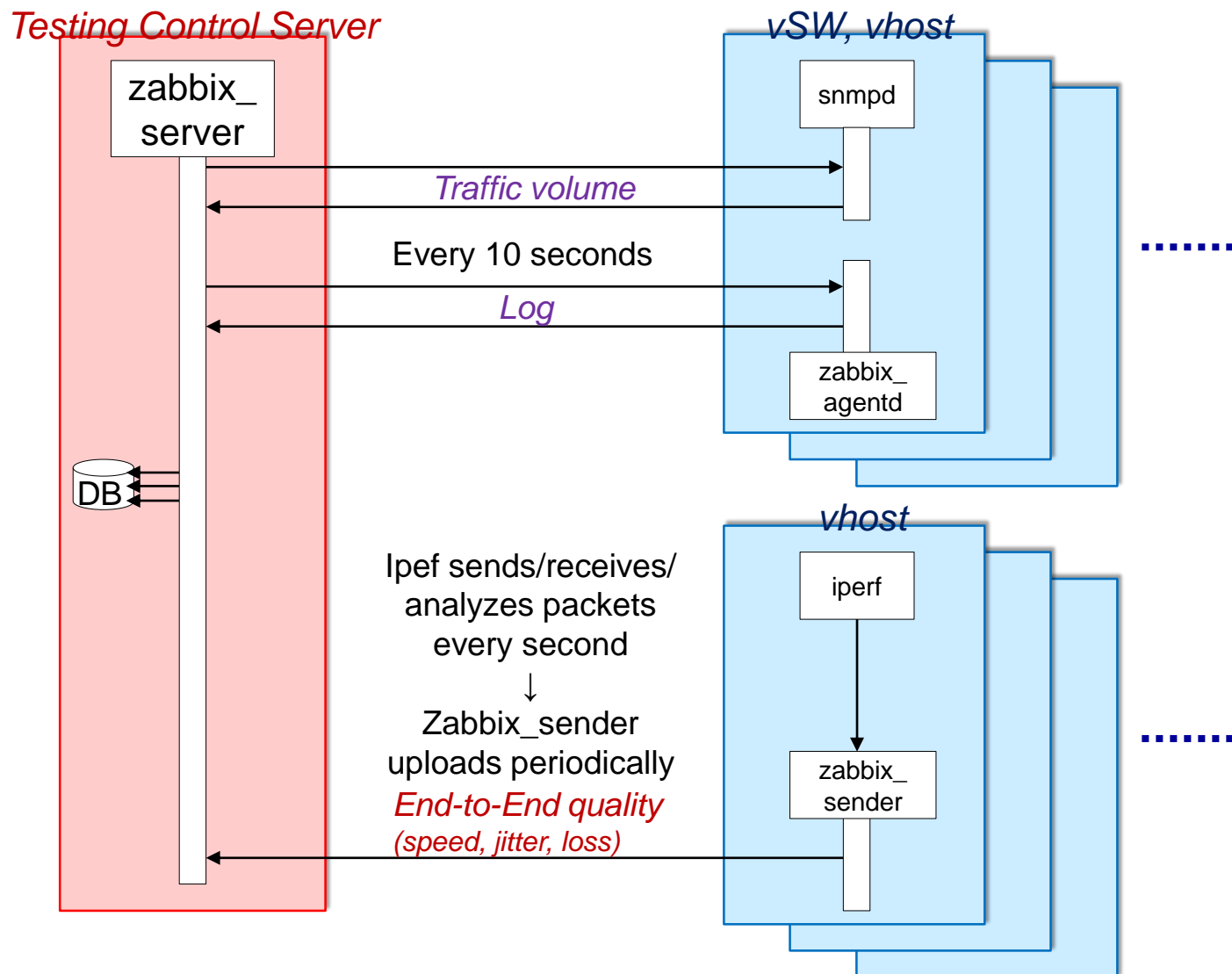
3.2 Automatic construction of *NtbT*



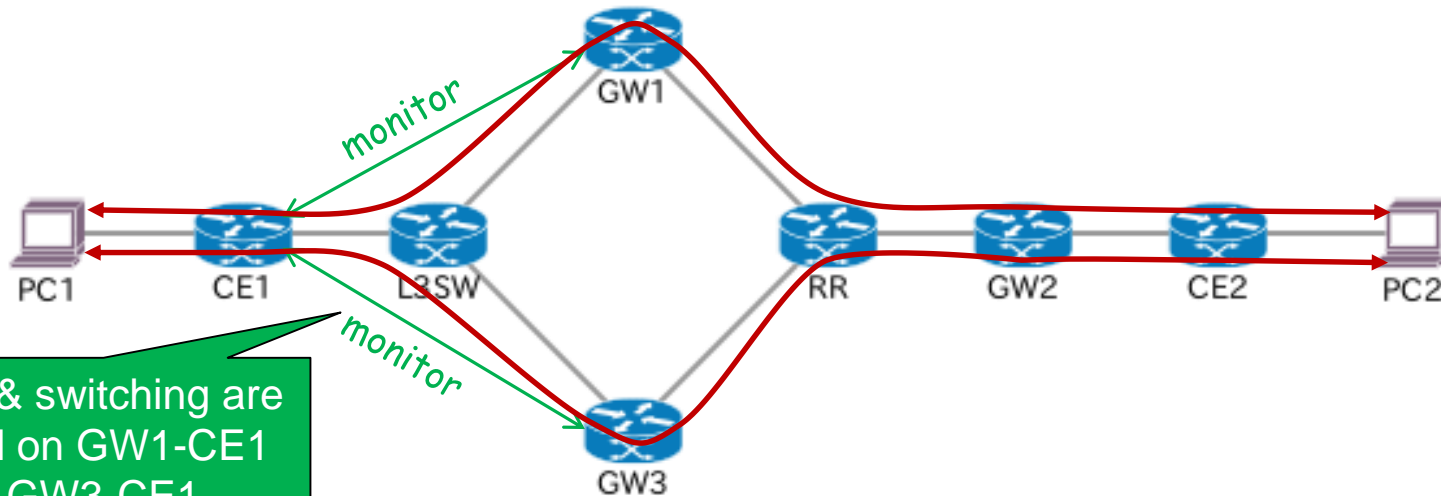
3.3 Automatic failure occurrence



3.4 Monitoring network status



4.1 Network topology for system evaluation



Monitor & switching are enabled on GW1-CE1 and GW3-CE1

● Monitor and Switching

Measured delay(s)	State
$\text{delay} < x$	NORMAL
$x \leq \text{delay} < y$	DELAY
$y \leq \text{delay}$	DOWN

※Threshold x, y is configured on GW.

The path of a state better than another becomes the working path

4.3 Failure scenario for system evaluation

Recipe No.	Failure Recipes [x = 3, y = 5]
1	Cause 2 sec delay on the link between GW1-CE1
2	Change the delay with 4 sec
3	Change the delay with 6 sec
4	Normalize the delay
5	Cause 2 sec delay on the link between GW3-CE1
6	Change the delay with 4 sec
7	Change the delay with 6 sec
8	Normalize the delay



Expected Results

GW1-CE1	GW3-CE1	Working path
NORMAL	NORMAL	A
DELAY	NORMAL	B
DOWN	NORMAL	B
NORMAL	NORMAL	B
NORMAL	NORMAL	B
NORMAL	DELAY	A
NORMAL	DOWN	A
NORMAL	NORMAL	A

Verify with GW log

Verify with traceroute (manual) or
visualized traffic on system GUI (with system)

4.4 Evaluation results

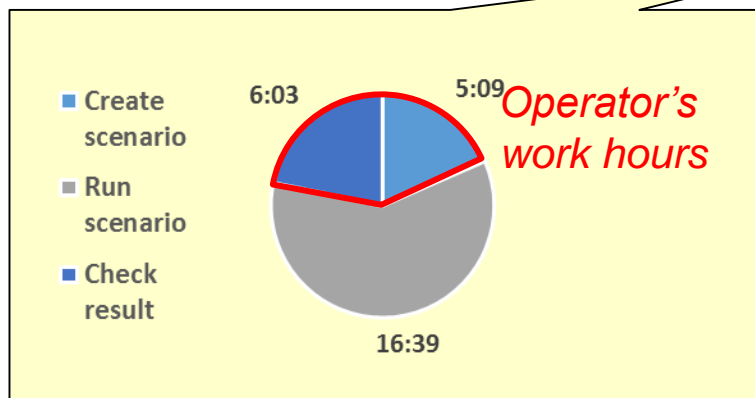
- Perform the scenario manually and, with the proposed system, twice, respectively

Step	Manual operation	With system
1	Execute command	Create scenario
2	Check result	Run scenario
3	Repeat 1-2	Check result

- Results

Case	Testing Operation	Average Time[min]	Average Work Hours[min]
Case-1	Manual operation	21:05	21:05
Case-2	With system	27:51	11:12

Reduced
46.9%



■Proposal

- Automatic system for network testing with quality degradation

■Implementation of automatic system

- Construction of *NtbT* and failure occurrence by Chef
- Monitoring network status by Zabbix

■System evaluation

- Testing on experimental network that consists of IP-Sec GW
 - Reduce testing workload by half
 - No human error risk
-



Ref.1) Creating a testing scenario

Execution time	Recipe	Node	Interface	Parameter
×	1			Traffic receiving start
×	0			Traffic sending start
×	15	GW11	GigaEthernet 1/2	Degradation start
×	15	GW11	GigaEthernet 1/2	Degradation change
×	15	GW11	GigaEthernet 1/2	Degradation change

Traffic parameter (IP version, bandwidth etc.)

- IPバージョン: IPv4
- 帯域幅(Mbps): 3
- UDPペイロード長(byte): 500
- 並列数: 1

Degradation parameter (Loss rate, Latency values etc.)

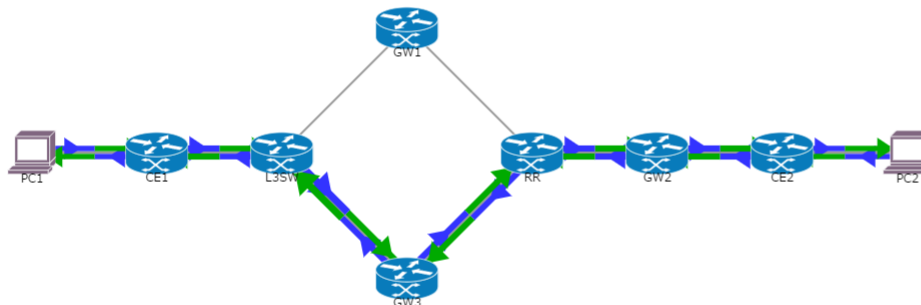
- ロス率(%): 0
- ロス率2(%): 0
- 遅延時間(ms): 2000
- 遅延ジッタ(ms): 0
- 遅延割合(%): 0
- 重複(%): 0
- 重複2(%): 0
- 順序逆転(%): 0
- 順序逆転2(%): 0

Ref.2) The scenario running

シナリオ: Monitor&Switching_Test2

プロパティ トポロジ 切断時間

日時: 2017/05/11 17:26:39.020, 処理時間: 111ms+309ms



1Mbps
3Mbps
10Mbps

1Mbps/px

イベント表示

開始
2017/05/11 17:18:56.569
トラヒック受信開始
トラヒック送信開始
2017/05/11 17:23:37.152
2017/05/11 17:24:13.902
2017/05/11 17:24:23.621
L3SW-GW1間遅延発生開始 GW1 GigaEthernet 1/2
2017/05/11 17:24:58.640
2017/05/11 17:25:24.004
L3SW-GW1間遅延発生停止 GW1 GigaEthernet 1/2
2017/05/11 17:25:58.792
2017/05/11 17:26:39.020
2017/05/11 17:27:09.552
L3SW-GW3間遅延発生開始 GW3 GigaEthernet 1/2
2017/05/11 17:27:47.389
2017/05/11 17:28:11.001
L3SW-GW3間遅延発生停止 GW3 GigaEthernet 1/2
2017/05/11 17:28:48.216
2017/05/11 17:29:28.931
2017/05/11 17:29:36.347
トラヒック送信停止
トラヒック受信停止
2017/05/11 17:33:00.074
終了