telestream

Dynamic Priority: A Technique to Reduce Unnecessary Grandmaster Changeovers in PTP Networks for Broadcast Media Applications

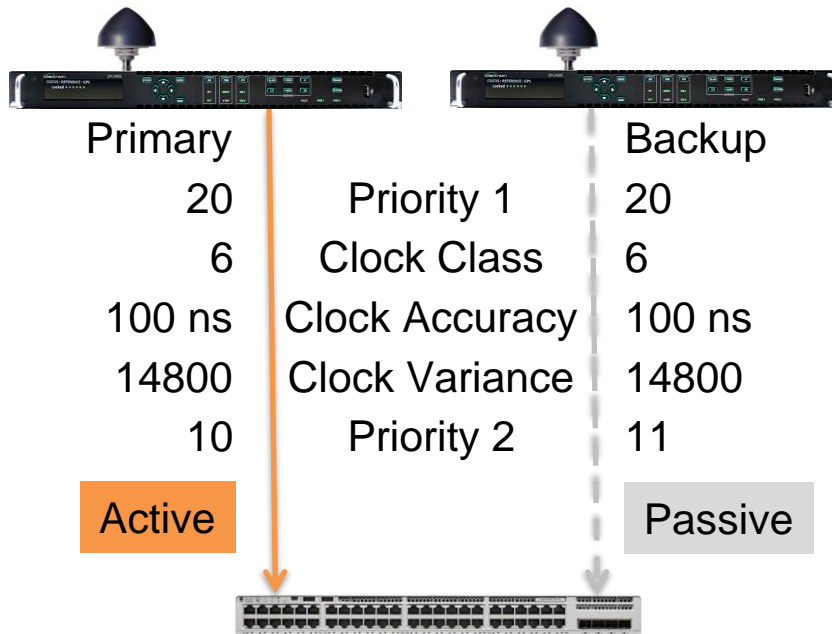## Presented by Mike Overton

Background

- Broadcast PTP networks often contain a large number of devices from a wide variety of vendors

- The network may operate in different modes depending on the program being produced

- The system may evolve over time with little opportunity for testing

- Many systems are unique

- Operators are justifiable concerned about the effects of a grandmaster changeover

Customer Request

- A customer asked us if we can disable the BMCA to avoid unnecessary GM changeovers

- Feature offered on some other devices

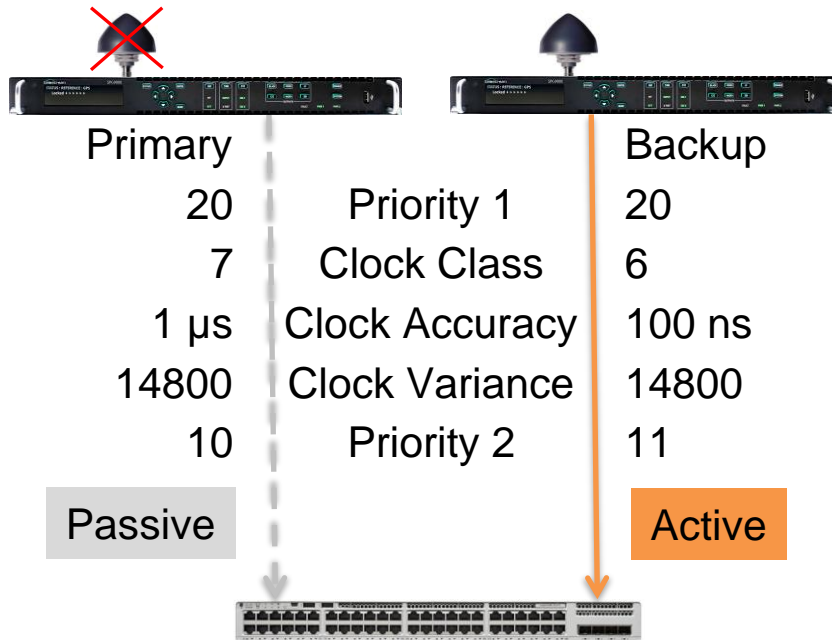- What is meant by an "unnecessary" changeover?

Basic Dual Leader PTP system

Primary		Backup
20	Priority 1	20
6	Clock Class	6
100 ns	Clock Accuracy	100 ns
14800	Clock Variance	14800
10	Priority 2	11

Active **Passive**

Both locked to GNSS, so initially they have the same clock quality

Use priority 2 to define the primary clock

Basic Dual Leader PTP system

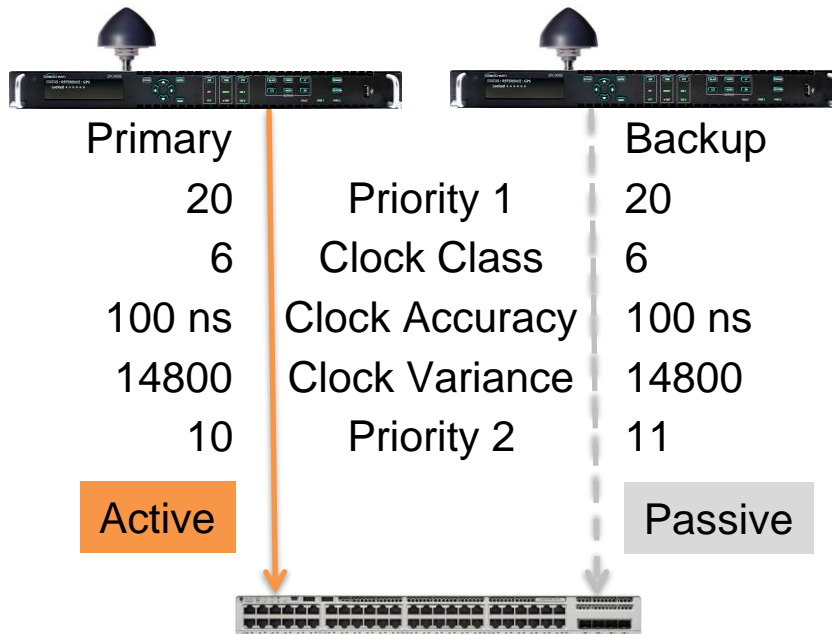| Primary		Backup
Primary		Backup
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7	Clock Class	6
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14800	Clock Variance	14800
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Use priority 2 to define the primary clock

If primary clock loses GNSS it will go into holdover; the backup clock will take over as GM per the BMCA

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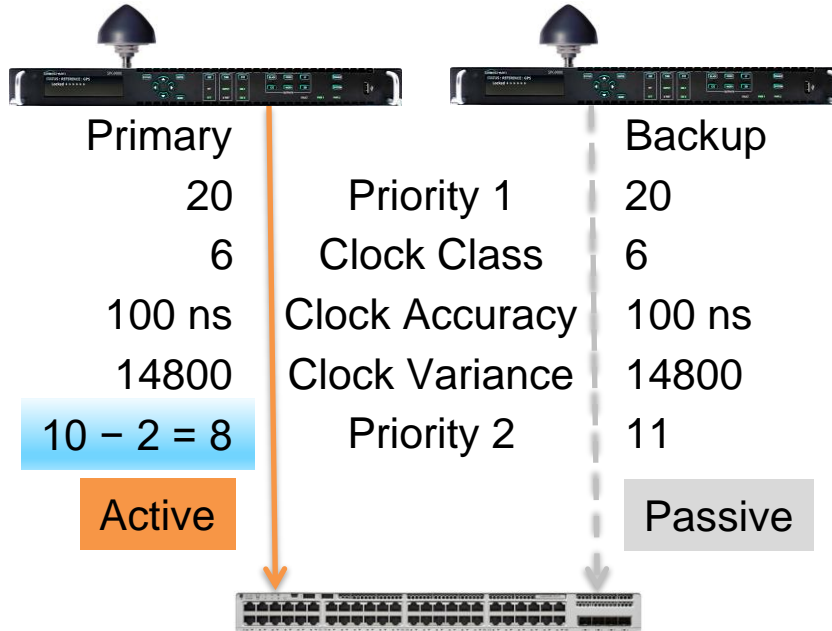If primary clock loses GNSS it will go into holdover; the backup clock will take over as GM per the BMCA

If primary clock regains the GNSS then it will resume the GM role – but is that really necessary?

Dynamic Priority Concept

- When a clock becomes the GM, the priority is modified to be "better"

- This allows clock to maintain the GM roll after other clocks are restored to normal operation

- Manipulating the system behavior without changing the BMCA
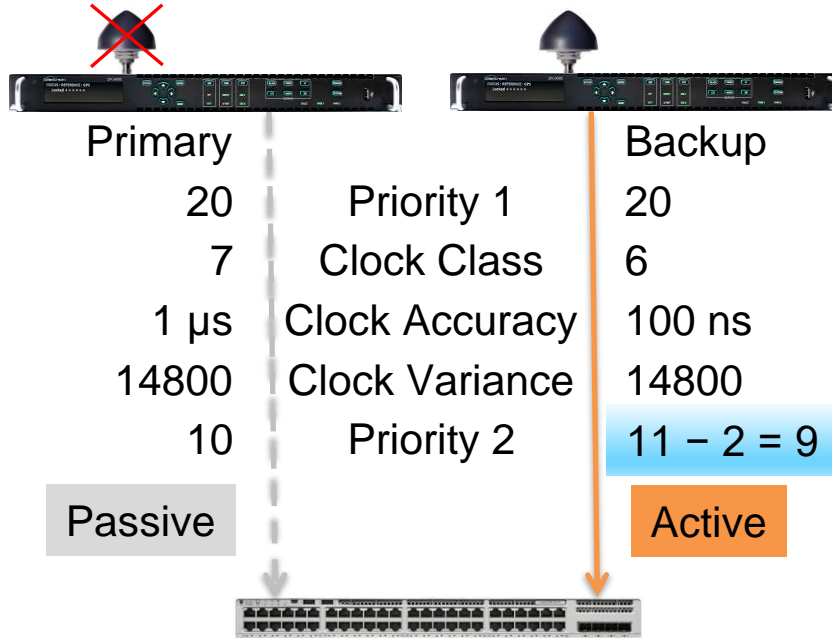
PTP system with Dynamic Priority

Primary		Backup
20	Priority 1	20
6	Clock Class	6
100 ns	Clock Accuracy	100 ns
14800	Clock Variance	14800
10 − 2 = 8	Priority 2	11
Active		Passive

Both clocks locked to GNSS, use priority 2 to define the primary

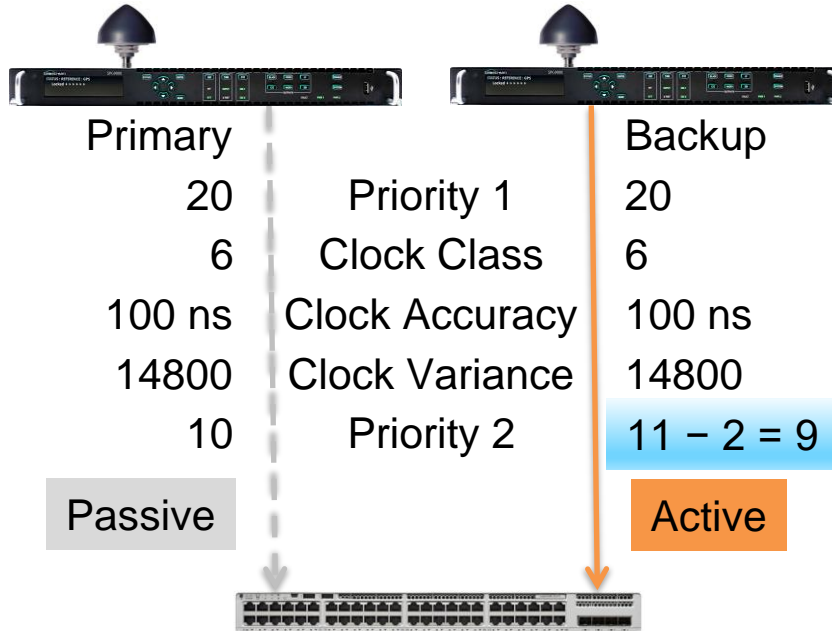**Dynamic Priority applies an offset of 2 to the priority 2 on the active GM**

PTP system with Dynamic Priority

Primary		Backup
20	Priority 1	20
7	Clock Class	6
1 μs	Clock Accuracy	100 ns
14800	Clock Variance	14800
10	Priority 2	11 − 2 = 9
Passive		Active

If the primary clock loses GNSS then it will go into holdover, the backup clock will take over as GM as per the BMCA

Dynamic Priority removes the offset from the primary clock and applies it to the backup clock

PTP system with Dynamic Priority

Primary		Backup
20	Priority 1	20
6	Clock Class	6
100 ns	Clock Accuracy	100 ns
14800	Clock Variance	14800
10	Priority 2	$11 - 2 = 9$

Passive

Active

If the GNSS is restored to the primary clock, the backup clock retains the active GM role

Dynamic Priority prevents the "unnecessary" GM changeover
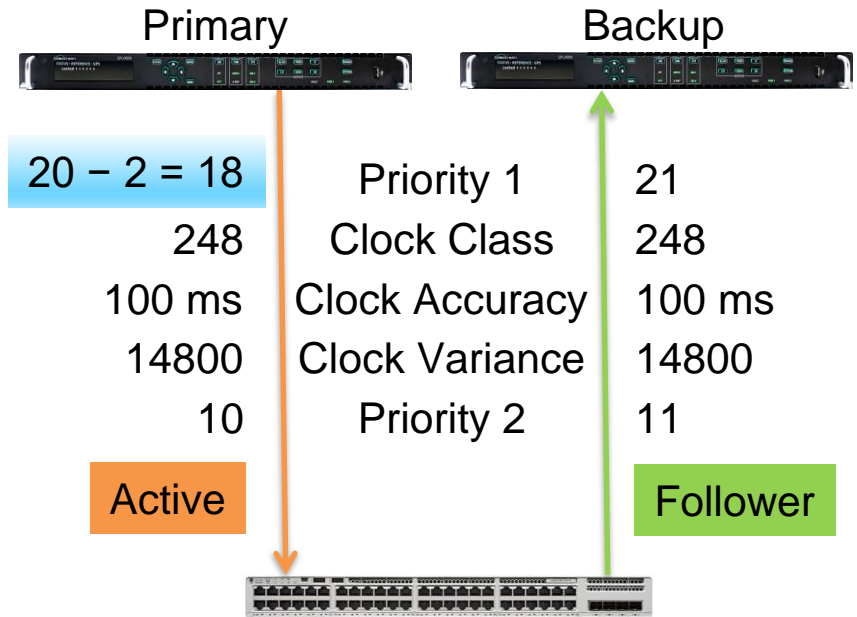
BMCA still able to react to faults

Dynamic Priority modifying priority 1

GNSS not available

Primary clock running on its internal oscillator and initially setting time by NTP

Secondary clock locking to primary via PTP – full ordinary clock mode

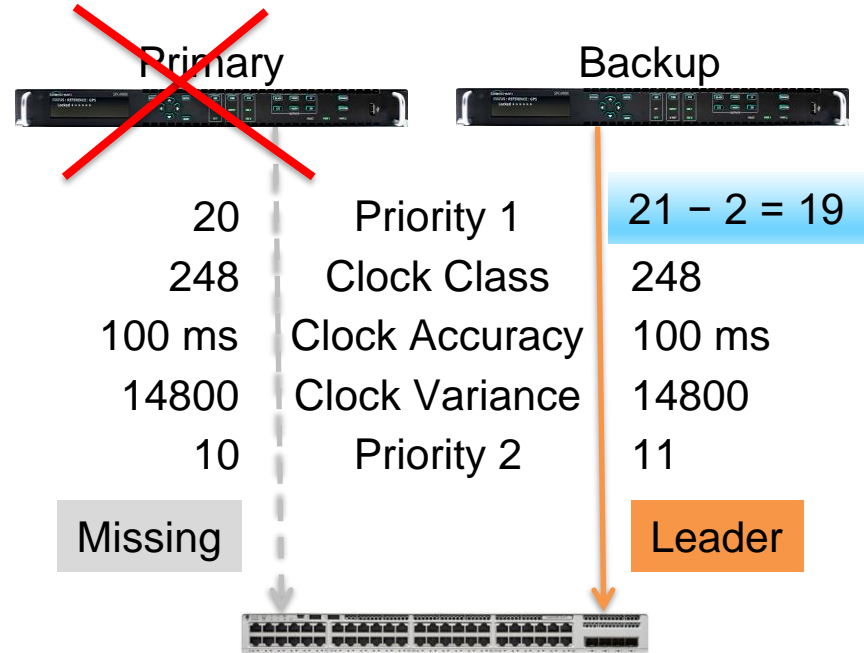| Primary		Backup
20 – 2 = 18	Priority 1	21
248	Clock Class	248
100 ms	Clock Accuracy	100 ms
14800	Clock Variance	14800
10	Priority 2	11
Active		Follower

Dynamic Priority modifying priority 1

Fault such as loss of power to primary clock

Backup clock changes from follower to leader and assumes the GM role

Time shift is small since backup was following primary
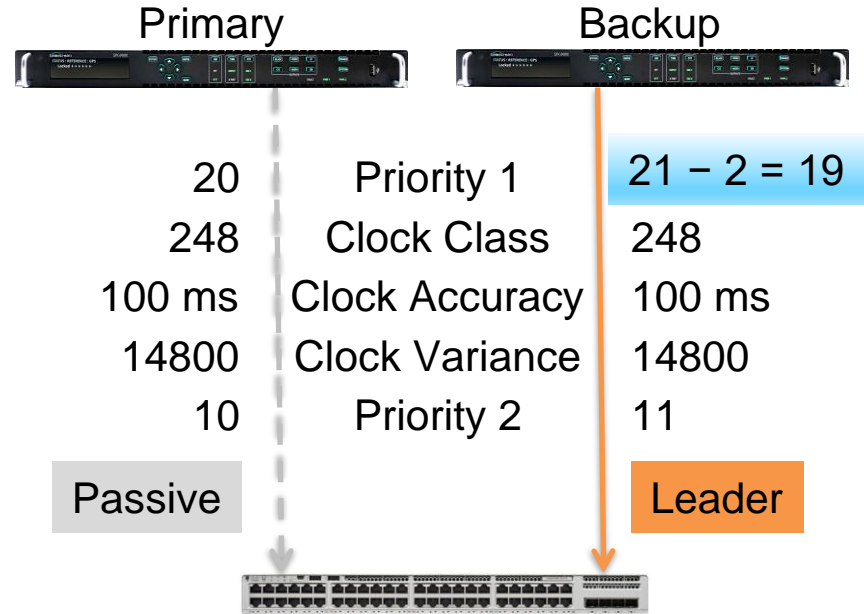
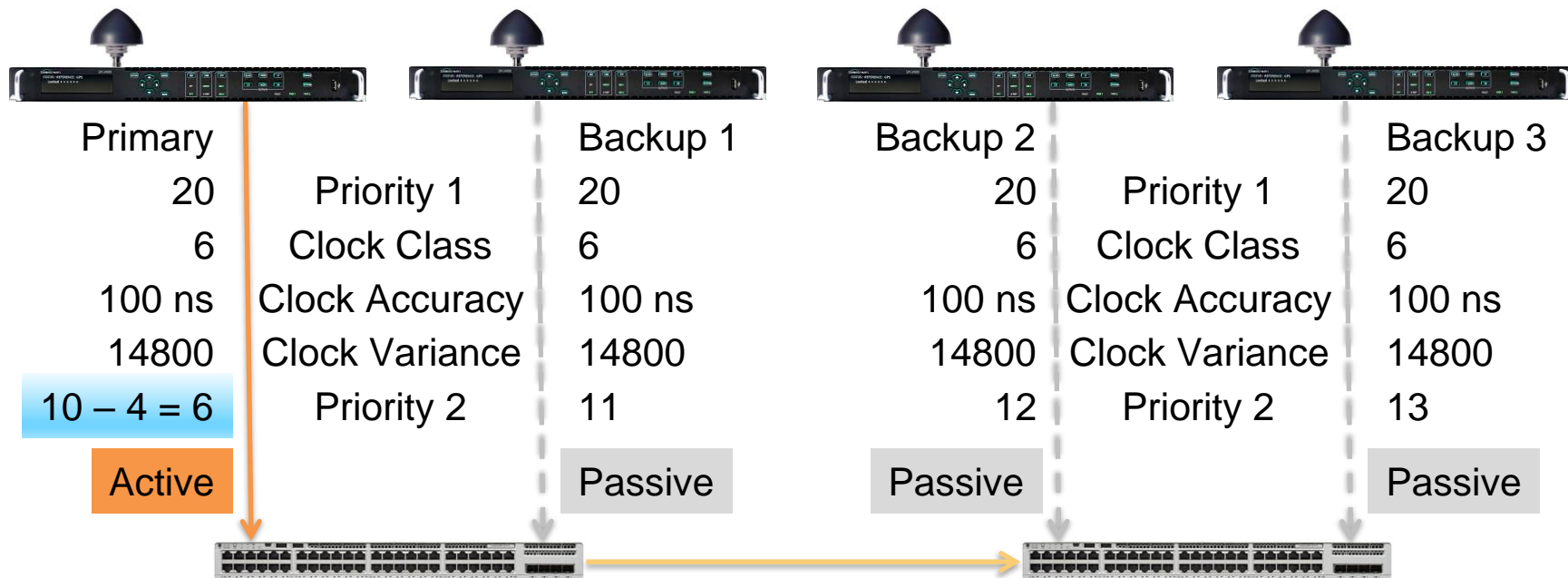| Primary		Backup
		21 − 2 = 19
20	Priority 1	
248	Clock Class	248
100 ms	Clock Accuracy	100 ms
14800	Clock Variance	14800
10	Priority 2	11
Missing		Leader

Dynamic Priority modifying priority 1

When the fault is corrected, primary clock is restored, but backup clock retains the GM role

If dynamic priority were not active, the primary clock would take over with possible large time shift due to poor accuracy of time set by NTP

Primary		Backup
Primary		**Backup**
20	Priority 1	**21 − 2 = 19**
248	Clock Class	248
100 ms	Clock Accuracy	100 ms
14800	Clock Variance	14800
10	Priority 2	11
Passive		**Leader**

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Larger PTP system with Dynamic Priority

Primary		Backup 1	Backup 2		Backup 3
20	Priority 1	20	20	Priority 1	20
6	Clock Class	6	6	Clock Class	6
100 ns	Clock Accuracy	100 ns	100 ns	Clock Accuracy	100 ns
14800	Clock Variance	14800	14800	Clock Variance	14800
10 – 4 = 6	Priority 2	11	12	Priority 2	13
Active		Passive	Passive		Passive

Implementation Details

- **Wait for the BMCA to converge before asserting the offset**

    - Announce Period × Announce Timeout Count × 2

- **On boot up, first clock to be ready wins. May not be optimal**

    - Helpful to provide a delay on start up

- **Helpful to provide a way to remove the offset and let the system converge on the nominally preferred clock**

Status

- Implemented Dynamic Priority about a year ago, in operation at multiple customers – including the original requester

- Telestream did not try to patent this

- Using open source PTP4L, so wanted to be in the spirt of that and move the industry forward

- Disclosed at tddcommons.org to maintain our rights to use this