Consideration for Power-Saving functionality

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Yasuyuki Kuroda
OF Networks Co., Ltd.

The sequence example #1 of GATE/REPORT in Clause 93

< Outline of operation >

> OLT

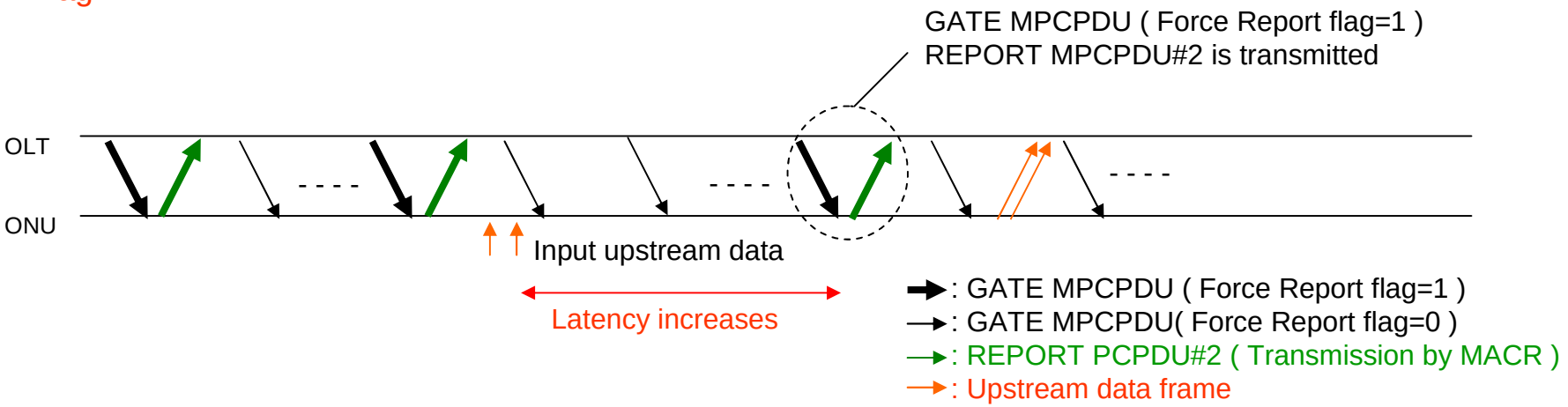
- GRANT is regularly provided by GATE MPCPDU.
- GATE MPCPDU which has Force Report flag=1 appears with some interval.

> ONU

- ONU sends REPORT MPCPDU whenever it receives the GATE MPCPDU which has Force Report flag=1.
- Although ONU doesn't have the upstream traffic, it sends REPORT MPCPDU.
- ONU doesn't send any REPORT MPCPDU when the GATE MPCPDU has Force Report flag=0.

< Features >

- Output power is saved because ONU doesn't send any REPORT MPCPDU when the GATE MPCPDU has Force Report flag=0.
- The upstream latency increases because ONU waits for the GATE MPCPDU which has Force Report flag=1.



The sequence example #2 of GATE/REPORT in Clause 93

< Outline of operation >

> OLT

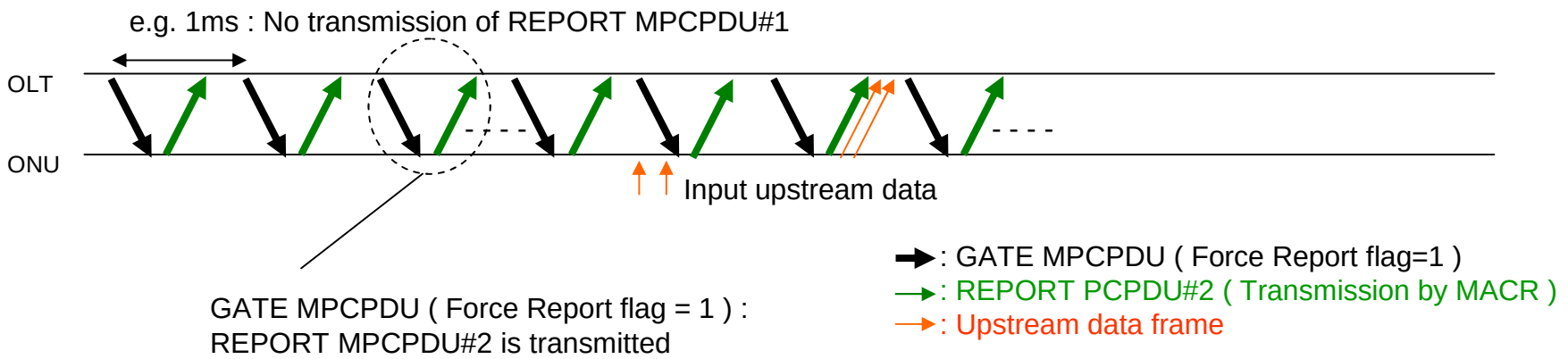
- GRANT is regularly provided by GATE MPCPDU.
- Set every GATE MPCPDU which has Force Report flag =1.

> ONU

- Although ONU doesn't have the upstream traffic, it sends REPORT MPCPDU.
- ONU sends REPORT MPCPDU whenever it receives the GATE MPCPDU.

< Features >

- The upstream latency is smaller than example #1 because ONU sends REPORT MPCPDU instantly.
- The power is larger than example #1 because ONU sends REPORT MPCPDU in response to every GATE MPCPDU.



The sequence proposal #1 of GATE/REPORT for Power Saving

< Outline of operation >

> OLT

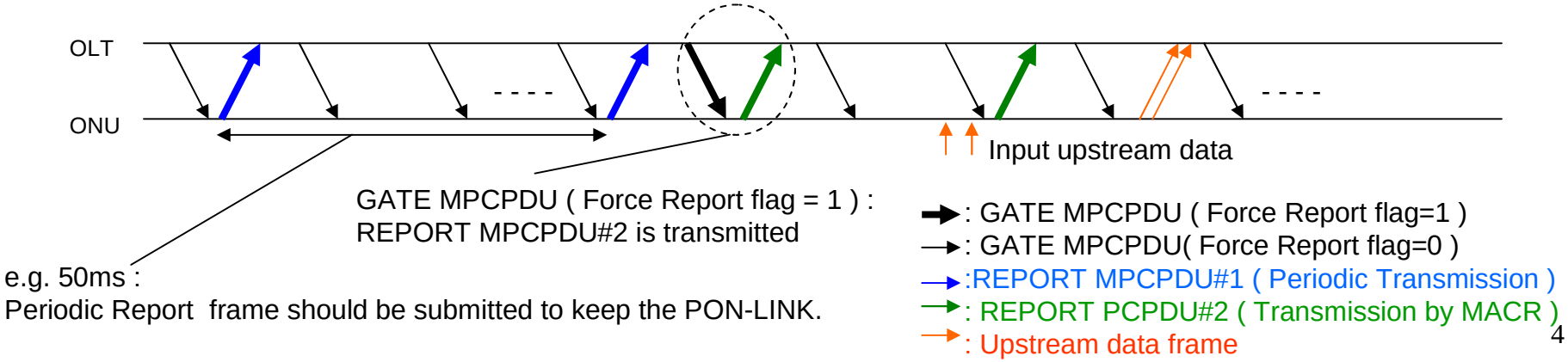
- GRANT is regularly provided by GATE MPCPDU.
- Usually, set GATE MPCPDU which has Force Report flag =0.
  It is allows that OLT sends GATE MPCPDU which has Force Report flag=1.

> ONU

- ONU responds to the GATE MPCPDU that has Force Report flag=0. REPORT MPCPDU contains;
  (a) A REPORT MPCPDU #1 (Periodic Transmission) with maximum interval if ONU requires no upstream traffic.
  (b) A REPORT MPCPDU #2 (Transmission by MACR) if ONU requires upstream traffic.
- ONU sends REPORT MPCPDU #2 (Transmission by MACR) whenever it receives the GATE MPCPDU which has Force Report flag=1.

< Features >

- Output power is saved because ONU sends minimum number of REPORT MPCPDU.
- The upstream latency is smaller than example #1 because ONU sends REPORT MPCPDU instantly.
- ONU sends REPORT MPCPDU whenever it receives the GATE MPCPDU which has Force Report flag=1



The sequence proposal #2 of GATE/REPORT for Power Saving

< Outline of operation >

> OLT

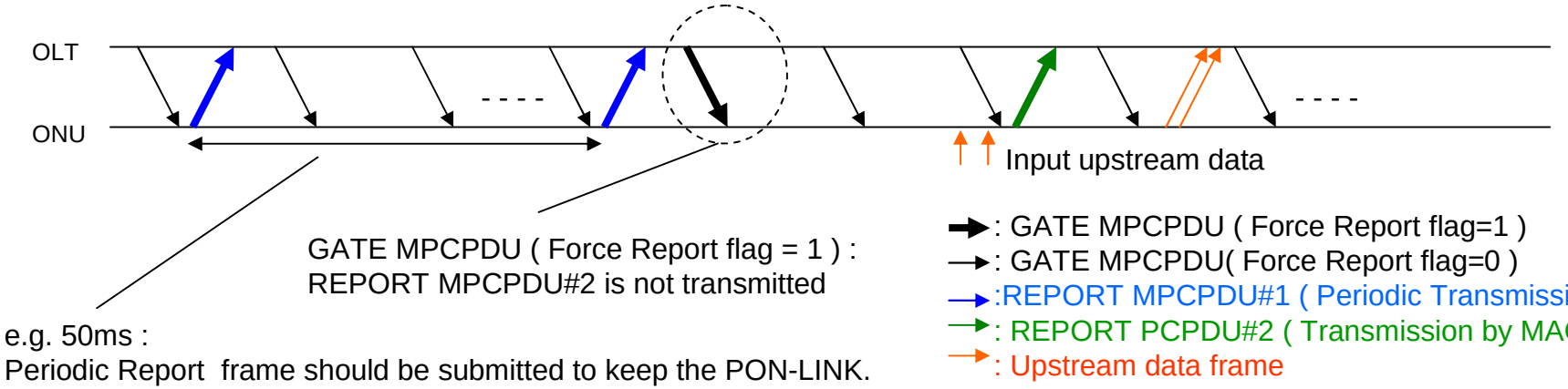
- GRANT is regularly provided by GATE MPCPDU.

> ONU

- ONU responds to the GATE MPCPDU that has Force Report flag=0 and 1. REPORT MPCPDU contains;
  (a) A REPORT MPCPDU #1 (Periodic Transmission) with maximum interval if ONU requires no upstream traffic.
  (b) A REPORT MPCPDU #2 (Transmission by MACR) if ONU requires upstream traffic.

< Features >

- Output power is saved because ONU sends minimum number of REPORT MPCPDU.
- The upstream latency is smaller than example #1 because ONU sends REPORT MPCPDU instantly.
- In case of ONU doesn't have (a) and (b), it doesn't send REPORT MPCPDU even if Force Report flag=1



Pros & Cons (Example #1, #2, Proposal #1, #2)

	Example #1	Example #2	Proposal #1	Proposal #2
Power Saving	Output power is saved because ONU doesn't send any REPORT MPCPDU when the GATE MPCPDU has Force Report flag=0.	The power is larger than example #1 because ONU sends REPORT MPCPDU in response to every GATE MPCPDU.	Output power is saved because ONU sends minimum number of REPORT MPCPDU.	Output power is saved because ONU sends minimum number of REPORT MPCPDU.
Latency	The upstream latency increases because ONU waits for the GATE MPCPDU which has Force Report flag=1.	The upstream latency is smaller than example #1 because ONU sends REPORT MPCPDU instantly.	The upstream latency is smaller than example #1 because ONU sends REPORT MPCPDU instantly.	The upstream latency is smaller than example #1 because ONU sends REPORT MPCPDU instantly.

Pros
Cons

Implementation of Example #1 and #2

If no changes to current Clause 93 are made, Example #1 and Example #2 which has Cons shown in slide 6 are possibly implemented.
This causes increased latency or unnecessary REPORT transmission.

< The implementation of the sequence example of GATE/REPORT in current CL 93. >

	OLT				ONU		
	MACR	gate_periodic_timer	Force Report flag	Grant	MACR	report_periodic_timer	Reception of Force Report flag=1
Current Clause 93	None	less than 50 ms	None (It is decided by operating MACR.)	None (It is decided by operating MACR.)	None	less than 50 ms	A REPORT frame should be issued.
Example #1	None	less than 50 ms	Force Report flag=1 appears with some interval.	GRANT is regularly provided by GATE MPCPDU.	(* 1)	less than 50 ms	A REPORT frame should be issued.
Example #2	None	less than 50 ms	Force Report flag = 1	GRANT is regularly provided by GATE MPCPDU.	None	less than 50 ms	A REPORT frame should be issued.

(* 1) When Force Report flag=0, ONU doesn't send REPORT.

Modification points in Clause 93 for Power Saving proposal

In order to achieve the reduction of Report transmission surely, several changes, highlighted in the following table should be required.

< Several changes to achieve the proposal for Power Saving. >

	OLT				ONU		
	MACR	gate_periodic_timer	Force Report flag	Grant	MACR	report_periodic_timer	Reception of Force Report flag=1
Current Clause 93	None	less than 50 ms	None (It is decided by operating MACR.)	None (It is decided by operating MACR.)	None	less than 50 ms	A REPORT frame should be issued.
Proposal #1 (for Power Saving)	None	less than 50 ms	Force Report flag = 0	GRANT is regularly provided by GATE MPCPDU.	(*2)	50 ms	A REPORT frame should be issued.
Proposal #2 (for Power Saving)	None	less than 50 ms	None (It is decided by operating MACR.)	GRANT is regularly provided by GATE MPCPDU.	(*2)	50 ms	None (Standard violation)

(* 2) (a) A REPORT MPCPDU #1 (Periodic Transmission) with maximum interval if ONU requires no upstream traffic.
(b) A REPORT MPCPDU #2 (Transmission by MACR) if ONU requires upstream traffic.

Conclusions

1. Power Saving proposal

For power saving, I proposed two ideas which describe how to realize the reduction of numbers of REPORT MPCPDU transmission.
As conclusion of my study, in order to obtain merits of the Power Saving,
current CL93 have to be modified or specified with additional condition.

< Requirement for Common >
- GRANT needs to be regularly provided by GATE MPCPDU.
- Maximize report_periodic_timer from “ less than 50ms ” to “ 50ms ”.

< Requirement for Proposal #1 >
- Usually, set GATE MPCPDU which has Force Report flag =0.
  (It is allows that OLT sends GATE MPCPDU which has Force Report flag=1.)
- Specify that the ONU report processing state diagram which allows transmission of
  A REPORT MPCPDU (Periodic Transmission) with maximum interval if ONU requires no upstream traffic.

< Requirement for Proposal #2 >
- Ignore for force report flag at ONU.

2. Study of Suggested Remedy for CL93

Still on going.
It would be more than welcome if someone can join in this task.

3. Other ideas for Power Saving

I proposed the reduction of numbers of Report frame transmission,
but if there may be other ideas, please issue and discuss on reflector and upcoming Tokyo meeting.