# PM9A1 FW Change Notification

2022. Aug

Memory Business, Quality Assurance Division

# Contents

# FW Change List

- **Purpose : Samsung PM9A1 NVMe SSD F/W Change**

- **Reason of change**
  - Samsung would like to improve the FW quality through fixing the problem

- **Samsung internal schedule**
  - Samsung internal Qualification : ~ Aug 22
  - Release schedule : Aug 24

## FW change List

- Samsung would like to improve FW Quality through FW Change notification.

| No. | Item | Change item | Risk Assessment |
|---|---|---|---|
| 1 | Improve FA debug feature | - Support UART feature<br>- Adding debug logging feature | Low |
| 2 | added FW W/A to improve AFC circuit malfunction of CTRL | - Add 2 times AFC circuit retry code when AFC circuit work abnormally<br>If AFC circuit work abnormally, the FW initializes AFC circuit after 10ms and 15ms | Low |
| 3 | Optimized Unmap range | - # of LPN per Unmap Range needs change<br>: Total # of LPN per Device (GXA7402Q) -> 1000 (GXA7602Q) -> 10000 (GXA7702Q) | Low |
| 4 | Fix FW<br>- SLC compaction victim block | - When exit PM( power management mode), FW only check whether the F/G SSB Compaction Victim exists and do not remove it from the list( Fixed FW ) | Low |
| 5 | Fixed LTR Latency value Register Structure | (Device internal) Register Mapping of FW Header is fixed.<br>- It is affected to below Message TLP. Register mapping related to Snoop/No-snoop latency of device FW Header was reversed.<br>- [R←][Msg][LTR][Snoop : --][No-snoop : --] | Low |

## PM9A1 P/N & New FW information

| Product | Density | Samsung P/N | Current Firmware | New Firmware |
|---|---|---|---|---|
| M.2 (SED) | 256GB | MZVL2256HCHQ-00B07 | GXA7602Q | GXA7702Q |
| | 512G | MZVL2512HCJQ-00B07 | | |
| | 1TB | MZVL21T0HCLR-00B07 | | |
| | 2TB | MZVL22T0HBLB-00B07 | GXB7602Q | GXB7702Q |
| M.2 (non SED) | 256GB | MZVL2256HCHQ-00A00 | GXA7601Q | GXA7701Q |
| | | MZVL2256HCHQ-00B00 | | |
| | 512G | MZVL2512HCJQ-00A00 | | |
| | | MZVL2512HCJQ-00B00 | | |
| | 1TB | MZVL21T0HCLR-00A00 | | |
| | | MZVL21T0HCLR-00B00 | | |
| | 2TB | MZVL22T0HBLB-00A00 | GXB7601Q | GXB7701Q |
| | | MZVL22T0HBLB-00B00 | | |

# (1st item) Detailed of Change

- **Purpose: More debug features and save to NAND in case of POR**
  - To enhance Debug feature to get more information
    - Command history/ Event ,interrupt log
    - Add debug log to have rich contents for FA
- **To save the failure information to NAND (for retrieving the logs from NAND even POR case)**
  - Customer VOC: The retention of dump log on the SSD after power down (e.g. system shutdown after SSD failure)

| Category | Item | Detail | Remark |
|---|---|---|---|
| PCIe Link failure | HCORE | NVME Feature Context | - PCIe Error count<br>- Interrupt log<br>- Event log<br>- Exception log<br>- Host Command history<br>- SQ/CS Head/Tail Doorbell<br>- Link Down history<br>- NAND information |
| | | Event Logger | |
| | PCIe SFR | PCIe SFR | |
| | Event Data | PCIe Trace Buffer | |
| | NVMe SFR | Host Command Info | |
| | | Controller Register Info | |
| | | Submission/Completion Q SFR | |
| NAND failure | Debug Level | Program order | |
| | | Host/ Interval | |
| | | Get Feature | |
| | | Status Read Info | |

※ SFR : Special Function Register

# (2nd item) Detailed of Change

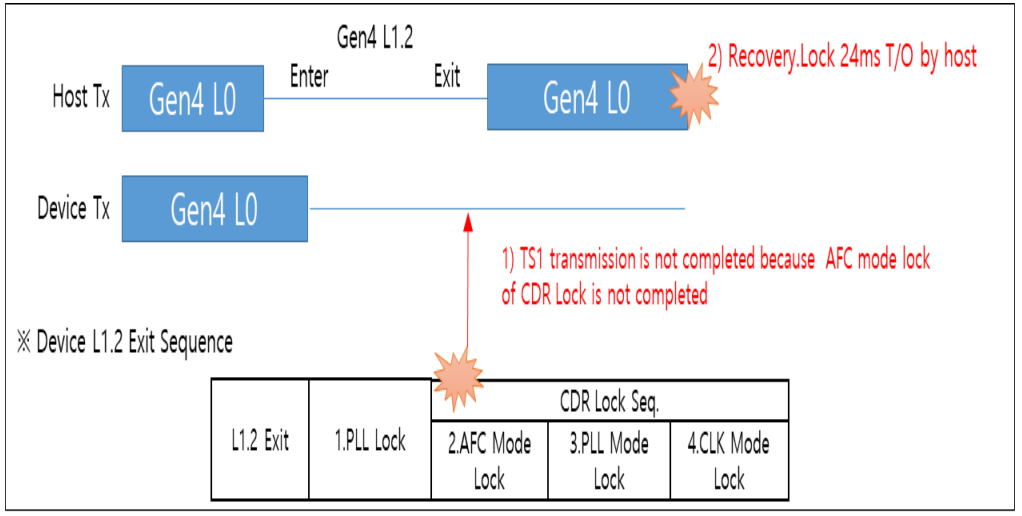
## Issue

- Found Recovery.Lock 24ms Timeout when exit L1.2 during Modern standby testing

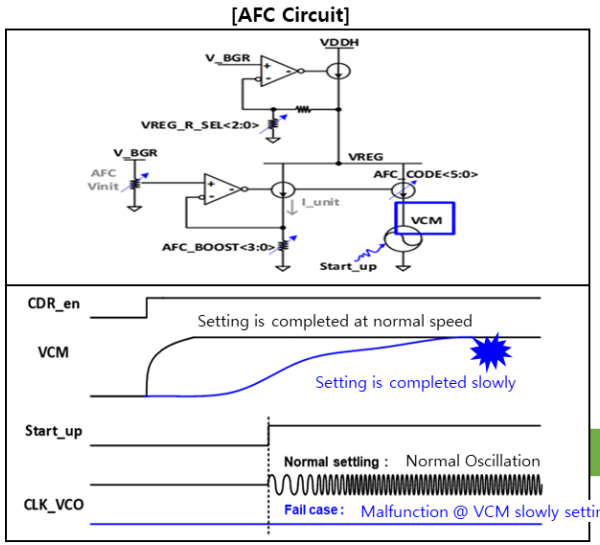
## Root cause (failure mechanism)

- Device couldn't send TS1 (training Sequence 1) to Host and finally Recovery.Lock 24ms Timeout occurred and Link down happened
- When exit L1.2, CDR (Clock and Data Recovery) Lock of CTRL is not properly completed [Fig 1]
- The slow completion of VCM(Reference voltage of VCO in AFC circuit) settling was observed with very low probability during the AFC Sequence
- VCO(Clock oscillation circuit) malfunctioned due to the slow completion of VCM settling at fail samples

[Fig 1]




[Fig 2]




**[Fail Mechanism]**

**1) SSD exit L1.2**

**2) VCM settling slowly during AFC @ Fail samples**

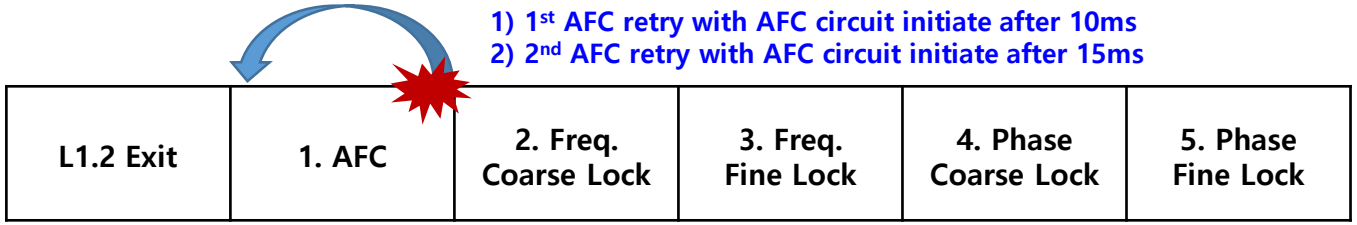
**3) VCO oscillator malfunctioned due to VCM settling**

**4) Can not meet target Frequency during AFC**

## Corrective action

- Improvement Action
  - Team added W/A point to improve AFC circuit malfunction
    - ✓ Add 2 times AFC circuit retry code when AFC circuit work abnormally

    So, If AFC circuit work abnormally, the FW initializes AFC circuit after 10ms and 15ms




[ AFC Retry code – 2 times ]

# (3rd item) Detailed of Change



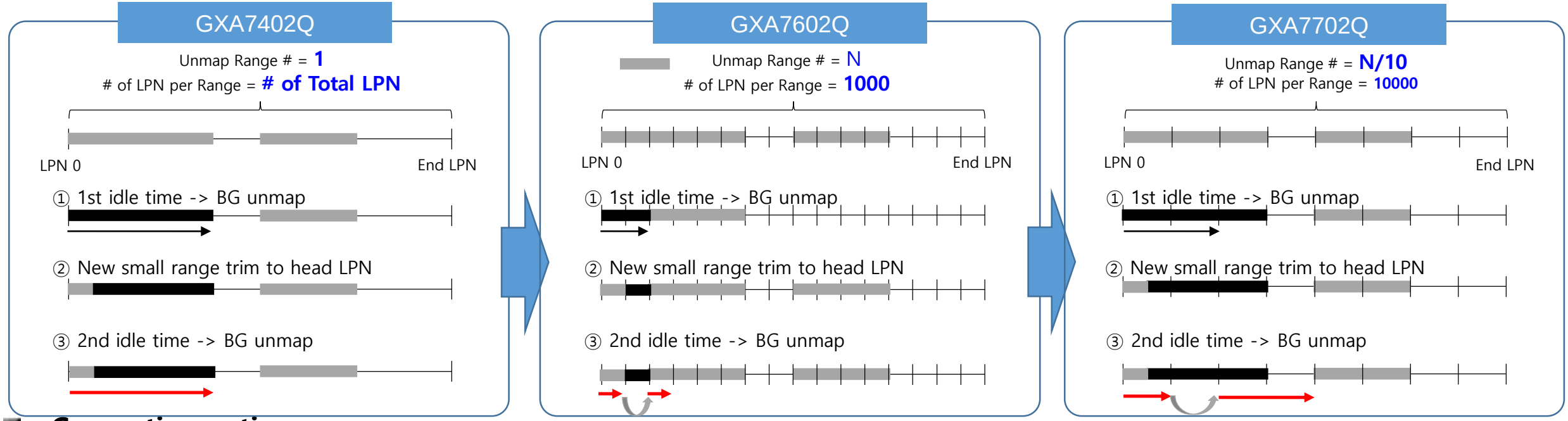
## Issue

- SW encryption time takes so long

## Root cause

- It is related to side effect from previous Change item( Unmap process optimization )
- Splitting # of LPN per Unmap Range was essential to guarantee to enter PM, but # was excessively small @ GXA7602Q
- FW handling time for Unmap are lengthened ➔ Free Blocks are generated more slowly

  → Ratio of unnecessary Migration & TLC write is increased




## Corrective action

- # of LPN per Unmap Range needs change : Total # of LPN per Device (GXA7402Q) -> 1000 (GXA7602Q) -> 10000 (GXA7702Q)

# (4rd item) Detailed of Change

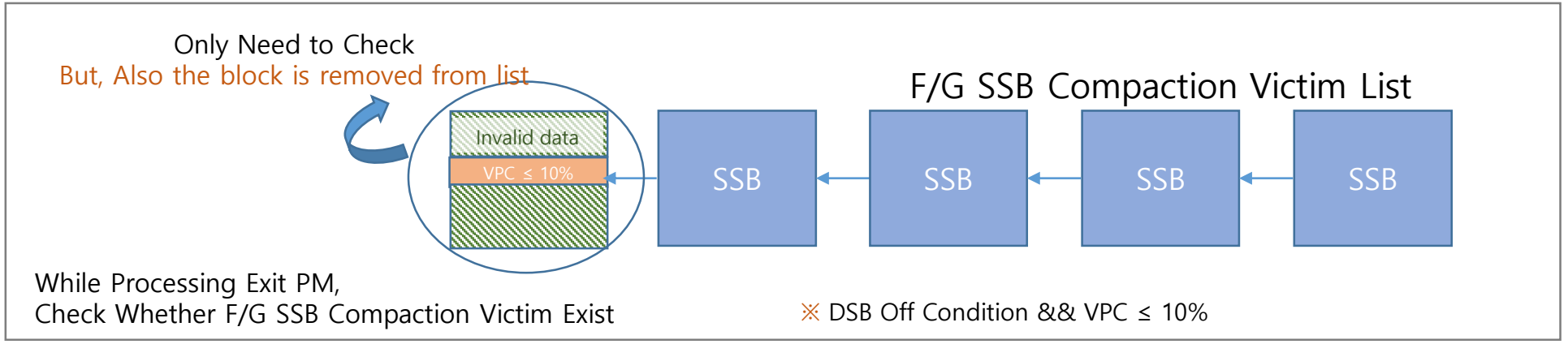


## Issue

- Seq Write performance was dropped after long idle

## Root cause

- In DSB Off state, Foreground SSB Compaction( a kind of garbage collection)  is executed to receive all write data from CDM to SSB as SLC area.
- FW checks the existence of the target block for F/G SSB Compaction in the process of checking whether there is a target SSB to perform F/G SSB Compaction after Exit PM – ( Select list for Victim block)
- But FW removed the target block checked from the Compaction Victim List.
- SSB Free block cannot be created  because the target block is not selected as Victim of F/G SSB Compaction,
- Finally, TLC write occurred because SSB doesn't have a room for write during CDM and Seq write performance showed TLC performance




## Corrective action

- When exit PM( power management mode), FW only check whether the F/G SSB Compaction Victim exists and do not remove it from the list.

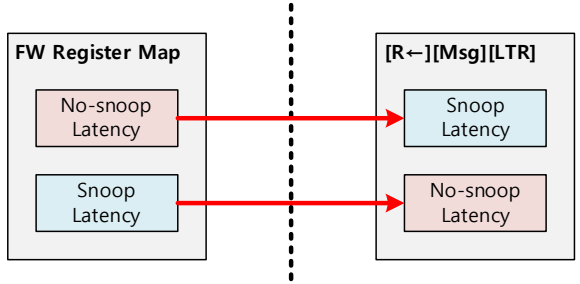
# (5th item) Detailed of Change

## Issue

- LTR Latency value Register was reversed

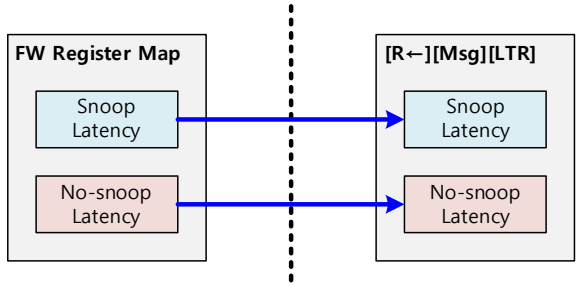
## Root cause

- Register mapping related to Snoop/No-snoop latency of device FW Header was reversed.




## Corrective action

- Header file of Device FW is fixed.



# THE NEXT CREATION STARTS HERE

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