



A solution to the effect of nand flash consistency on QoS

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What is QoS ?

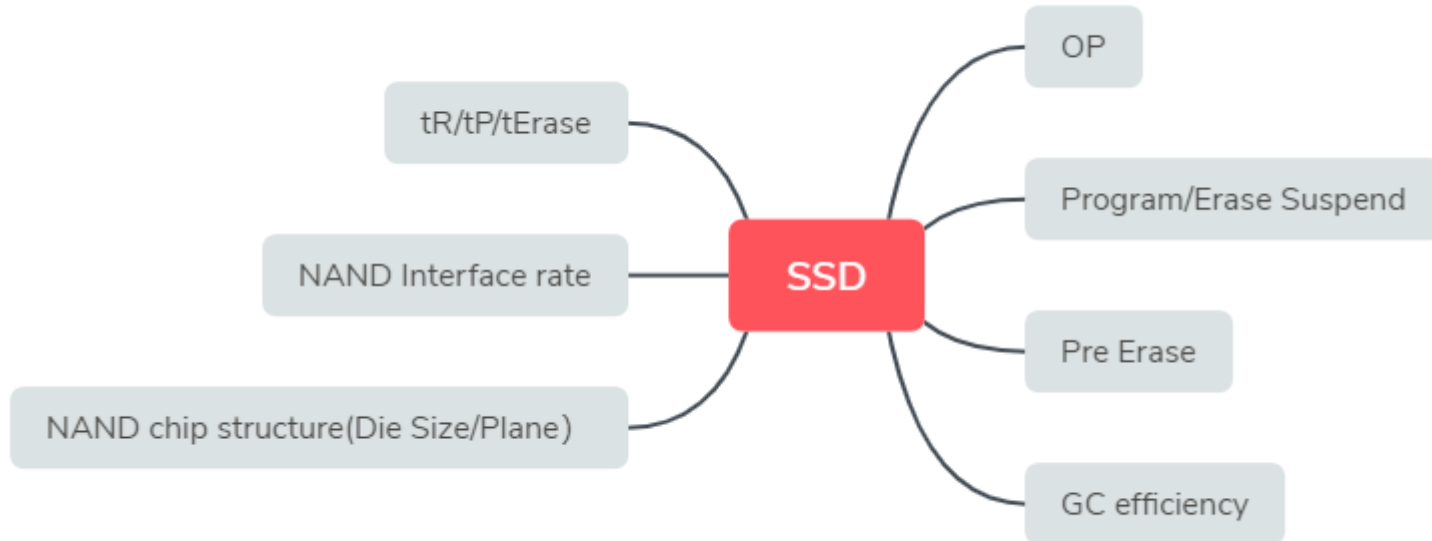
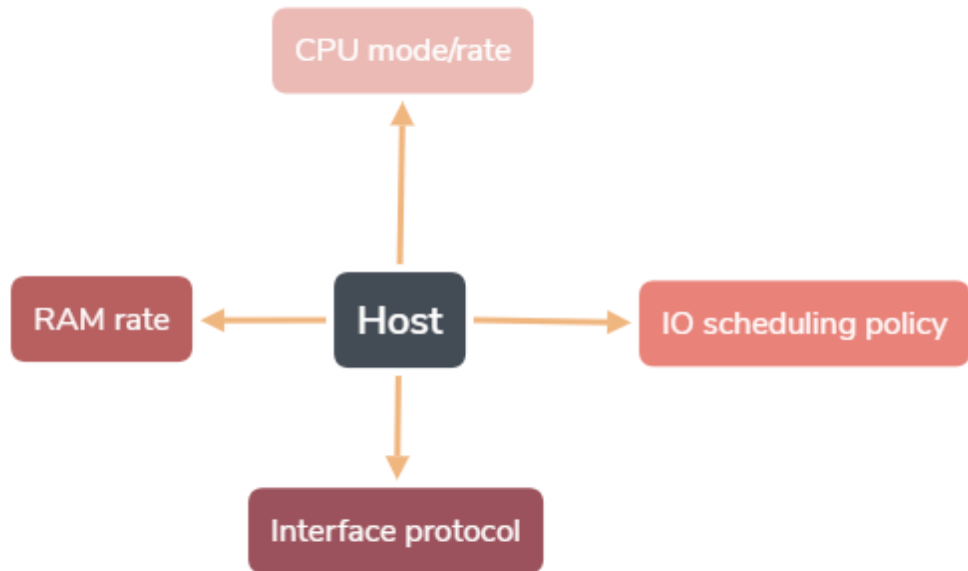


- QoS (Quality of Service) is the quality of service. Under the limited bandwidth resources, QoS allocates bandwidth for various services and provides end-to-end service quality assurance for services. Initially, it is used in network quality. With the development of SSD and the rise of cloud services, QoS has gradually become an important indicator for enterprise SSDs to be measured. In the SNIA test about SSD energy generation, some test items require QoS values to confirm test results, which also reflects the gold content of debugging and optimization of this specific indicator by SSD manufacturers.
- In SSD performance evaluation, QoS(Quality of Service) is the top priority, representing the stability of SSD performance index, QoS evaluation parameters, average latency, 99%QoS, 99.9% QoS, 99.99% QoS, 99.999% QoS, etc., the more 9, the higher the stability requirements for the delay.

What are the factors that affect QoS ?



The main factors affecting QoS include but are not limited to the following factors:



What's so special about today ?



01

NAND Flash program latency consistency (tP)



The impact of nand flash consistency on QoS

02

NAND Flash read latency consistency (tR)

The Basic Performance for each Nand



Flash Memory Summit

```
aver exe time:  erase(us) |      prog(us) |      read(us) |
SLC            5522|      86|      40|
TLC            5499| 1140/ 0/ 0| 45/ 59/ 48/ 0|
```

Rank1

```
stdev exe time:  erase|      prog|      read|
SLC:            33.30|    01.06|    00.00|
TLC:            29.32| 09.84|00.00|00.00| 00.00|00.35|00.87|00.00|
```

```
aver errbit:  plane0(bits) |  plane1(bits) |  plane2(bits) |  plane3(bits) |
SLC           0|           0|           0|           0|
TLC          7/ 5/ 6/ 0|  7/ 6/ 6/ 0|  9/ 7/ 6/ 0|  7/ 6/ 7/ 0|
```

```
stdev errbit:  plane0|           plane1|           plane2|           plane3|
SLC:          00.00|           00.00|           00.00|           00.00|
TLC: 00.71|00.71|01.00|00.00| 00.87|00.61|00.79|00.00| 01.17|00.87|00.71|00.00| 01.17|01.12|00.50|00.00|
```

```
aver exe time:  erase(us) |      prog(us) |      read(us) |
SLC            4934|      149|      17|
TLC            5365| 1760/ 0/ 0| 17/ 33/ 32/ 0|
```

```
stdev exe time:  erase|      prog|      read|
SLC:            32.42|    05.34|    00.00|
TLC:            39.27| 22.51|00.00|00.00| 00.56|00.25|00.00|00.00|
```

```
aver errbit:  plane0(bits) |  plane1(bits) |
SLC           0|           0|
TLC          3/ 4/ 4/ 0|  4/ 5/ 4/ 0|
```

```
stdev errbit:  plane0|           plane1|
SLC:          00.00|           00.00|
TLC: 01.46|01.55|01.05|00.00| 01.50|01.70|01.58|00.00|
```

```
aver exe time:  erase(us) |      prog(us) |      read(us) |
SLC            2743|      198|      37|
TLC            3882| 293/ 1126/ 1743| 54/ 53/ 66/ 0|
```

Rank2

```
stdev exe time:  erase|      prog|      read|
SLC:            432.4|    02.78|    00.00|
TLC:            32.95| 02.24|29.62|19.49| 00.00|00.79|00.94|00.00|
```

```
aver errbit:  plane0(bits) |  plane1(bits) |  plane2(bits) |  plane3(bits) |
SLC           0|           0|           0|           0|
TLC          1/ 1/ 1/ 0|  1/ 1/ 1/ 0|  1/ 1/ 1/ 0|  1/ 1/ 1/ 0|
```

```
stdev errbit:  plane0|           plane1|           plane2|           plane3|
SLC:          00.00|           00.00|           00.00|           00.00|
TLC: 00.35|00.87|00.00|00.00| 00.35|00.87|00.00|00.00| 00.00|00.87|00.00|00.00| 00.35|00.87|00.00|00.00|
```

```
aver exe time:  erase(us) |      prog(us) |      read(us) |
SLC            5187|      294|      31|
TLC            8163| 1882/ 0/ 0| 47/ 61/ 48/ 0|
```

Rank4

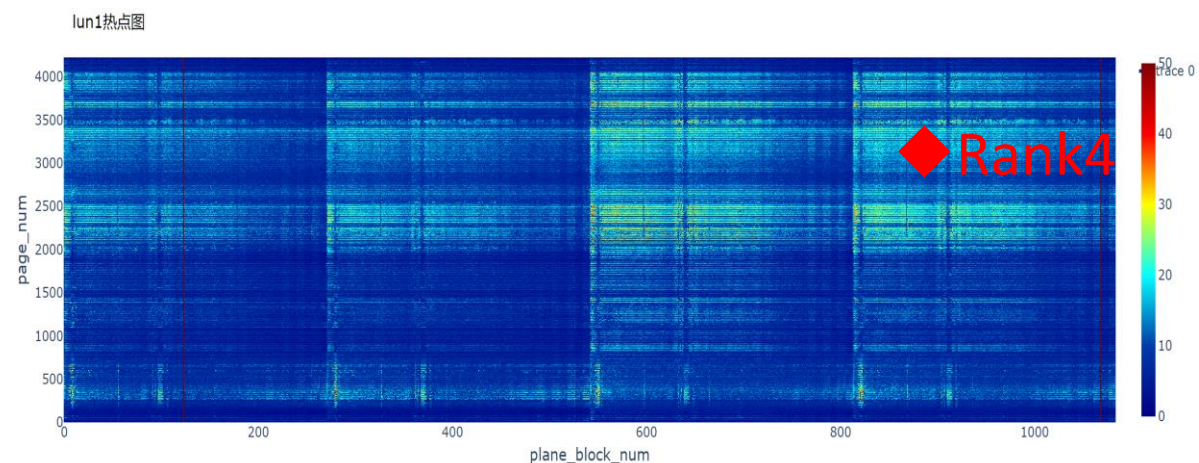
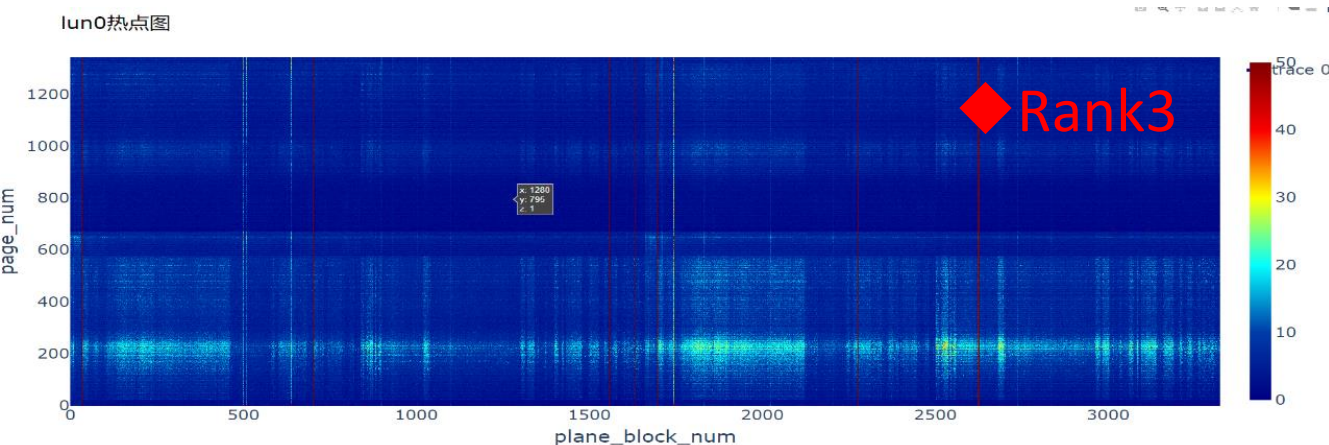
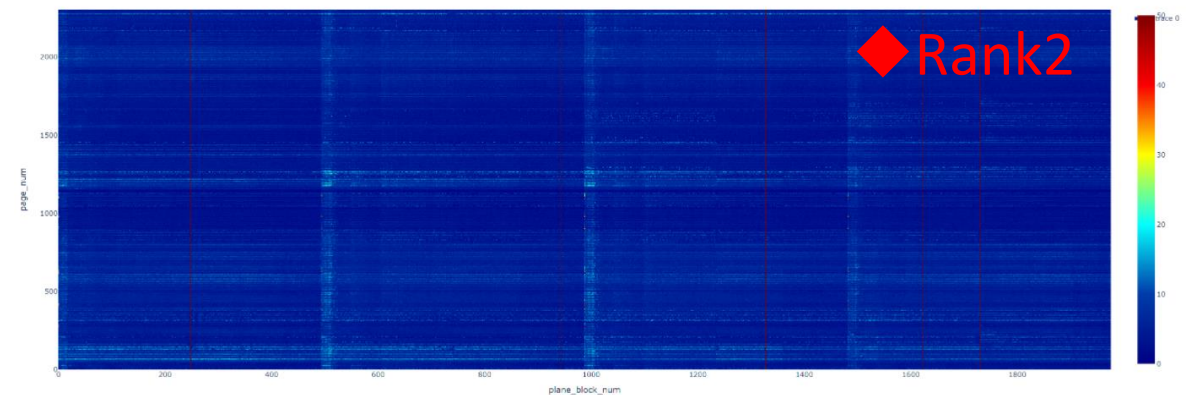
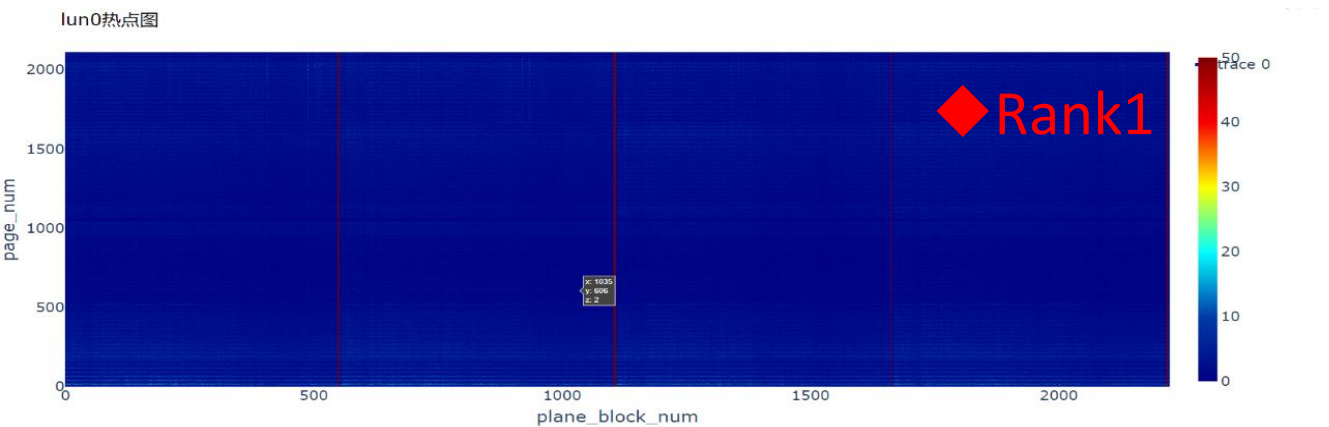
```
stdev exe time:  erase|      prog|      read|
SLC:            18.76|    05.73|    00.00|
TLC:            150.2| 26.52|00.00|00.00| 00.43|00.50|00.00|00.00|
```

```
aver errbit:  plane0(bits) |  plane1(bits) |  plane2(bits) |  plane3(bits) |
SLC           0|           0|           0|           0|
TLC          3/ 4/ 7/ 0|  4/ 4/ 6/ 0|  4/ 4/ 6/ 0|  3/ 4/ 8/ 0|
```

```
stdev errbit:  plane0|           plane1|           plane2|           plane3|
SLC:          00.00|           00.00|           00.00|           00.00|
TLC: 01.31|00.95|01.82|00.00| 00.92|00.87|01.53|00.00| 00.83|01.12|01.63|00.00| 01.24|01.09|01.98|00.00|
```

*The basic performance impact the basic write/read performance.

Consistency for (eTLC) Read

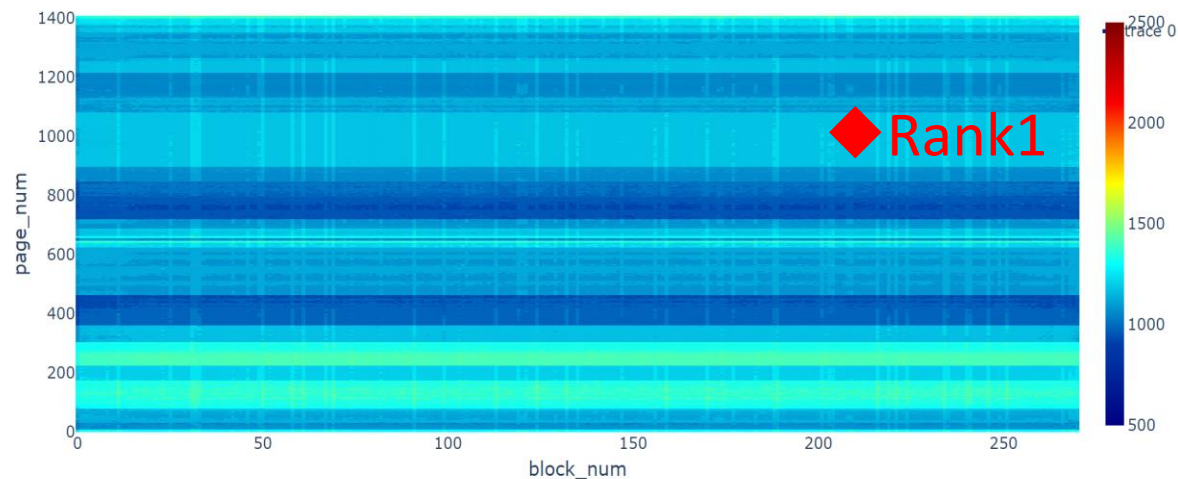


- * The darker the blue, the better the consistency and the more red the color, the less consistent it is.
- * The read consistency can impact the read QoS

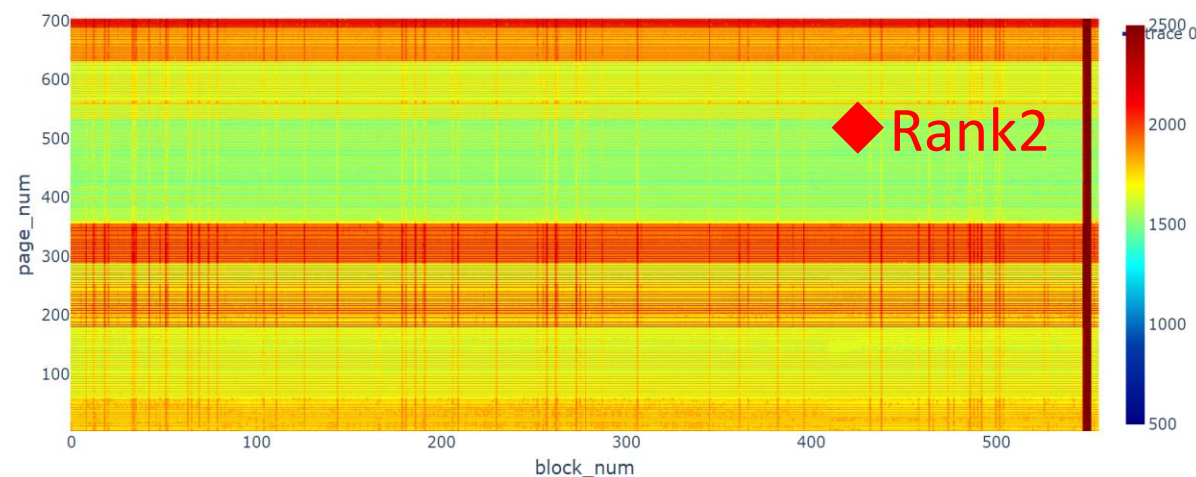
Consistency for (eTLC) write



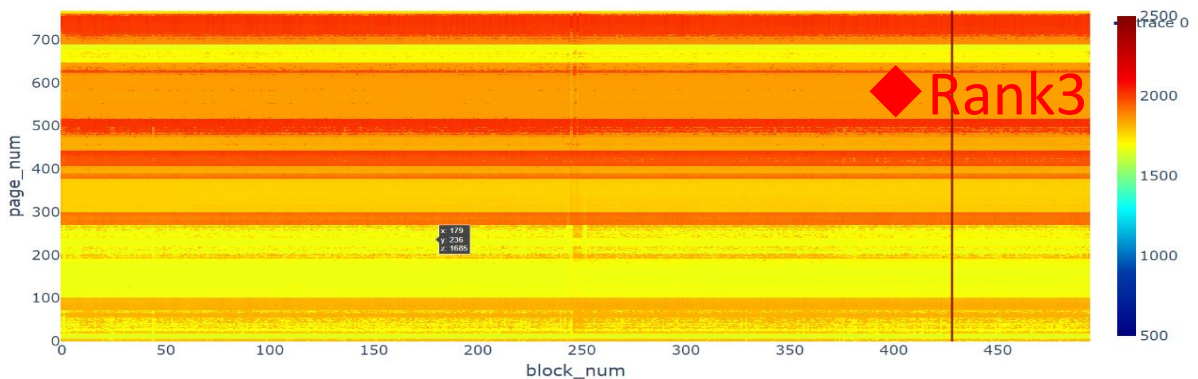
lun0 tlc tPROG 热点图



lun0 tlc tPROG 热点图



lun0 tlc tPROG 热点图



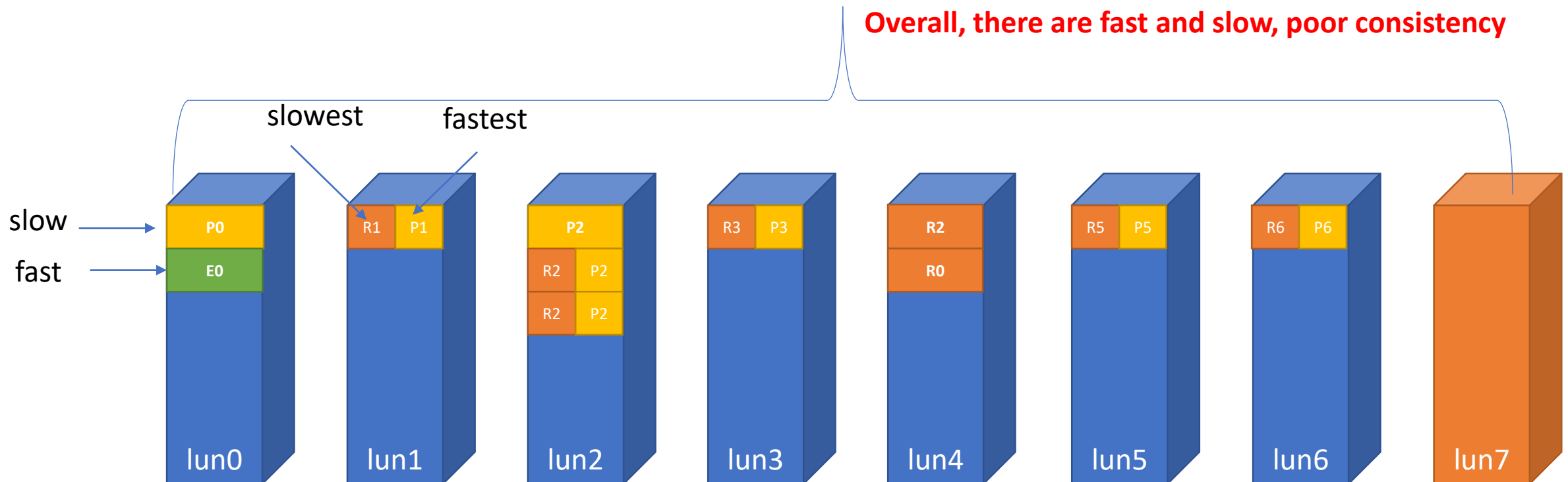
- * The darker the blue, the better the consistency and the more red the color, the less consistent it is.
- * The write consistency can impact the write QoS.

The impact of nand flash consistency on QoS



P=Program
R=RAID-Parity
E=Erase

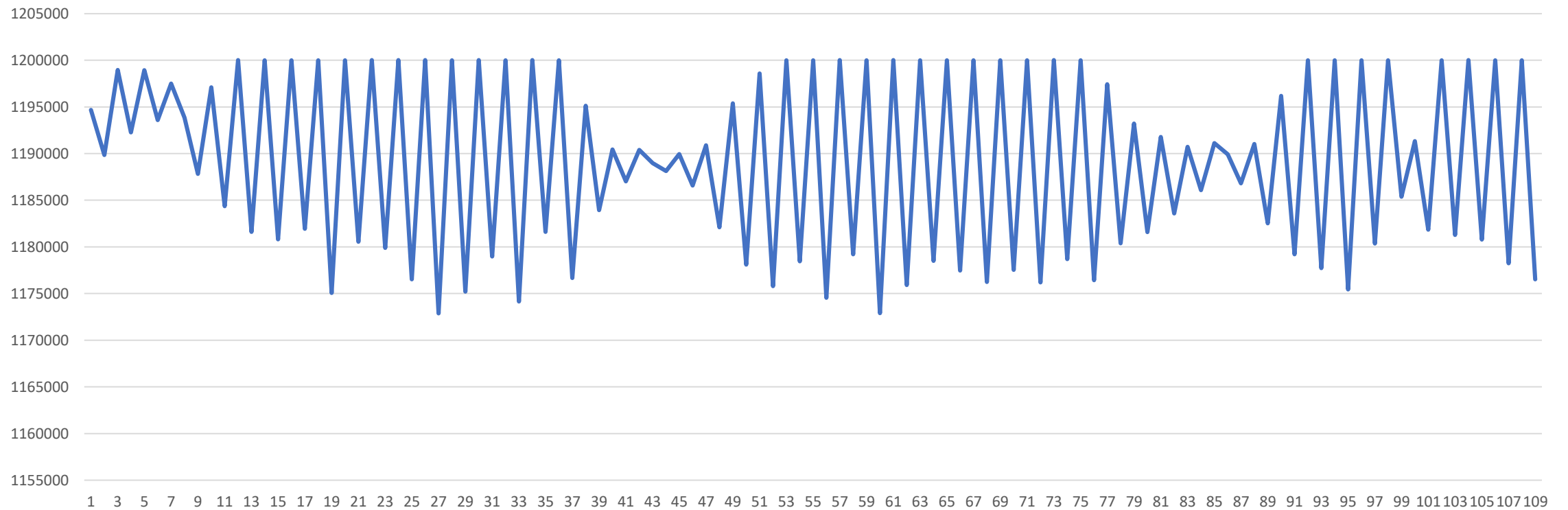
1. Because different luns may be inconsistent, the data return time of a single Lun may be different.
2. In the real business scenario, because the business itself is continuous, the consistency problem may be superimposed, and the performance is worse



QoS performance affected by NAND consistency



The impact of nand flash consistency on QoS



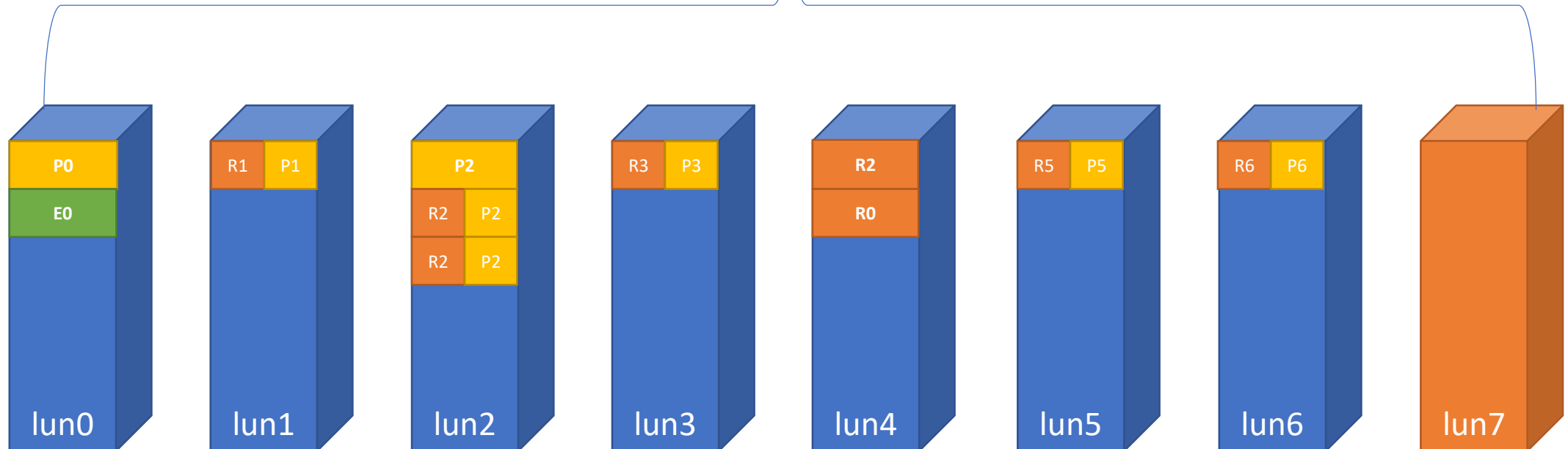
Starblaze QoS technology solves the problem



P=Program
R=RAID-Parity
E=Eraser

1. When Erase is encountered in Program, the RAID Parity of P0 is separated to the free lun for calculation
2. When the Program encountered high queue pressure, it separated the RAID-Parity of P0 to an idle lun for calculation

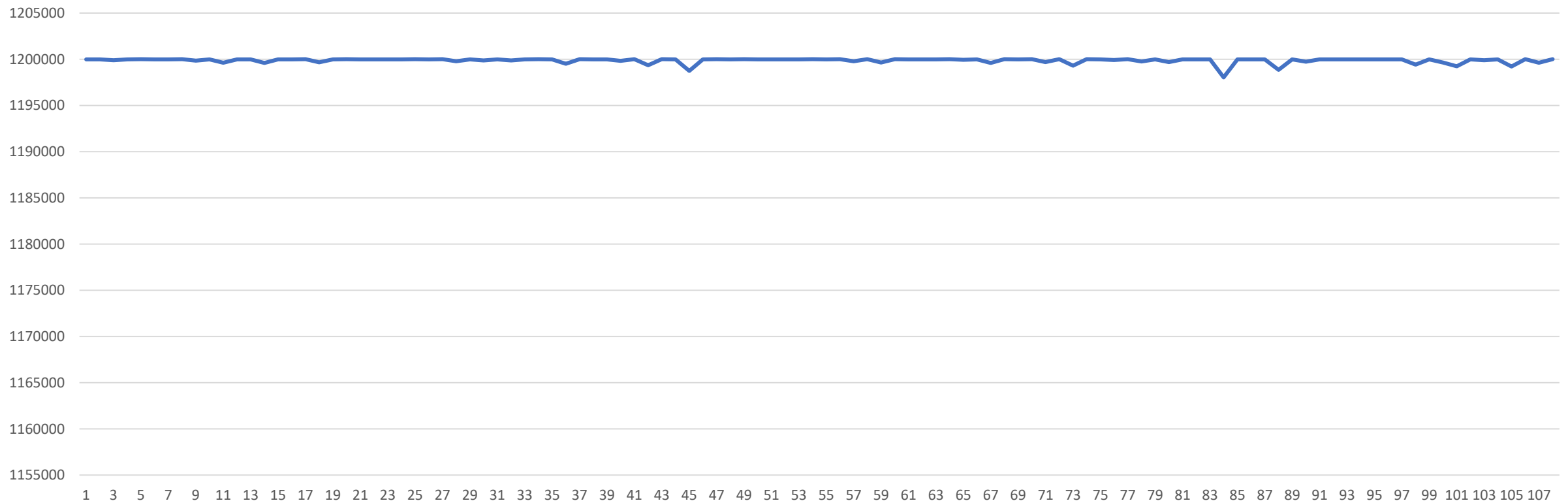
Each LUN is synchronized, so the consistency is good



The application effect of STAR QoS technology



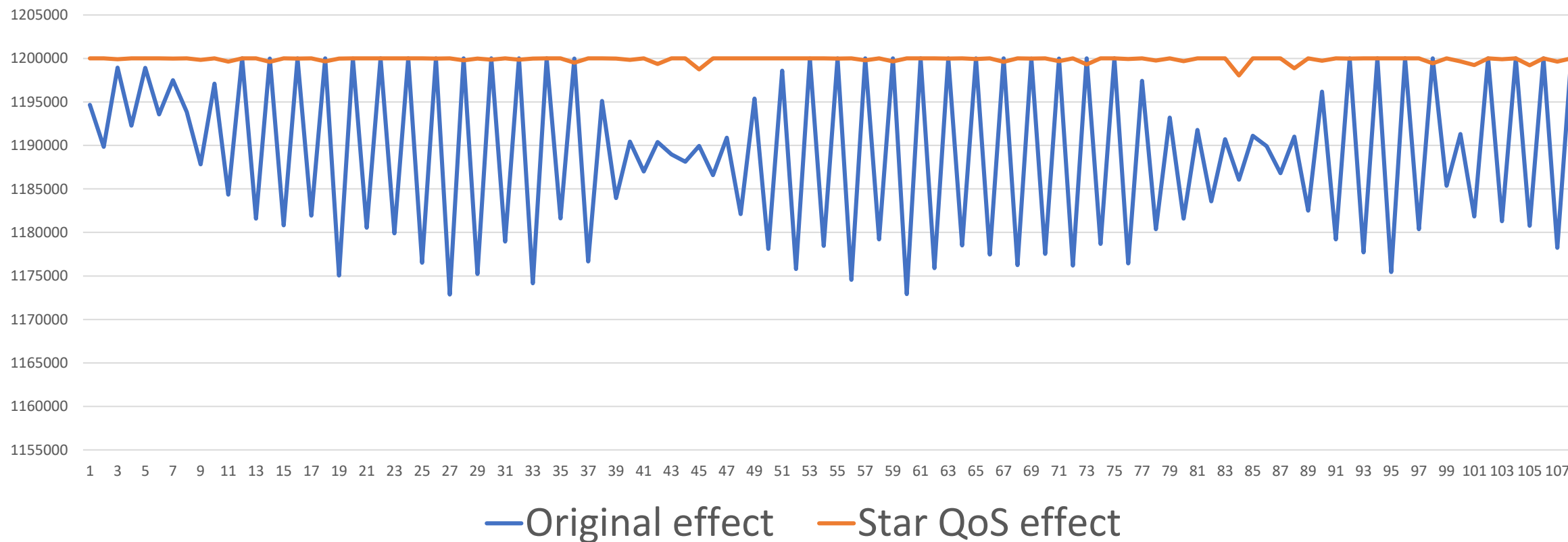
The application effect of STAR QoS technology



Original effect Vs Star QoS effect



Original effect Vs Star QoS effect



Q & A



- Starblaze Booth: **xxx**

TODO – advertise our other pretention ...

Invitation	Topic	Presenter