Possibilities

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Advanced QoS troubleshooting of the NCS5500 (IOS-XR) made easy

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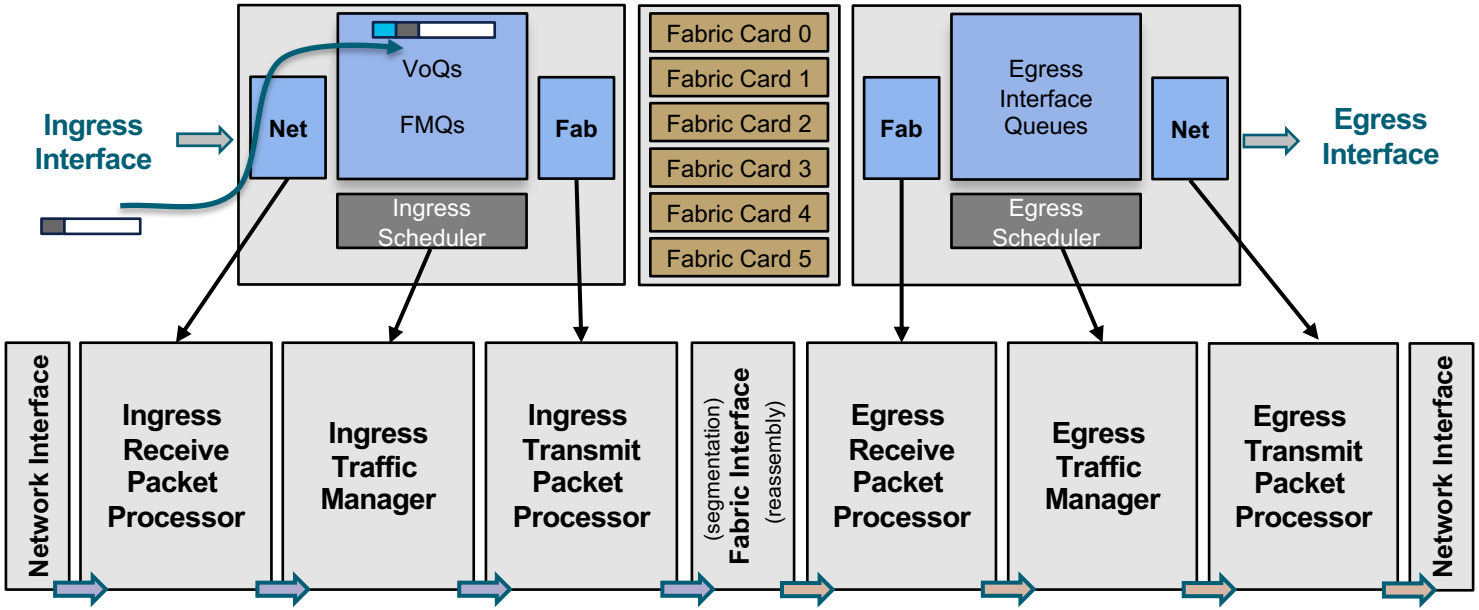
Agenda

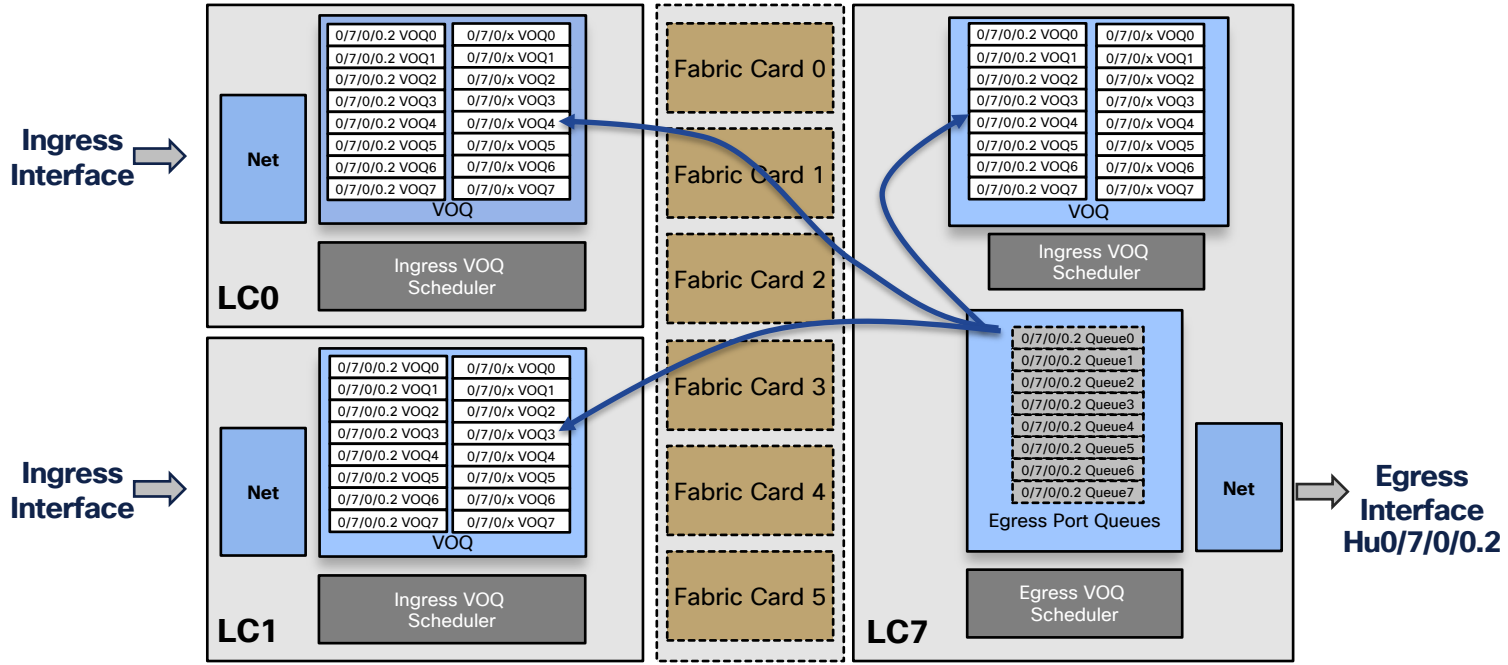
- QoS architecture brief reminder
- QoS troubleshooting Demo

QoS architecture on NCS 5500

Reminder on VOQ-only Architecture



Virtual Output Queues (VOQ) - reminder



More details:
CiscoLive 2020 Barcelona BRKSPG-2900 Deepdive in the Merchant Silicon High-end SP Routers

Virtual Output Queues (VOQ) mapping

- CLI illustration: Local and Remote visibility of the Output Queues

```
RP/0/RP0/CPU0:ios#sh contr npu voq-usage interface all instance 0 location 0/0/CPU0

--------------------------------------------------------------------------------
Node ID: 0/0/CPU0
Intf          Intf      NPU NPU   PP    Sys    VOQ    Flow    VOQ     Port
name          handle     #  core Port  Port   base   base    port    speed
              (hex)                                      type    (Gbps)
--------------------------------------------------------------------------------
Hu0/3/0/5     1800100    0   0     1   1537   1072   10280  remote  100
Hu0/0/0/26    200        4   1    17    273   1424    4136  local   100
Hu0/3/0/6     1800108    1   1    21   1621   1080    1064  remote  100
Hu0/0/0/27    208        4   0     9    265   1432    5416  local   100
Hu0/3/0/7     1800110    1   1    13   1613   1088    2344  remote  100
Hu0/0/0/28    210        4   0     5    261   1440    7208  local   100
Hu0/3/0/8     1800118    1   1    17   1617   1096    4136  remote  100
Hu0/0/0/29    218        4   0     1    257   1448    8488  local   100
Hu0/3/0/9     1800120    1   0     9   1609   1104    5416  remote  100
Hu0/0/0/30    220        5   1    21    341   1456    2344  local   100
```

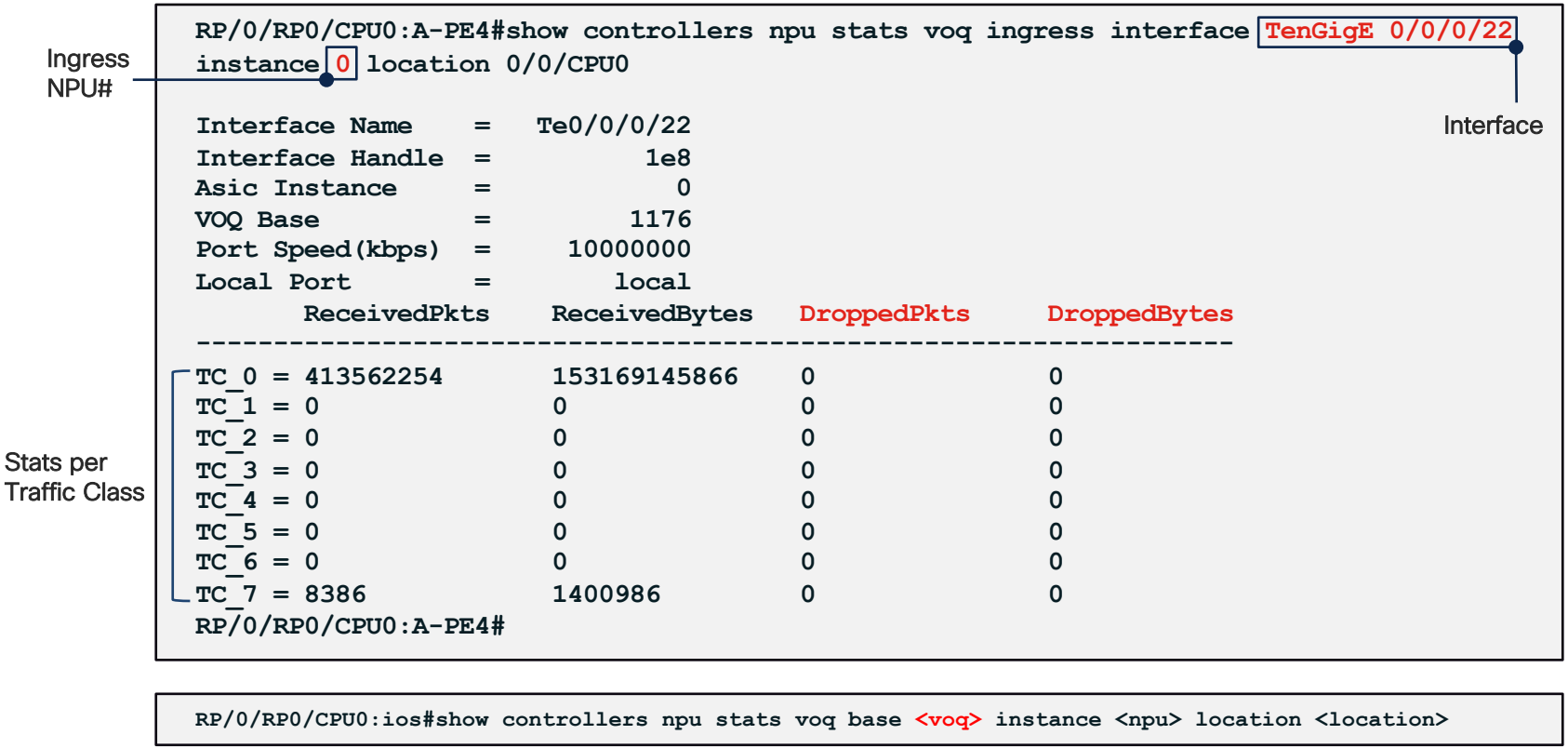
LC 0/0 point of view

VOQ number

Local for LC 0/0

Remote for LC 0/0

VOQ Stats




```
RP/0/RP0/CPU0:A-PE4#show controllers npu stats voq ingress interface TenGigE 0/0/0/22
instance 0 location 0/0/CPU0

Interface Name     =   Te0/0/0/22
Interface Handle   =          1e8
Asic Instance      =            0
VOQ Base           =         1176
Port Speed(kbps)   =     10000000
Local Port         =        local
       ReceivedPkts    ReceivedBytes    DroppedPkts     DroppedBytes
-------------------------------------------------------------------
TC_0 = 413562254       153169145866     0               0
TC_1 = 0               0                0               0
TC_2 = 0               0                0               0
TC_3 = 0               0                0               0
TC_4 = 0               0                0               0
TC_5 = 0               0                0               0
TC_6 = 0               0                0               0
TC_7 = 8386            1400986          0               0
RP/0/RP0/CPU0:A-PE4#
```

```
RP/0/RP0/CPU0:ios#show controllers npu stats voq base <voq> instance <npu> location <location>
```

Port Mapping

- Mapping Physical ports to NPU, NPU core, PP port and source system port
  - PP port: Port Termination ID
  - Flow base ID: connector ID linking VOQ to egress scheduling elements
  - System port ID: source port (used in egress)

```
RP/0/RP0/CPU0:A-PE4#show controllers npu voq-usage interface TenGigE 0/0/0/22 instance
all location 0/0/CPU0

------------------------------------------------------------------
Node ID: 0/0/CPU0
Intf          Intf      NPU  NPU   PP    Sys   VOQ   Flow   VOQ     Port
name          handle    #    core  Port  Port  base  base   port    speed
              (hex)                                        type
------------------------------------------------------------------------
Te0/0/0/22    1e8       0    1     48     48   1176   5456 local     10G
```

NCS5500 Forwarding ASIC Statistics

For Reference

```
RP/0/RP0/CPU0:ios#sh controllers npu stats counters-all instance 0 location 0/0/CPU0

FIA Statistics Rack: 0, Slot: 0, Asic instance: 0

Per Block Statistics:

Ingress:

NBI RX:
   RX_TOTAL_BYTE_COUNTER          = 0
   RX_TOTAL_PKT_COUNTER           = 0

IRE:
   CPU_PACKET_COUNTER             = 0
   NIF_PACKET_COUNTER             = 0
   OAMP_PACKET_COUNTER            = 47
   OLP_PACKET_COUNTER             = 0
   RCY_PACKET_COUNTER             = 0
   IRE_FDT_INTRFACE_CNT           = 128

IDR:
   MMU_IDR_PACKET_COUNTER         = 32
   IDR_OCB_PACKET_COUNTER         = 1

IQM:
   ENQUEUE_PKT_CNT                = 47
   DEQUEUE_PKT_CNT                = 47
   DELETED_PKT_CNT                = 0
   ENQ_DISCARDED_PACKET_COUNTER   = 0

IPT:
   EGQ_PKT_CNT                    = 47
   ENQ_PKT_CNT                    = 47
   FDT_PKT_CNT                    = 0
   CFG_EVENT_CNT                  = 47
   CFG_BYTE_CNT                   = 3611

FDT:
   IPT_DESC_CELL_COUNTER          = 0
   IRE_DESC_CELL_COUNTER          = 0
   TRANSMITTED_DATA_CELLS_COUNTER = 0

Egress:
```

Network Int. counters

Network buffer and Interlaken block
It manages the RX buffers for the interface.

IRPP counters

Ingress Receive Editor
Receives the packet segments from the packet interface.

Ingress DRAM Assembly
Reassembles the data segments into full packets to be sent to DRAM or to OCB.

ITM counters

Ingress Queue Manager
Handles en-queue and de-queue commands from IRR (Ingress Replicator) and IPS (Ingress Packet Scheduler).

ITPP counters

Ingress Packet Transmit
Receives packet context from IQM.

Fabric Int. counters

Fabric Data transmit
Receives data packets from IPT and TDM packets from IRE.

* Drop counters in red.

NCS5500 Forwarding ASIC Statistics

For Reference

```
FDR:
   P1_CELL_IN_CNT                = 0
   P2_CELL_IN_CNT                = 0
   P3_CELL_IN_CNT                = 0
   CELL_IN_CNT_TOTAL             = 0

FDA:
   CELLS_IN_CNT_P1               = 0
   CELLS_IN_CNT_P2               = 0
   CELLS_IN_CNT_P3               = 0
   CELLS_IN_TDM_CNT              = 0
   CELLS_IN_MESHMC_CNT           = 0
   CELLS_IN_IPT_CNT              = 47
   CELLS_OUT_CNT_P1              = 0
   CELLS_OUT_CNT_P2              = 0
   CELLS_OUT_CNT_P3              = 0
   CELLS_OUT_TDM_CNT             = 0
   CELLS_OUT_MESHMC_CNT          = 0
   CELLS_OUT_IPT_CNT             = 47
   EGQ_DROP_CNT                  = 0
   EGQ_MESHMC_DROP_CNT           = 0
```

Fabric Int. counters

Fabric Data Receive
Receives data packets from IPT and FDT and data cells from fabric. Maps cells to one of the cores of EGQ (egress queue).

```
EGQ:
   FQP_PACKET_COUNTER            = 47
   PQP_UNICAST_PKT_CNT           = 47
   PQP_DSCRD_UC_PKT_CNT          = 0
   PQP_UC_BYTES_CNT              = 3611
   PQP_MC_PKT_CNT                = 0
   PQP_DSCRD_MC_PKT_CNT          = 0
   PQP_MC_BYTES_CNT              = 0
   EHP_UNICAST_PKT_CNT           = 47
   EHP_MC_HIGH_PKT_CNT           = 0
   EHP_MC_LOW_PKT_CNT            = 0
   DELETED_PKT_CNT               = 0
   EHP_MC_HIGH_DSCRD_CNT         = 0
   EHP_MC_LOW_DSCRD_CNT          = 0
   ERPP_LAG_PRUNING_DSCRD_CNT    = 0
   ERPP_PMF_DISCARDS_CNT         = 0
   ERPP_VLAN_MBR_DSCRD_CNT       = 0
```

ERPP / ETM counters

Egress Queue
Includes the ERPP and ETM logic (packet reassembly, egress acl's, scheduling, etc).

```
EPNI:
   EPE_BYTES_COUNTER             = 4363
   EPE_PKT_COUNTER               = 47
   EPE_DSCRD_PKT_CNT             = 0
```

ETPP counters

Egress process network interface
Manages all packet editing.

```
NBI TX:
   TX_TOTAL_BYTE_COUNTER         = 0
   TX_TOTAL_PKT_COUNTER          = 0
```

Network Int. counters

Network buffer and Interlaken block
It manages the TX buffers for the interface.

* Drop counters in red.

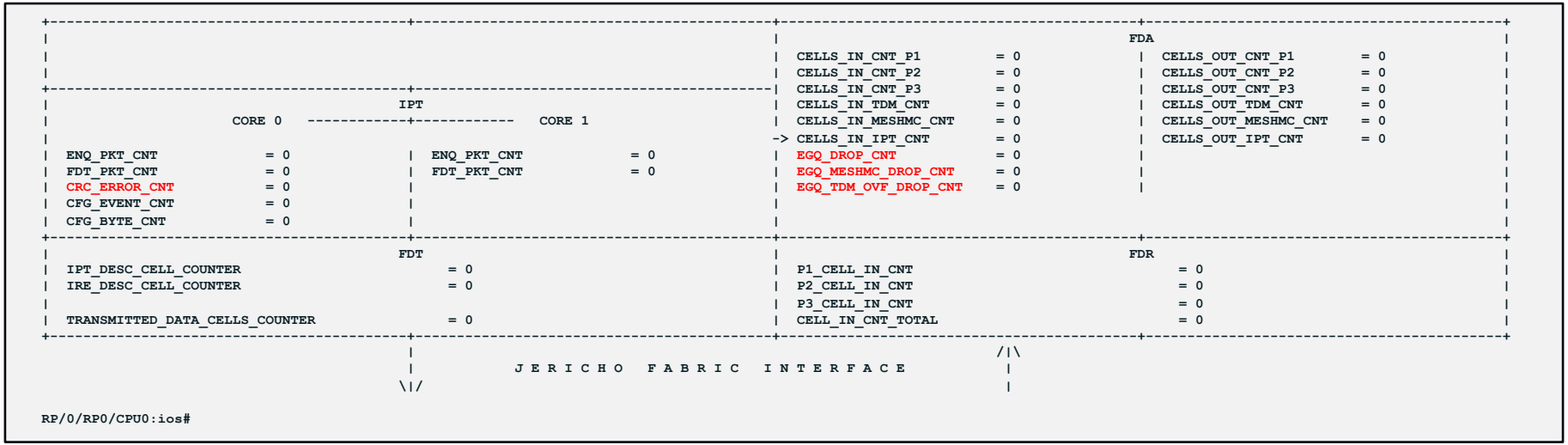
For Reference

NCS5500 Forwarding ASIC Counters

```
RP/0/RP0/CPU0:ios# show controllers np diag counters graphical cdsp instance 0 location 0/0/CPU0
                                           |                                                           /|\
                                           |          J E R I C H O   N E T W O R K   I N T E R F A C E   |
                                          \|/                                                           |
+-------------------------------------------+-------------------------------------------+-------------------------------------------+-------------------------------------------+
|                                                                                    NBI                                                                                        |
|  RX_TOTAL_BYTE_COUNTER                            = 0                     |  TX_TOTAL_BYTE_COUNTER                          = 0                                          |
|  RX_TOTAL_PKT_COUNTER                             = 0                     |  TX_TOTAL_PKT_COUNTER                           = 0                                          |
|  RX_TOTAL_DROPPED_EOPS                            = 0                     |                                                                                             |
+-------------------------------------------+-------------------------------------------+-------------------------------------------+-------------------------------------------+
|                                           IRE                              |                                              EPNI                                           |
|  CPU_PACKET_COUNTER      = 0                |                               |                                                                                             |
|  NIF_PACKET_COUNTER_0    = 0                |  NIF_PACKET_COUNTER_1   = 0   |  EPE_BYTES_COUNTER       = 0          |  EPE_BYTES_COUNTER       = 0                       |
|  OAMP_PACKET_COUNTER     = 0                |                               |  EPE_PKT_COUNTER         = 0          |  EPE_PKT_COUNTER         = 0                       |
|  OLP_PACKET_COUNTER      = 0                |                               |  EPE_DSCRD_PKT_CNT       = 0          |  EPE_DSCRD_PKT_CNT       = 0                       |
|  RCY_PACKET_CNT_0_0      = 0                |  RCY_PACKET_CNT_1_0     = 0   |                                                                                             |
|  RCY_PACKET_CNT_0_1      = 0                |  RCY_PACKET_CNT_1_1     = 0   |                                                                                             |
|  IRE_FDT_INTRFACE_CNT    = 0                |                               |                                                                                             |
+-------------------------------------------+-------------------------------------------+-------------------------------------------+-------------------------------------------+
|                                           IDR                              |                                              EGQ                                            |
|                                                                            |                  CORE 0   ------------+------------   CORE 1                               |
|  MMU_IDR_PACKET_COUNTER                           = 0                     |  FQP_PACKET_COUNTER      = 0          |  FQP_PACKET_COUNTER      = 0                       |
|  IDR_OCB_INTERFACE_COUNTER                        = 0                     |  PQP_UNICAST_PKT_CNT     = 0          |  PQP_UNICAST_PKT_CNT     = 0                       |
|                                                                            |  PQP_DSCRD_UC_PKT_CNT    = 0          |  PQP_DSCRD_UC_PKT_CNT    = 0                       |
|                                                                            |  PQP_UC_BYTES_CNT        = 0          |  PQP_UC_BYTES_CNT        = 0                       |
+-------------------------------------------+--------------------------------+  PQP_MC_PKT_CNT          = 0          |  PQP_MC_PKT_CNT          = 0                       |
|                                           IQM                              |  PQP_DSCRD_MC_PKT_CNT    = 0          |  PQP_DSCRD_MC_PKT_CNT    = 0                       |
|                    CORE 0   ------------+------------   CORE 1             |  PQP_MC_BYTES_CNT        = 0          |  PQP_MC_BYTES_CNT        = 0                       |
|  ENQUEUE_PKT_CNT         = 0                |  ENQUEUE_PKT_CNT        = 0   |  EHP_UNICAST_PKT_CNT     = 0          |  EHP_UNICAST_PKT_CNT     = 0                       |
|  DEQUEUE_PKT_CNT         = 0                |  DEQUEUE_PKT_CNT        = 0   |  EHP_MC_HI_PKT_CNT       = 0          |  EHP_MC_HI_PKT_CNT       = 0                       |
|  DELETED_PKT_CNT         = 0                |  DELETED_PKT_CNT        = 0   |  EHP_MC_LOW_PKT_CNT      = 0          |  EHP_MC_LOW_PKT_CNT      = 0                       |
|  ENQ_DSCRD_PKT_CNT       = 0                |  ENQ_DSCRD_PKT_CNT      = 0   |  DELETED_PKT_CNT         = 0          |  DELETED_PKT_CNT         = 0                       |
|                                                                            |  RQP_PKT_CNT             = 47         |  RQP_PKT_CNT             = 0                       |
|                                                                            |  RQP_DSCRD_PKT_CNT       = 0          |  RQP_DSCRD_PKT_CNT       = 0                       |
|                                                                            |  PRP_PKT_DSCRD_TDM_CNT   = 0          |  PRP_PKT_DSCRD_TDM_CNT   = 0                       |
|                                                                            |  PRP_SOP_DSCRD_UC_CNT    = 0          |  PRP_SOP_DSCRD_UC_CNT    = 0                       |
|                                                                            |  PRP_SOP_DSCRD_MC_CNT    = 0          |  PRP_SOP_DSCRD_MC_CNT    = 0                       |
|                                                                            |  PRP_SOP_DSCRD_TDM_CNT   = 0          |  PRP_SOP_DSCRD_TDM_CNT   = 0                       |
|                                                                            |  EHP_MC_HIGH_DSCRD_CNT   = 0          |  EHP_MC_HIGH_DSCRD_CNT   = 0                       |
|                                                                            |  EHP_MC_LOW_DSCRD_CNT    = 0          |  EHP_MC_LOW_DSCRD_CNT    = 0                       |
|                                                                            |  EHP_MC_LOW_DSCRD_CNT    = 0          |  EHP_MC_LOW_DSCRD_CNT    = 0                       |
|                                                                            |  ERPP_PMF_DSCRD_CNT      = 0          |  ERPP_PMF_DSCRD_CNT      = 0                       |
|                                                                            |  ERPP_VLAN_MBR_DSCRD_CNT = 0          |  ERPP_VLAN_MBR_DSCRD_CNT = 0                       |
+-------------------------------------------+-------------------------------------------+-------------------------------------------+-------------------------------------------+
```

* Drop counters in red.

NCS5500 Forwarding ASIC Counters

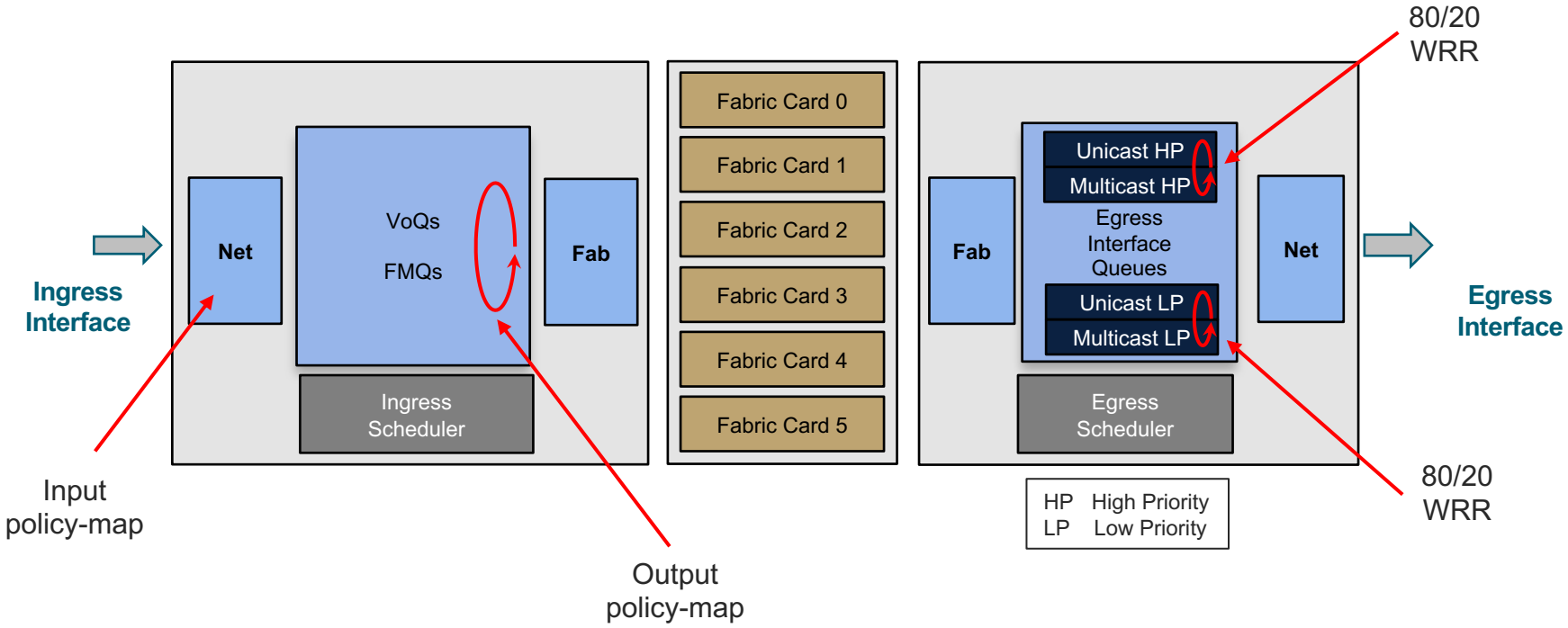


* Drop counters in red.

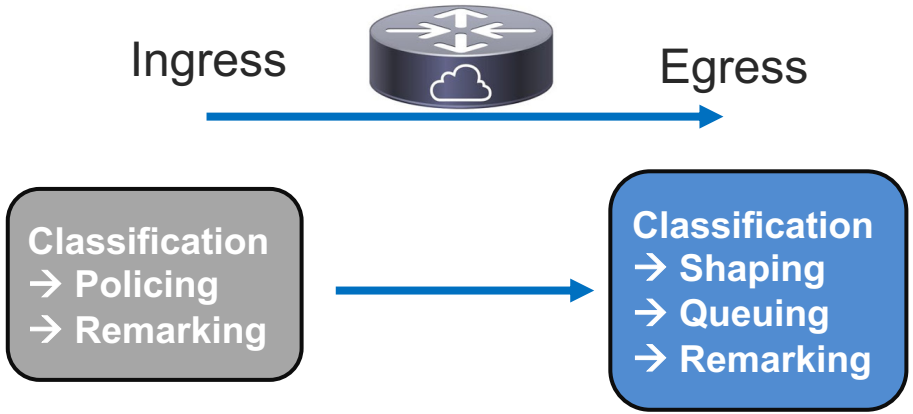
Output Queues

- Deep output queues maintained on ingress line cards
  - From a configuration perspective, it's an output policy
- Buffers are shared across VOQs
  - Default max depth is 10 msec.
  - Support for WRED, with up to 3 configurable profiles
- Configurable using Modular QoS CLI
  - Define traffic classes
  - class-map
  - Define actions for each class
  - policy-map
  - Attach policies to interfaces
  - service-policy

Recap – Unicast and Multicast

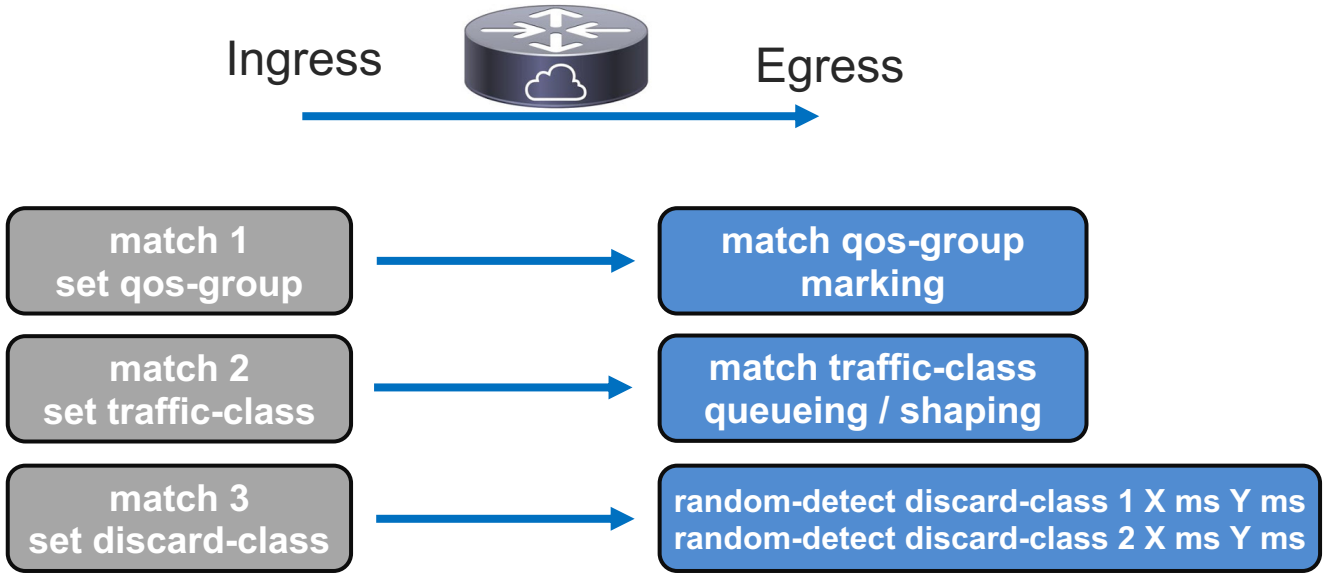


QoS Actions



QoS configuration

- We use internal markers at ingress to take egress actions



Policer example

Class-Map
Match criterias

Set qos-group (optional)

Set dscp/… (optional)

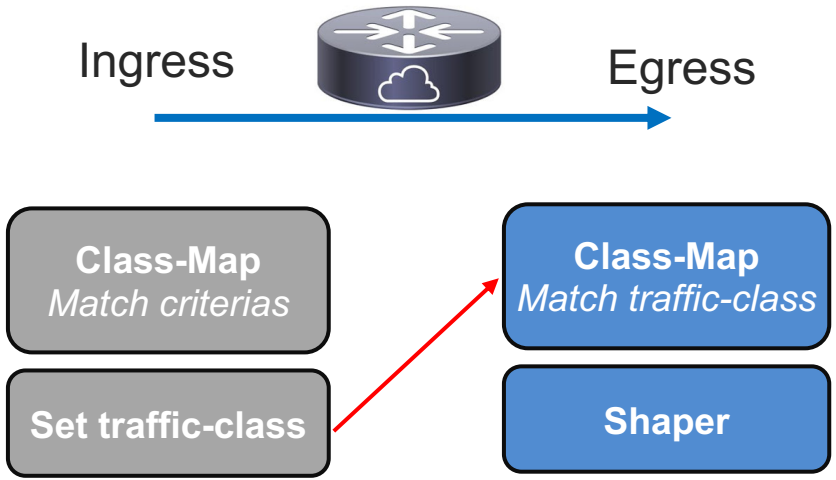
Set traffic-class (optional)

Policer

```
class-map example-map
  match precedence 1

policy-map policer
  class example-map
    set qos-group A
    set dscp BC
    set traffic-class D
    police rate percent <.>

interface hu 0/0/0/0
  service-policy input policer
```

Shaper example

```
class-map match-any class1
 match precedence 1
 end-class-map
!
class-map match-any class2
 match precedence 2
 end-class-map
!
policy-map setter
 class class1
  set traffic-class 1
 !
 class class2
  set traffic-class 2
 !
 class class-default
  set traffic-class 7
 !
 end-policy-map

interface bundle-ether <>
  service-policy input setter
```




```
class-map match-any out1
 match traffic-class 1
 end-class-map
!
class-map match-any out2
 match traffic-class 2
 end-class-map
!
policy-map shaper
 class out1
  priority level 1
  shape average percent 20
 !
 class out2
  shape average percent 50
 !
 class class-default
 !
 end-policy-map
!
interface hu 0/0/0/0
  service-policy output shaper
```

QoS Troubleshooting DEMO

Thank you

Possibilities

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