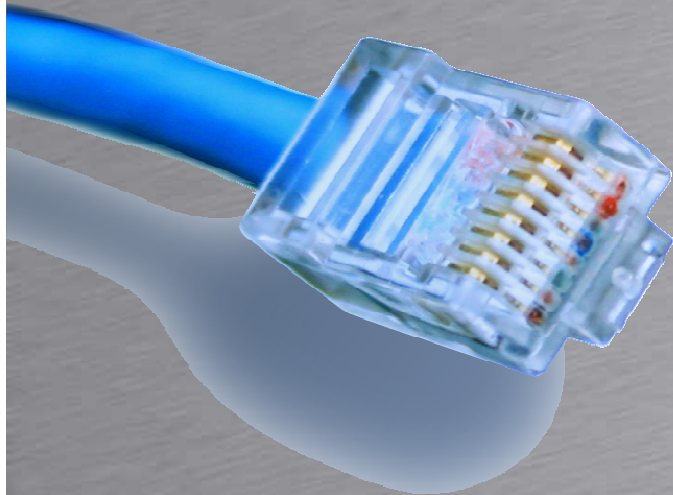


# CoS



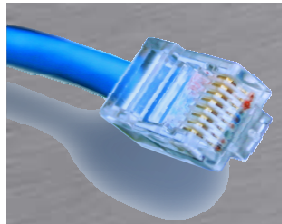
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- en del af **mercantec<sup>+</sup>**

## Class of Service

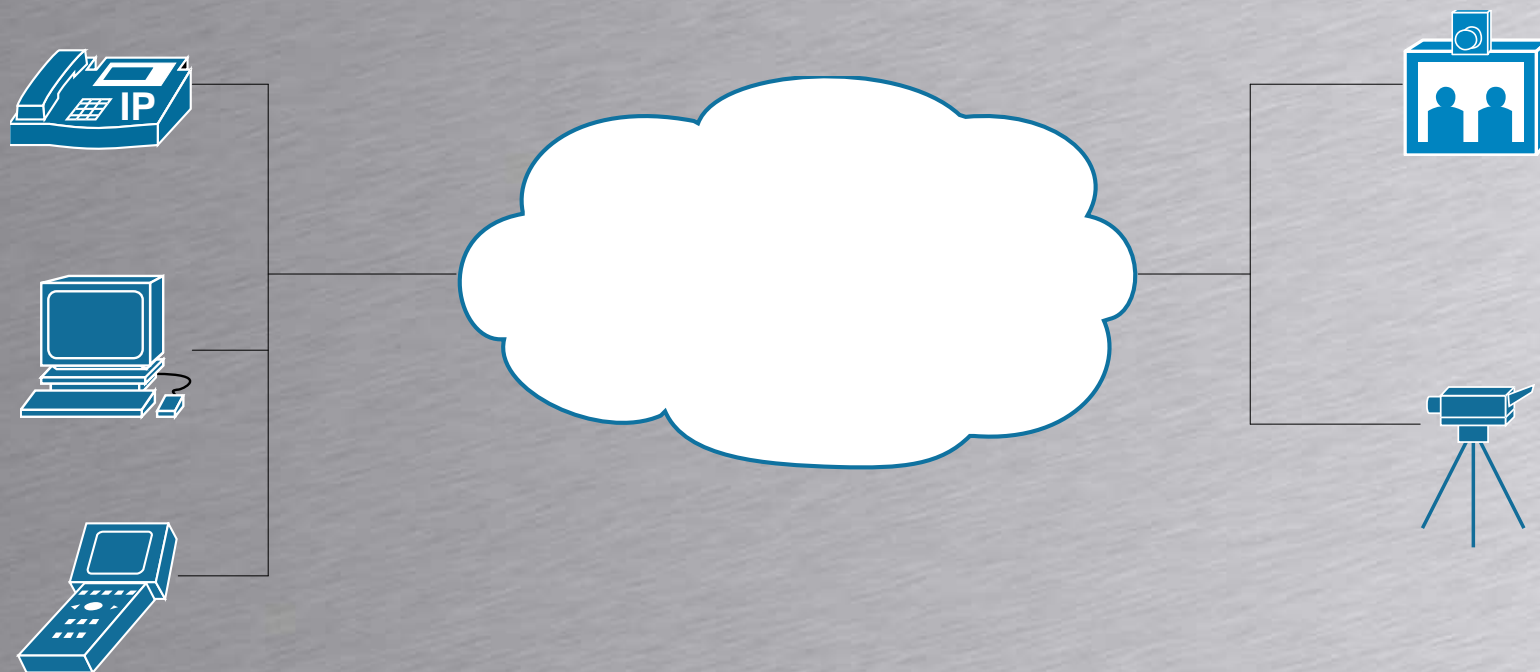
Rasmus Elmholt V1.0

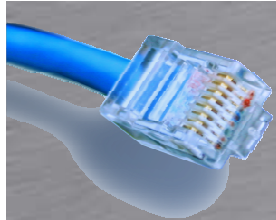


# CoS



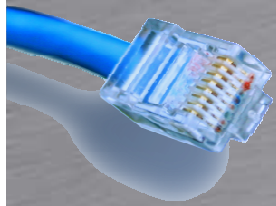
- Converged networks





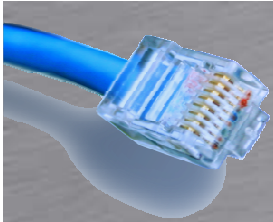
# CoS

- Converged network ser god ud på papiret
  - Flere netværk bliver samlet i et bærenet
  - Maksimal return of investment
  - Men fordelene forsvinder hurtigt ved uproductive netværk
    - Hvis Mission Critical trafik ikke kommer frem pga. surf på facebook.



# CoS

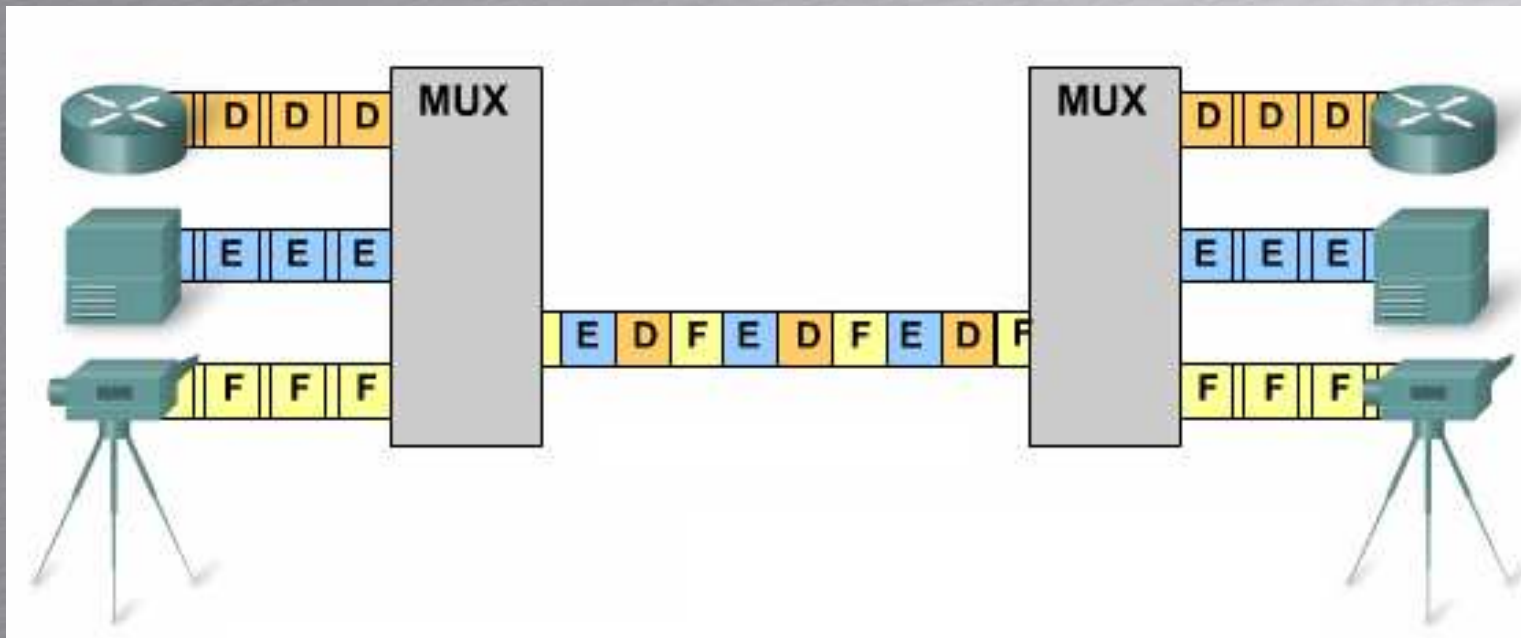
- Vi kommer fra en tid med kredsløbskoblede teknologier
  - Lavt delay
  - Fixed delay/jitter
  - Lavt pakketab
  - Dedikerede resourcer
  - Call Admission Control

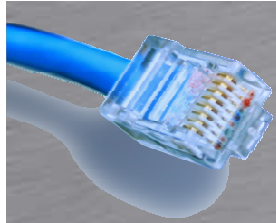


# CoS



- Multiplexing
  - Time Division Multiplexing

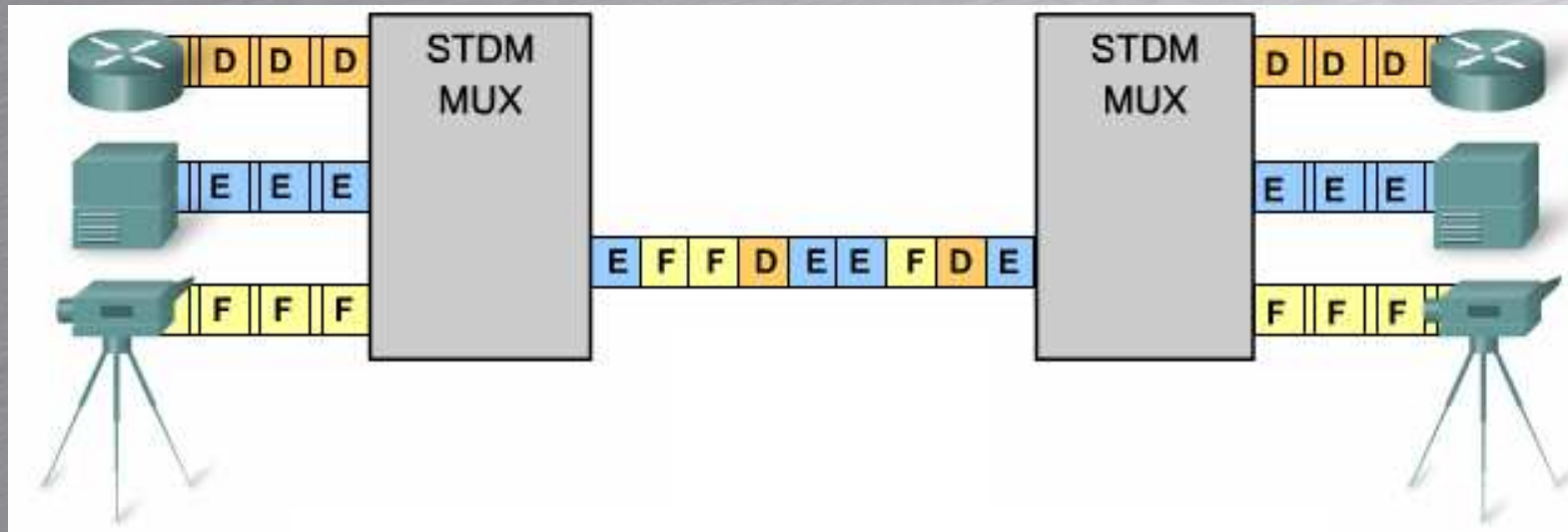


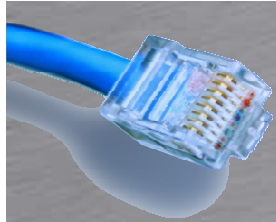


# CoS



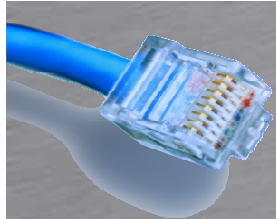
- Statistical Multiplexing
  - Statistical Time Division Multiplexing





# CoS

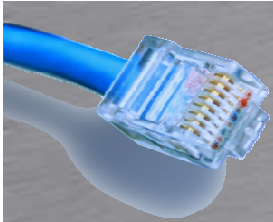
- Ethernet bruger STDM MUX
  - Udnytter båndbredden bedre
  - Bruger buffer til at gemme pakker
    - Uendelig buffer løser ikke vores problem, men tilføjer bare delay
  - Har ikke samme jitterløse egenskaber som vi kender fra kredsløbskoblede netværk



# CoS

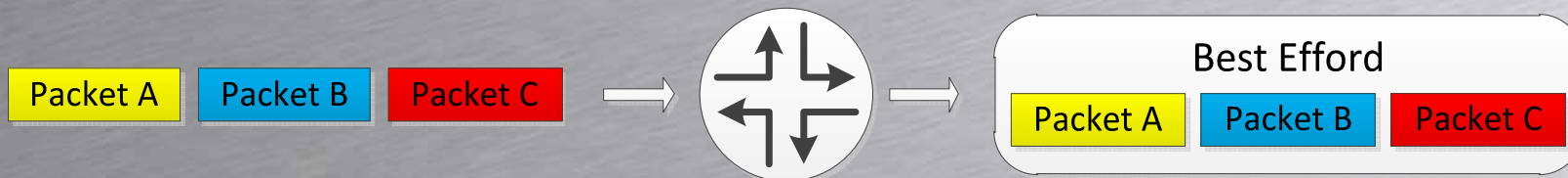
- Hvad kan man gøre for at undgå uproductive netværk?
  - Mere båndbrede
    - Bliver billigere og billigere
    - Skaleres kun til et vist punkt
  - Når vi kommer over 80% forbrug bliver CoS relevant

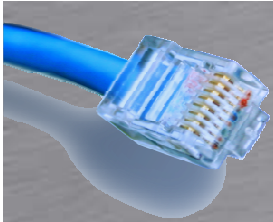




# CoS

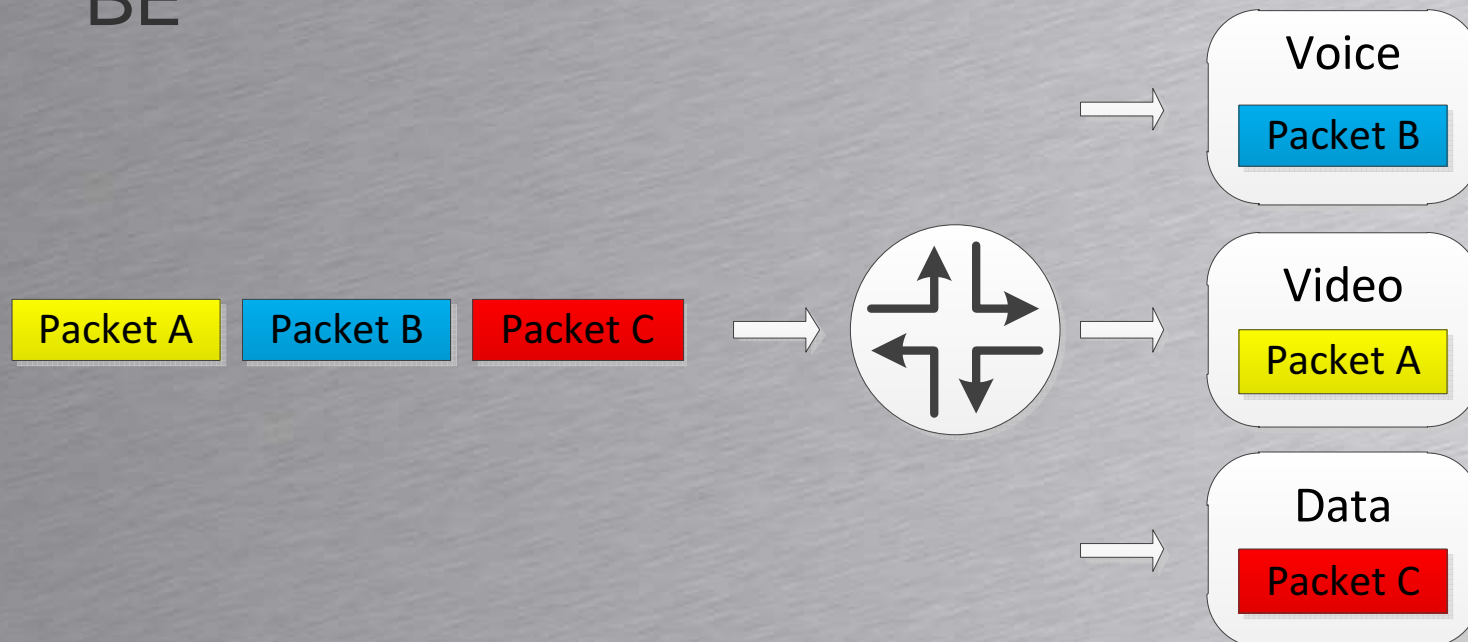
- Som Default bliver alle pakker håndteret ens
  - Alle pakker kommer i de samme input og output kører – FIFO
  - Dette kaldes Best Efford.

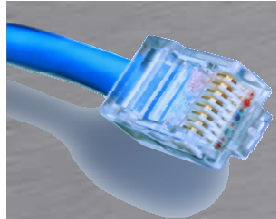




# CoS

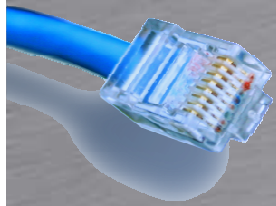
- På Juniper udstyr kan man aktivere CoS
  - Class of Service & Quality of Service er ca. det samme...
  - CoS bruges hvor der er behov for mere end BE





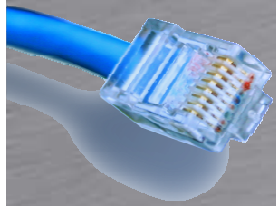
# CoS Toolbox

- Class of Service
  - Markering af pakker så efterfølgende routere kan nøjes med at kigge på markeringen
  - Kan håndtere trafik typer forskelligt
    - Bandwidth
    - Delay
    - Delay Variation/Jitter
    - Loss
    - Loss pattern
  - Eller en kombination af flere af ovenstående



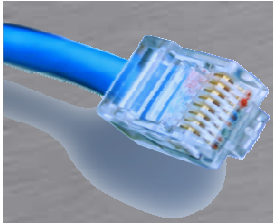
# CoS Toolbox

- Classification
  - Classification kan ske ud fra 2 metoder.
- Behavioral Aggregate – BA
  - DSCP
  - IP Precedence
  - MPLS EXP
  - 802.1p
- Multifield Classification
  - Matcher trafik ud fra Firewall regler



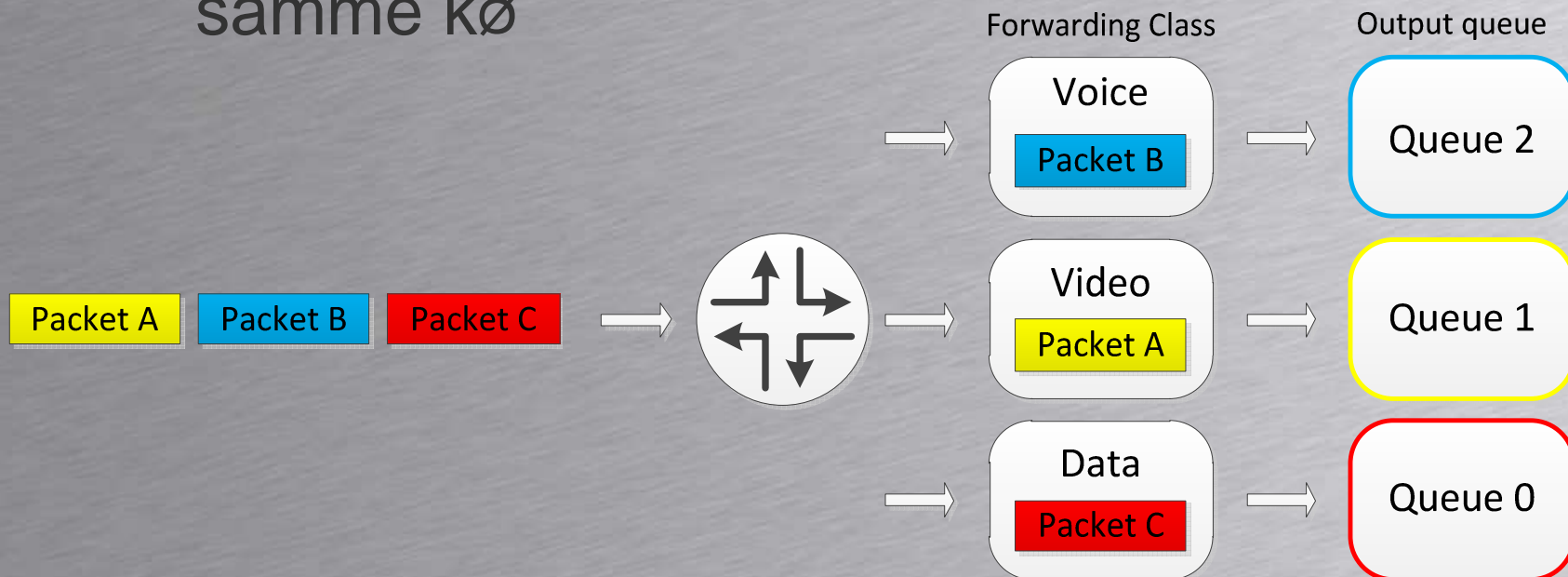
# CoS Toolbox

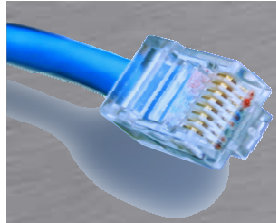
- Forwarding Classes
  - Forwarding Classes er et koncept Juniper bruger for at identificere trafik der skal have samme behandling – BA
  - Trafik bliver smidt i en Forwarding Class under Classification processen



# CoS Toolbox

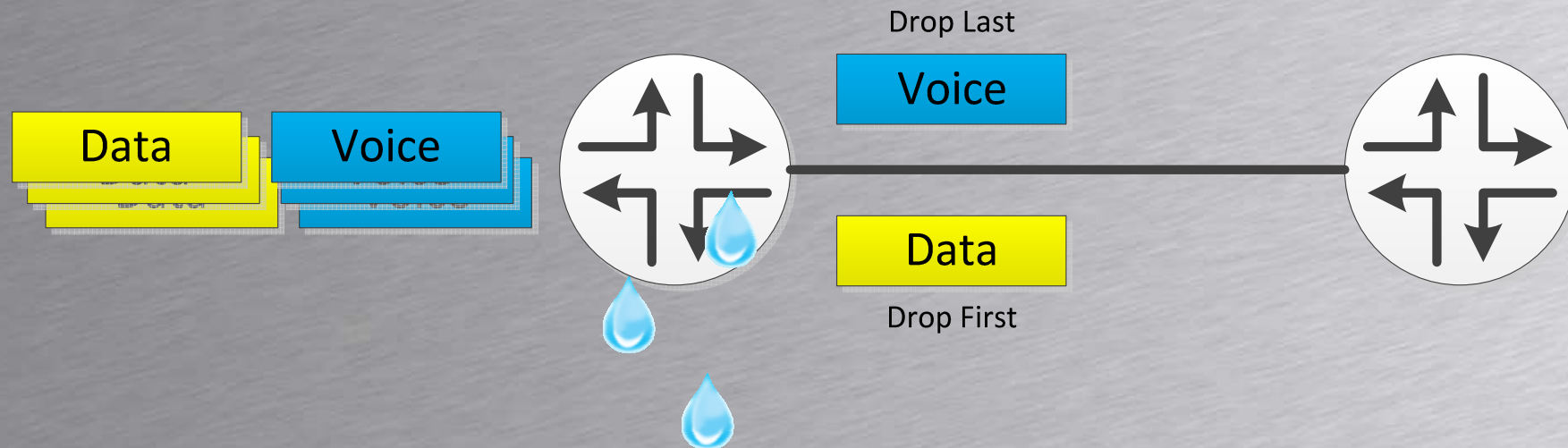
- Forwarding Classes
  - Forwarding Classes bliver smidt i bestemte køer på egress interfacet
  - Forwarding Classes er ikke det samme som en kø, da flere Forwarding Classes kan ende i samme kø

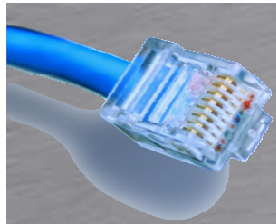




# CoS Toolbox

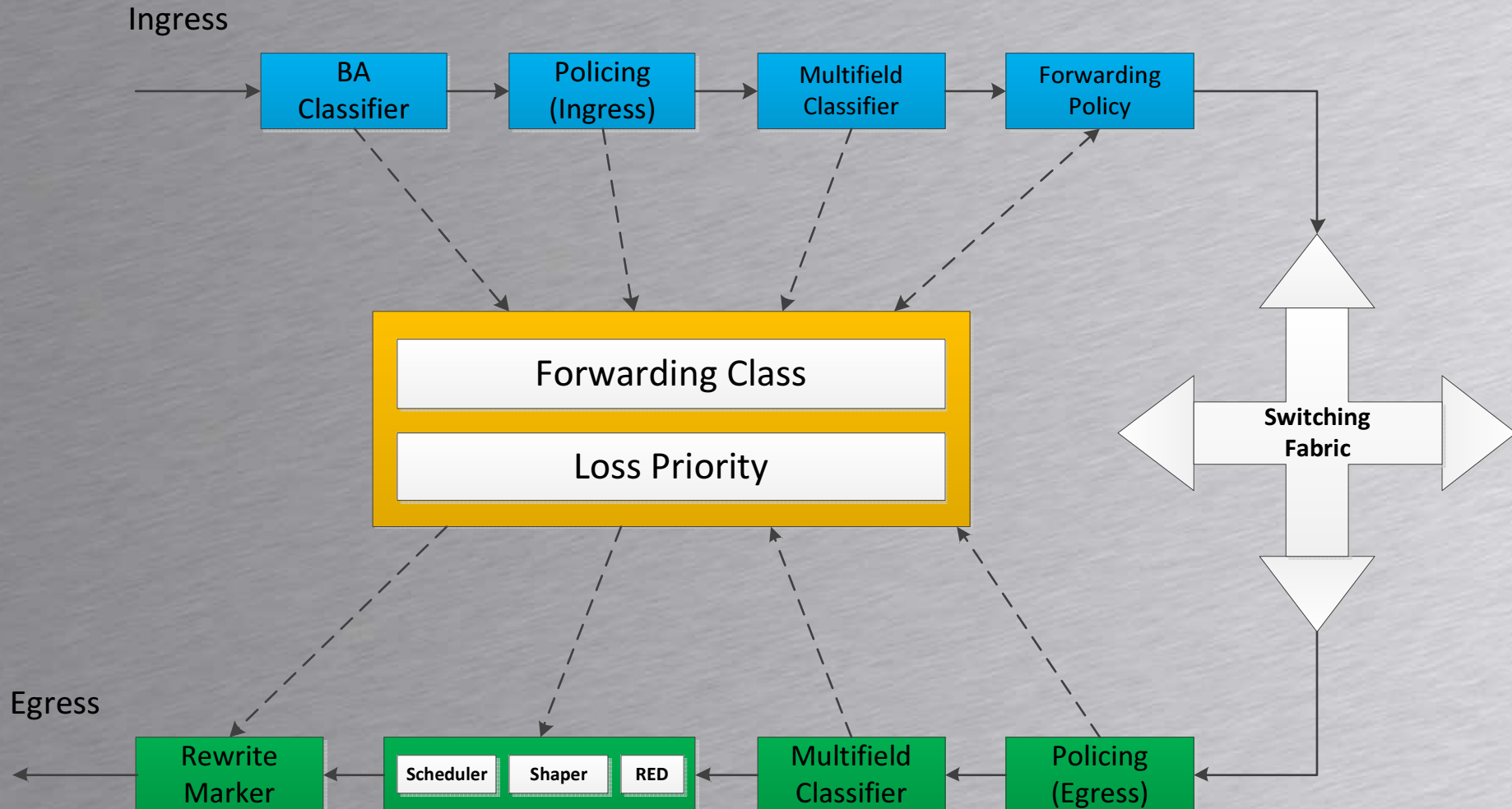
- Packet Loss Priority
  - Man kan tilføje en PLP til en pakke
  - PLP'en kan bruges i RED profiler til at definere drop probability



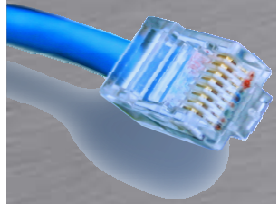


# CoS Toolbox

- CoS Processering

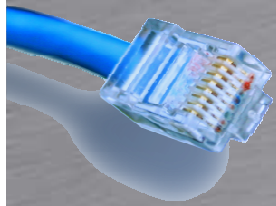






# CoS Toolbox

- CoS Processering
  - Multifield classifiers matcher ud fra firewall politikker
    - Bruges til at sætte Forwarding Class
    - Bruges til at sætte Loss Priority
    - Sættes i *then* klausulen
  - Forwarding politikker kan bruges for at ændre routing for bestemte CoS pakker – *Ikke en del af dette kursus*



# CoS Classification



- Multifield Classifier - Eksempel

```
[edit firewall family inet filter APPLY-COS]
```

```
root@SRX240# show
```

```
term ADMIN-NET {
```

```
  from {
```

```
    source-address {
```

```
      192.168.146.0/24;
```

```
    }
```

```
  }
```

```
  then {
```

```
    forwarding-class expedited-forwarding;
```

```
    accept;
```

```
  }
```

```
}
```

```
term ALL-OTHER {
```

```
  then accept;
```

```
}
```

```
[edit interfaces ge-0/0/1 unit 0]
```

```
root@SRX240# show
```

```
family inet {
```

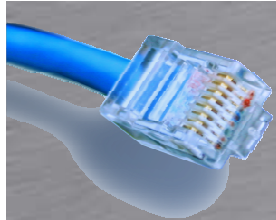
```
  filter {
```

```
    input APPLY-COS;
```

```
  }
```

```
  address 192.168.146.100/24;
```

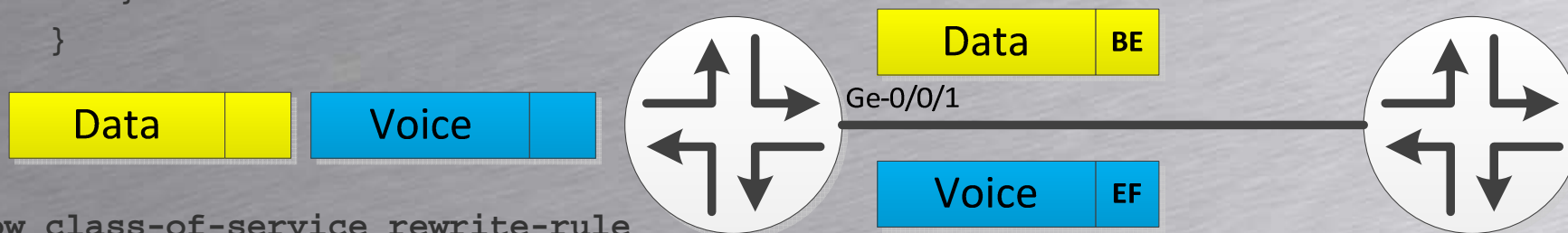
```
}
```



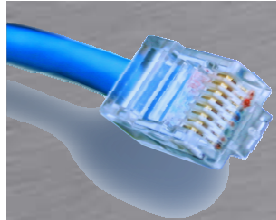
# CoS Rewrite

- Behavior Aggregate Rewrite – Eksempel  
– Sættes på Egress interface

```
[edit class-of-service]
root@SRX240# show
interfaces {
  ge-0/0/1 {
    unit 0 {
      rewrite-rules {
        inet-precedence default;
      }
    }
  }
}
```



Show class-of-service rewrite-rule

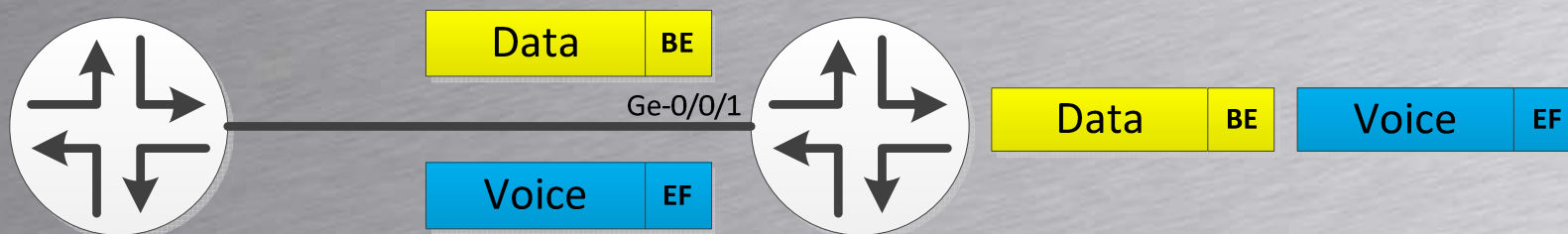


# CoS Classification

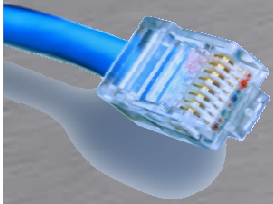
- Behavior Aggregate Classifier – Eksempel  
– Sættes på Ingress interface

```
[edit class-of-service]
root@SRX240# show
interfaces {
  ge-0/0/1 {
    unit 0 {
      classifiers {
        inet-precedence default;
      }
    }
  }
}
```

Vi stoler nu på trafik og sætter det i default Queue for trafik typen



Show class-of-service forwarding-table

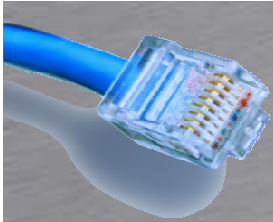


# CoS Queues

- Forwarding Classes bliver kædet sammen med en kø
- Default sammenkædning er ens på de fleste enheder med Junos OS:

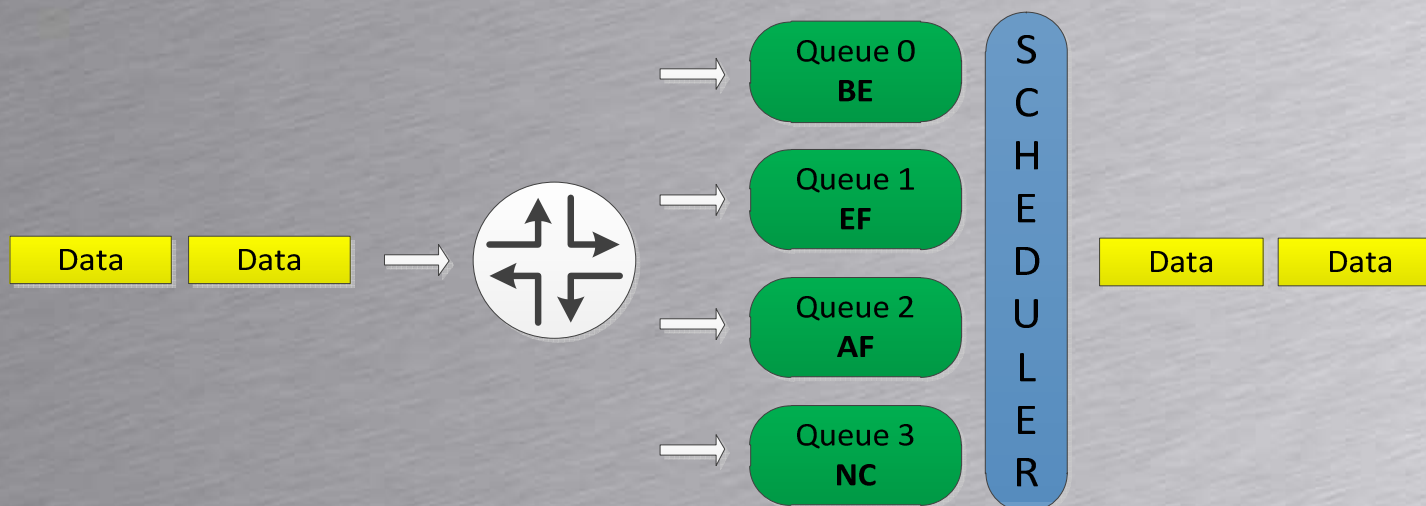
Forwarding Class	Navn	Kø Nummer
0	Best-Efford	0
1	Expedited-Forwarding	1
2	Assured-Forwarding	2
3	Network-Control	3

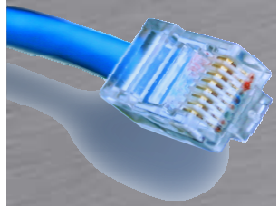
```
[edit class-of-service]  
root@SRX240# set forwarding-classes queue 2 teacher-traffic  
  
Show class-of-service forwarding-class
```



# CoS Queues

- Når trafikken rammet et Egress interface bliver hver Forwarding Class smidt i en kø.
  - Antal mulige køer varierer pga. HW.
  - Som default sendes Routing Protokoller og andet i Queue 3(NC)
  - Alt andet trafik smides i Queue 0(BE)





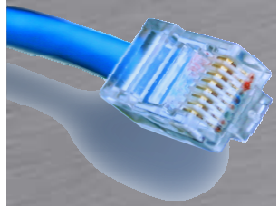
# CoS Schedulers

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- For at bestemme hvordan trafik bliver afsendt skal der konfigureres nogle schedulers
  - Priority
  - Transmission rate
  - Buffer size
  - RED
- Junos OS Software Default
  - Queue 0 får 95% buffer og båndbredde
  - Queue 3 får 5% buffer og båndbredde

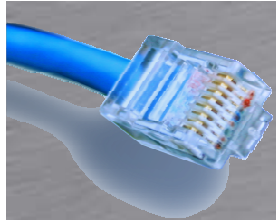


# CoS Schedulers

- Priority angiver rækkefølgen hvori køer bliver tømt.
- Den tømmer altid den med højeste prioritet først og arbejder sig nedefter.
  - Strict-high - PQ
  - High
  - Medium-high
  - Medium-low
  - Low

Køerne skal have positiv credit for denne prioritering virker.





# CoS Schedulers

- Schedulers - Eksempel

```
[edit class-of-service schedulers]
```

```
root@SRX240# show
```

```
scheduler-best-efford {
```

```
    transmit-rate percent 50;
```

```
    buffer-size percent 50;
```

```
    priority low;
```

```
}
```

```
scheduler-assured-forwarding {
```

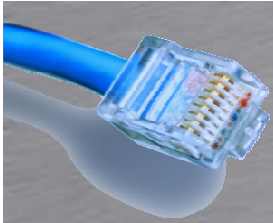
```
    transmit-rate percent 10 exact;
```

```
    buffer-size percent 10;
```

```
    priority high;
```

```
}
```

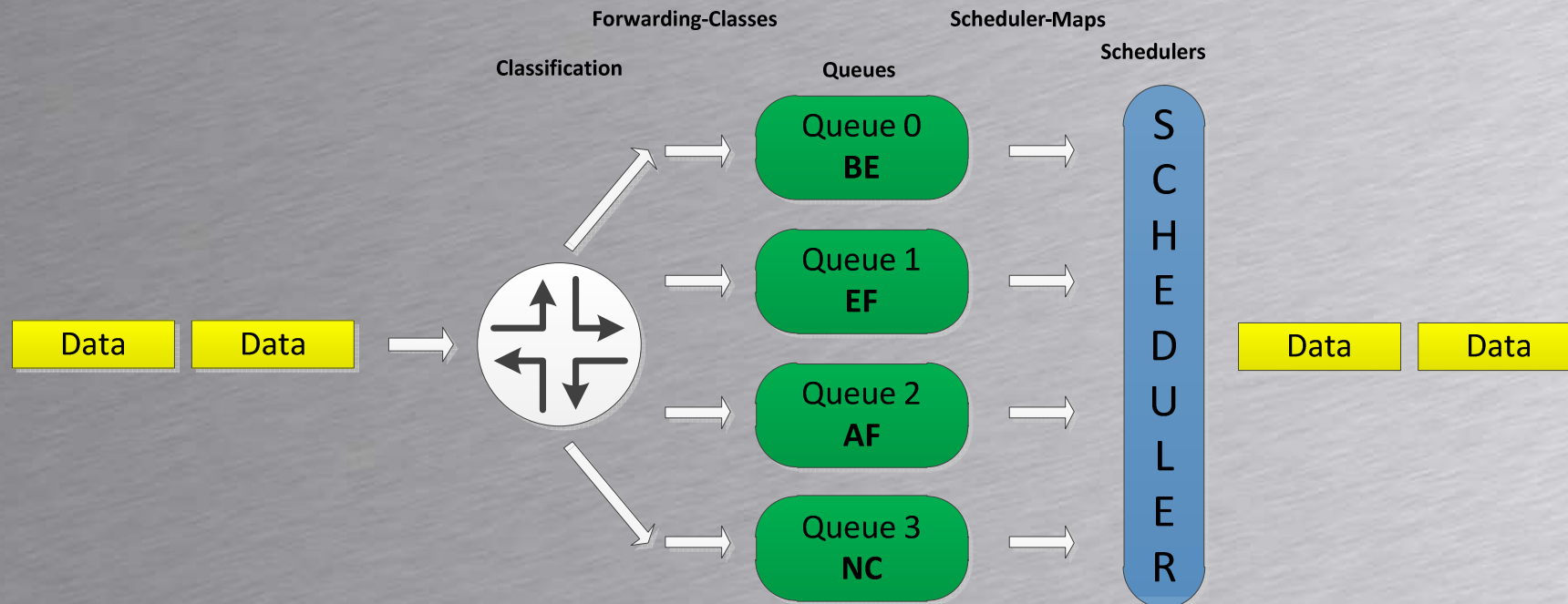
← Køen må ikke overskride 10%

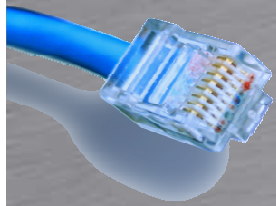


# CoS Scheduler-maps



- Scheduler-maps kæder forwarding-classes sammen med Schedulers og deres køer

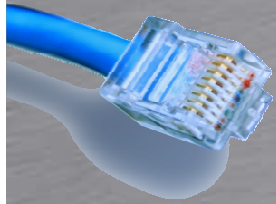




# CoS Scheduler-maps

- Scheduler-maps - Eksempel

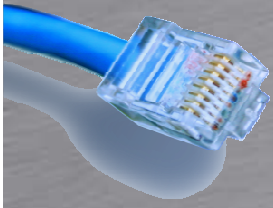
```
[edit class-of-service scheduler-maps]
root@SRX240# show
GE-0/0/0-OUT {
    forwarding-class best-effort scheduler scheduler-best-efford;
    forwarding-class assured-forwarding scheduler scheduler-assured-forwarding;
}
```



# CoS Scheduler-maps

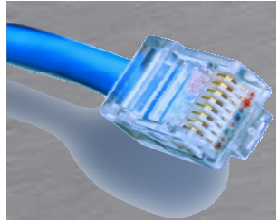
- Før det hele virker skal scheduler-maps sættes på et interface
  - Tilføjes på Egress interface
  - Man kan bruge wildcards

```
[edit class-of-service interfaces]
root@SRX240# show
fe-* {
    scheduler-map FE-OUT;
}
ge-0/0/0 {
    scheduler-map GE-0/0/0-OUT;
}
```



# CoS Policing

- Hvis man vil forhindre kunderne i at sende for meget EF trafik kan vi police
- Policing kan bruges på 2 måder:
  - Traffic rate limiting
  - CoS traffic conforming
    - Alt trafik der overskrider den definerede båndbredde bliver nedmarkeret.

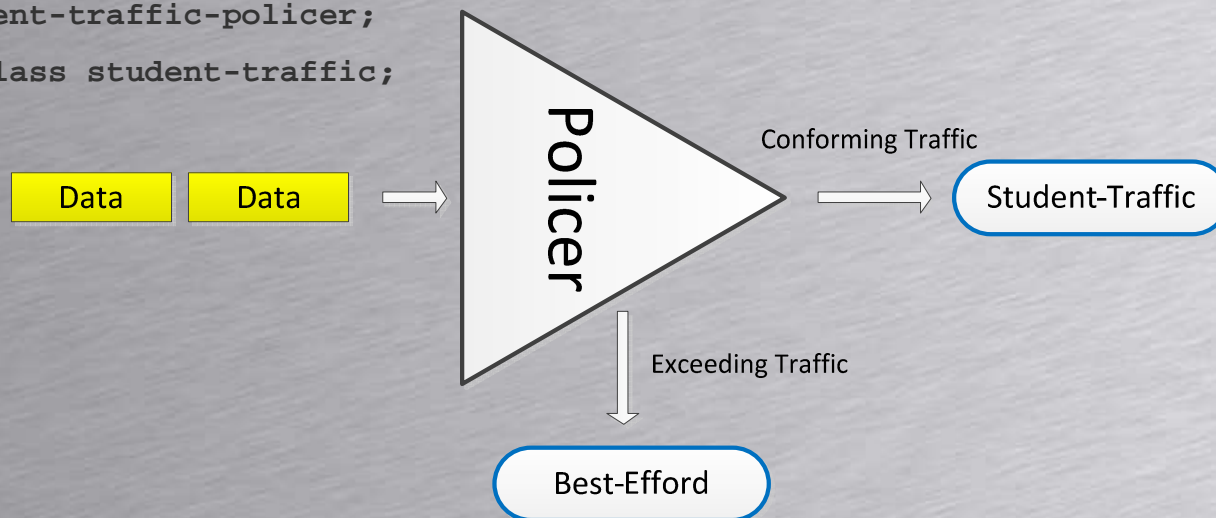


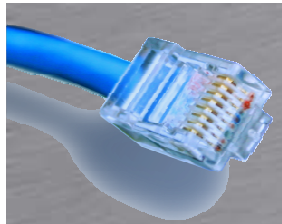
# CoS Policing

- CoS Policing - Eksempel

```
family inet {
  filter if-cos-filter {
    term student-traffic {
      from {
        source-address {
          10.0.0.0/24;
        }
      }
      then {
        policer student-traffic-policer;
        forwarding-class student-traffic;
        accept;
      }
    }
    term all-other {
      then accept;
    }
  }
}
```

```
[edit firewall]
root@SRX240# show
policer student-traffic-policer {
  if-exceeding {
    bandwidth-limit 10m;
    burst-size-limit 3k;
  }
  then forwarding-class best-effort;
}
```





# CoS Toolbox

- CoS Processering - Summary

