1. Receive INFLOWS
IP SWITCHES...

1. Receive INFLOWS

2. BUFFER & Route
IP SWITCHES

1. Receive INFLOWS
2. BUFFER & Route
3. Transmit OUTFLOWS
IP SWITCHES

1. Receive INFLOWS
2. BUFFER & Route
3. Transmit OUTFLOWS

TRAFFIC SHAPING AFFECTS HOW MUCH BUFFER AN IP SWITCH NEEDS
THE PRINCIPLE IS ANALOGOUS TO WATER FLOWING IN & OUT OF A BUCKET

DATA IN

DATA OUT

ANALOGY

WATER IN

WATER OUT
THE PRINCIPLE IS ANALOGOUS TO WATER FLOWING IN & OUT OF A BUCKET

1. Both have INFLOWS

DATA IN

DATA OUT

WATER IN

WATER OUT
THE PRINCIPLE IS ANALOGOUS TO WATER FLOWING IN & OUT OF A BUCKET

1. Both have INFLOWS
2. Both BUFFER
THE PRINCIPLE IS ANALOGOUS TO WATER FLOWING IN & OUT OF A BUCKET

1. Both have INFLOWS
2. Both BUFFER
3. Both have OUTFLOWS
IN THIS ANALOGY...

UNIFORM PACKET SPACING
(NARROW TRAFFIC SHAPE)

\[ \Delta t_1 \approx \Delta t_2 \approx \Delta t_3 \approx \Delta t_4 \]

UNIFORM WATER FLOW

EQUATES TO
WITH THE WATER/BUCKET ANALOGY...

IF THE WATER FLOW IS UNIFORM

UNIFORM WATER FLOW
If the water flow is uniform and

amount of water entering = amount of water exiting
UNIFORM WATER FLOW

IF THE WATER FLOW IS UNIFORM

AND

AMOUNT OF WATER ENTERING = AMOUNT OF WATER EXITING

UNIFORM WATER FLOW

THE BUCKET NEVER OVERFLOWS
WITH AN IP SWITCH...

IF PACKET SPACING IS UNIFORM
(TRAFFIC PROFILE IS VERY NARROW)
WITH AN IP SWITCH…

If packet spacing is uniform (traffic profile is very narrow) and

\[
\text{Amount of data entering} = \text{Amount of data exiting}
\]
WITH AN IP SWITCH...

IF PACKET SPACING IS UNIFORM (TRAFFIC PROFILE IS VERY NARROW)

AND

AMOUNT OF DATA ENTERING = AMOUNT OF DATA EXITING

SWITCH MEMORY NEVER OVERFLOWS
WITH THE WATER/BUCKET ANALOGY…

**If** the water flow is “bursty” **Non-uniform water flow**
WITH THE WATER/BUCKET ANALOGY…

**IF** THE WATER FLOW IS “BURSTY”

AND

AVERAGE AMOUNT OF WATER ENTERING = AVERAGE AMOUNT OF WATER EXITING

**NON-UNIFORM WATER FLOW**
WITH THE WATER/BUCKET ANALOGY…

**IF** THE WATER FLOW IS “BURSTY”

AND

AVERAGE AMOUNT OF WATER ENTERING = AVERAGE AMOUNT OF WATER EXITING

THEN WATER LEVEL VARIES…

…and IF THE BUCKET ISN’T BIG ENOUGH…

**NON-UNIFORM WATER FLOW**
WITH THE WATER/BUCKET ANALOGY…

IF THE WATER FLOW IS “BURSTY”

AND

AVERAGE AMOUNT OF WATER ENTERING = AVERAGE AMOUNT OF WATER EXITING

THEN WATER LEVEL VARIES…

…AND IF THE BUCKET ISN’T BIG ENOUGH…

THE BUCKET OVERFLOWS
WITH AN IP SWITCH…

**IF** PACKET FLOW IS “BURSTY” (TRAFFIC PROFILE IS WIDE)

DATA IN

DATA OUT
WITH AN IP SWITCH...

IF PACKET FLOW IS “BURSTY”
(TRAFFIC PROFILE IS WIDE)

AND

AVERAGE AMOUNT OF DATA ENTERING = AVERAGE AMOUNT OF DATA EXITING
WITH AN IP SWITCH…

IF PACKET FLOW IS “BURSTY” (TRAFFIC PROFILE IS WIDE)

AND

AVERAGE AMOUNT OF DATA ENTERING = AVERAGE AMOUNT OF DATA EXITING

THEN BUFFER LEVEL VARIES…

…and if the switch buffer isn’t big enough…
WITH AN IP SWITCH...

IF PACKET FLOW IS “BURSTY” (TRAFFIC PROFILE IS WIDE)
AND
AVERAGE AMOUNT OF DATA ENTERING = AVERAGE AMOUNT OF DATA EXITING

THEN BUFFER LEVEL VARIES...

...AND IF THE SWITCH BUFFER ISN’T BIG ENOUGH...

THE BUFFER OVERFLOWS

IF PACKET FLOW IS “BURSTY” (TRAFFIC PROFILE IS WIDE)
AND
AVERAGE AMOUNT OF DATA ENTERING = AVERAGE AMOUNT OF DATA EXITING

THEN BUFFER LEVEL VARIES...

...AND IF THE SWITCH BUFFER ISN’T BIG ENOUGH...

THE BUFFER OVERFLOWS
CONCLUSION

As non-uniform water flows require a big enough bucket to account for water level variation...
CONCLUSION

AS NON-UNIFORM WATER FLOWS REQUIRE A BIG ENOUGH BUCKET TO ACCOUNT FOR WATER LEVEL VARIATION...

...NON-UNIFORM DATA FLOWS (WIDE TRAFFIC SHAPES) REQUIRE ENOUGH IP SWITCH BUFFER MEMORY TO ACCOUNT FOR DATA LEVEL VARIATION WITHIN THE SWITCH
CONCLUSION

TAKEAWAYS

• SUCH DEEP BUFFER MEMORY SWITCHES ARE AVAILABLE AND CAN BE SPECIFIED WHEN USING SMPTE ST 2110-21 WIDE TRAFFIC SHAPING. A DESIGN WITH WIDE TRAFFIC SHAPING ENABLES AN ALL SOFTWARE SOLUTION AND SUPPORTS THE MOVE TO DEMATERIALIZED FACILITIES

• USING SMPTE ST 2110-21 NARROW TRAFFIC SHAPING MINIMIZES SWITCH MEMORY REQUIRED

...NON-UNIFORM DATA FLOWS (WIDE TRAFFIC SHAPES) REQUIRE ENOUGH IP SWITCH BUFFER MEMORY TO ACCOUNT FOR DATA LEVEL VARIATION WITHIN THE SWITCH