97-0859 Measurement Experiences with the Revised MIMO Latency Definition

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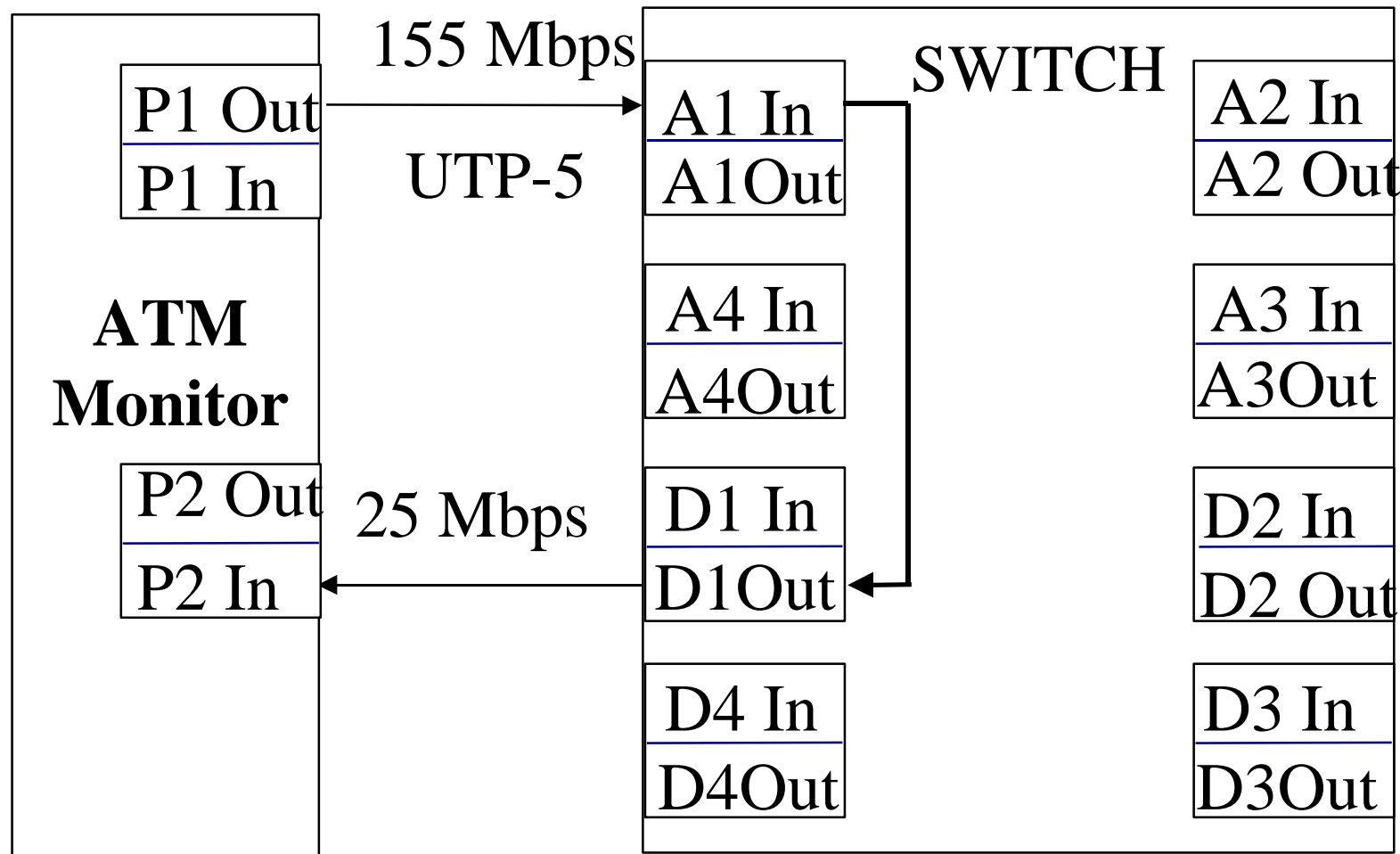Washington University in Saint Louis
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Overview

❑ MIMO latency measurement for

   ❑ Input link rate > Output link rate

   ❑ Input link rate < Output link rate

❑ MIMO = FILO - NFOT, if Input rate > Output rate
      = LILO, otherwise

Test Configuration for Measurement of MIMO Latency

ATM Monitor

| P1 Out |
| P1 In |

| P2 Out |
| P2 In |

155 Mbps

UTP-5

25 Mbps

SWITCH

| A1 In |
| A1Out |

| A4 In |
| A4Out |

| D1 In |
| D1Out |

| D4 In |
| D4Out |

| A2 In |
| A2 Out |

| A3 In |
| A3Out |

| D2 In |
| D2 Out |

| D3 In |
| D3Out |

Input Rate > Output Rate

❑ Input Link 155 Mbps UTP-5

❑ Output Link 25 Mbps

❑ Cell Input Time (CIT) = 424[bits]/Input Link Rate
$$= 2.83 \ \mu sec.$$

❑ Cell Output Time (COT) = 424[bits]/Output Rate
$$= 16.56 \ \mu \ sec.$$

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Input Rate > Output Rate (Cont.)

- In this case (Expression 1.):
  MIMO Latency = First Cell Transfer Delay +
  + First Cell to Last Cell inter-arrival time – NFOT

- We have experimented MIMO measurement with
  different frame patterns.
  - All the frames have 32 cells.
  - They have different inter-cell gaps.
  - Each gap has the duration of one cell time.

Input Cell Pattern

155 Mbps   25 Mbps

1 Cell

x gaps

x gaps

Measured Results I (in μsec)

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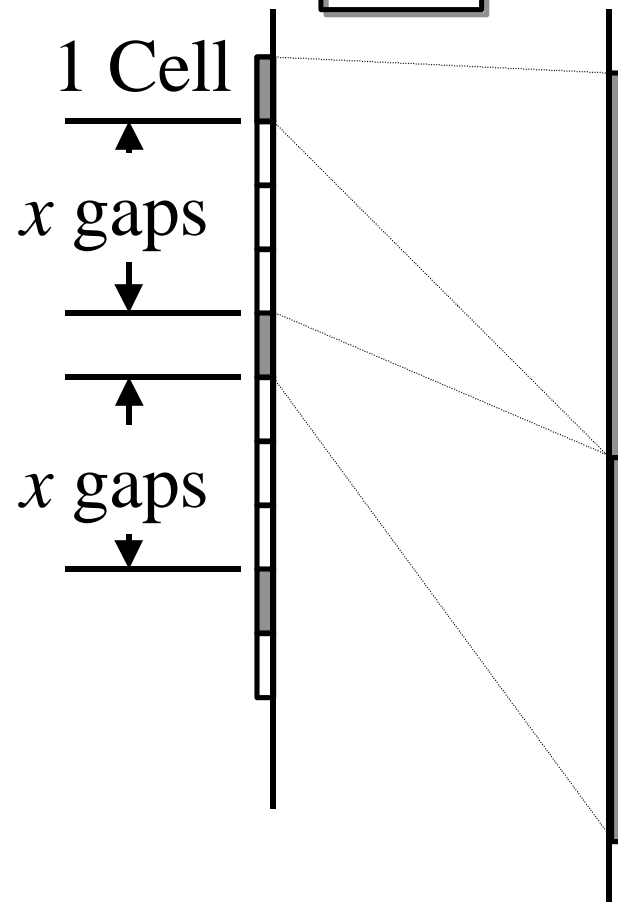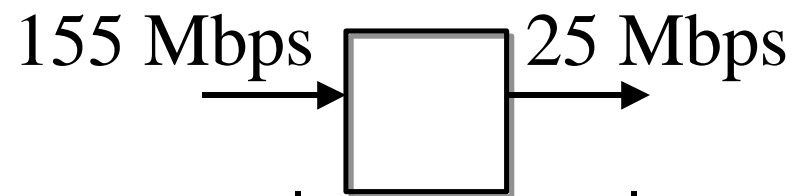
Results (cont.)

❑ We have calculated MIMO latency for different frame patterns.

❑ In the first five cases the cells have to wait for the output of the previous cell. In this case the switch introduces additional delays because of the overhead of processing queues of cells in its memory

Input Rate < Output Rate

❑ Frames are sent in Opposite direction of what is shown in the previous configuration

❑ Input Link 25 Mbps
Output Link 155 Mbps UTP-5

❑ Cell Input Time (CIT) = 16.56 μsec.

❑ Cell Output Time (COT) = 2.83 μsec.

❑ Each frame consists of 32 cells or 64 cells.

❑ In this case (Expression 2.):
MIMO Latency = LILO Latency
$\qquad\qquad$ = Last Cell's Transfer Delay – CIT

Cell Pattern

25 Mbps → ☐ → 155 Mbps

1 Cell
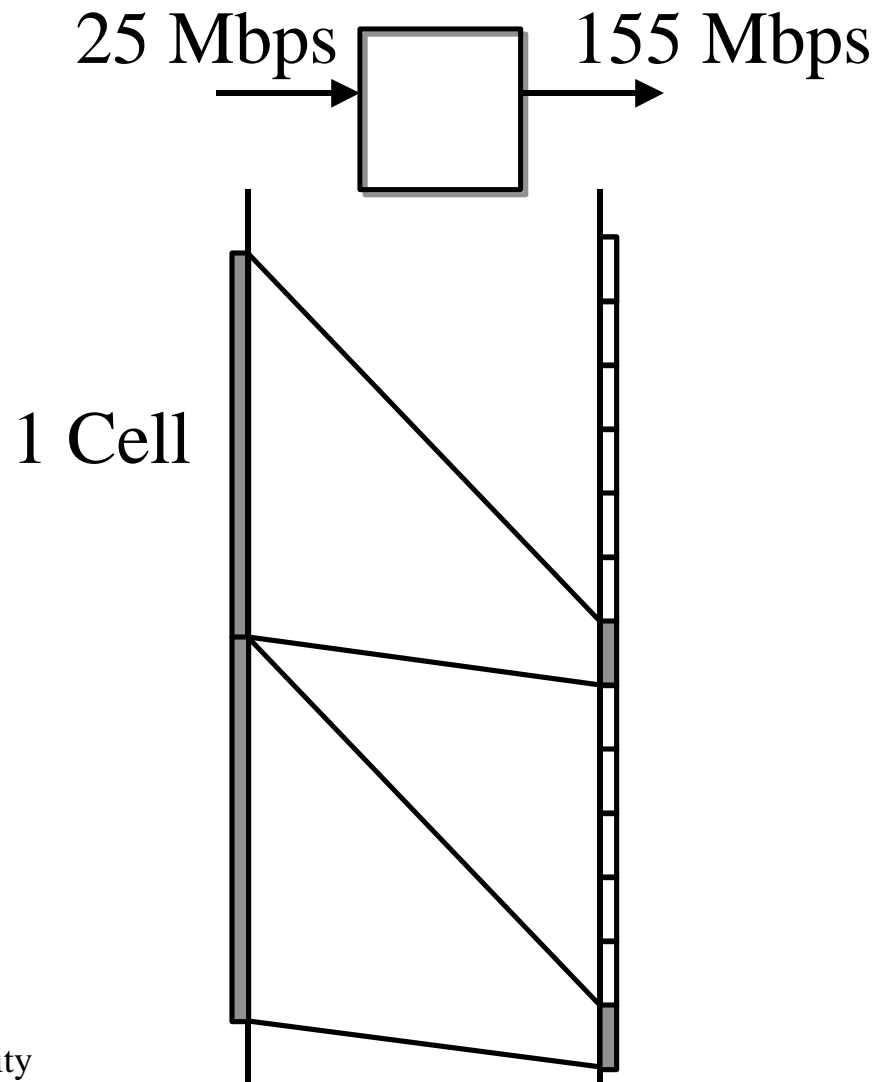
Measured Results II (in μsec)

Test Case No.	1	2
Last Cell Delay	32.0	32.5
MIMO Latency using Expression 2	15.4	15.9
First Cell's delay	31.0	33.0
First-to-last cell inter-arrival time	535.0	1067.5
NFOT	550.0	1082.6
MIMO Latency using Expression 1	16.0	17.9

Results (Cont)

❑ It can be observed that good agreement of MIMO latency values can be obtained using the two expressions for its calculation.

❑ So, in this case, we can use the shorter expression.

Summary

❑ Our experiments confirm the correctness of both MIMO expressions.

❑ MIMO can be measured easily using the contemporary ATM monitors.

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