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ISSUES ADDRESSED: Common Scenarios for Simulation Studies of Cell Delay Variation Tolerance

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ABSTRACT

This contribution describes test configurations, test source loads, test scenarios, and measurements for the simulation studies of cell delay variation tolerance. The objective of this contribution is to document a common set of assumptions used in the simulation studies in order to facilitate a coordinated effort by various member companies, We propose that this contribution be treated as a working document during the course of the simulation studies.

NOTICE

1. Introduction

CCITT Recommendation I.371 states that cell delay variation (CDV) tolerance τ between the source and the T_B reference point needs to be specified in the traffic contract in order for the UPC to accommodate the potential distortion of the source traffic shape caused by the customer premise network multiplexing. A work item was identified during the Traffic Management group's January meeting in order to provide guidelines for CDV tolerance specification. It called for simulation studies of the cell delay variation tolerance (CDVT) caused by an ATM customer premises network and of the effect of shaping or scheduling in controlling the magnitude of the CDVT.

It is important that a common set of assumptions is documented and used in order to facilitate a coordinated effort by various member companies. This contribution describes the test configurations, test source loads, measurements, and test scenarios for the simulation studies to be performed. We propose that this contribution be treated as a working document during the course of the simulation studies.

2. Test Configurations

We propose the following configurations:

Configuration 1 (Figure 1):

- The intermediate system has N input ports and one output port. Each input port is connected to one end system, each end system has one source attached, and each source corresponds to one ATM connection.
- The input and output link rates of the intermediate system are identical and equal to 149.76 Mbps (353207.547 cells/s).

Configuration 2 (Figure 2):

- Each type-1 intermediate system i has a similar node configuration as the intermediate system in Configuration 1, with $N1_i$ input ports (i=1,2,...,$S1$). The number of input ports for each system may differ, i.e., $N1_i$ ports need not be identical.
- Each type-2 intermediate system j has $N2_j$ input ports (j=1,2,...,$S2$). $N2_j^a$ input ports are connected to end systems and each end system has one source attached. Each source corresponds to one ATM connection. The $N2_j^b$ remaining input ports are connected to the output port of a type-1 intermediate system ($N2_j^a + N2_j^b = N2_j$). The input and output link rates are identical and equal to 149.76 Mbps (353207.547 cells/s).
- Type-3 intermediate system k has $N3_k$ input ports (k=1,2,...,$S3$). $N3_k^a$ input ports are connected to the output port of a type-1 intermediate system. The $N3_k^b$ remaining input ports are connected to the output port of a type-2 intermediate system ($N3_k^a + N3_k^b = N3_k$). The input and output link rates are identical and equal to 149.76 Mbps (353207.547 cells/s).

Buffers at intermediate systems in all configurations are assumed to be sufficiently large to prevent cell loss due to buffer overflow. Node processing delays and propagation delays between nodes (end systems, intermediate systems) are assumed to be zero.

3. Test Source Loads

We propose the following types of sources loads:

Source Type 1: CBR source with the constant cell rate equal to 118979 cells/s. This source type represents a DS3 circuit emulation type of connections.

Source Type 2: CBR source with the constant cell rate equal to 4106 cells/s. This source type represents a DS1 circuit emulation type of connections.

Source Type 3: CBR source with the constant cell rate equal to 170 cells/s. This source type represents a DS0 circuit emulation type of connections.

Source Type 4: CBR source with constant cell rate equal to 10638 cells/s. This source type represents a 4 Mbps circuit emulation type of connections.

Source Type 5: A Poisson arrival source with an average arrival rate λ in cells per seconds. This source type represents the background aggregate traffic.

Source Type 6: CBR source with a random constant cell rate. The constant cell rate R_i for CBR source i is chosen among five intervals using a set of probabilities, p_1, p_2, p_3, p_4, and p_5 (where $p_1+p_2+p_3+p_4+p_5=1$). If L is the link rate,

- R_i < 1% of L, with probability p_1
  (Min R_i = 100 kbps = 0.006% of 149.76 Mbps)
- 1% of $L \le R_i <$ 2% of L, with probability p_2
- 2% of $L \le R_i <$ 5% of L, with probability p_3
- 5% of $L \le R_i <$ 10% of L, with probability p_4
- 10% of $L \le R_i <$ 25% of L, with probability p_5.

4. Test Scenarios

We currently propose the following five test scenarios:

Test Scenario 1:

- Configuration 1 (N=20)
- 1 Type 1 source
- 19 Type 4 sources.

Test Scenario 2:

- Configuration 1 (N=20)
- 1 Type 1 source
- 18 Type 2 sources
- 1 Type 5 source, with $\lambda = n \times 17660.35$ cells/s, where $n=0,1,...,8$.

Test Scenario 3:

- Configuration 1 (N = 20)

- 1 Type 1 source
- 18 Type 3 sources
- 1 Type 5 source, with $\lambda = n \times 17660.35$ cells/s, where $n = 0, 1, ..., 12$.

Test Scenario 4:

- Configuration 1 (N=20)
- 1 Type 1 source
- 3 Type 4 sources
- 15 Type 3 sources
- 1 Type 5 source, with $\lambda = n \times 17660.35$ cells/s, where $n = 0, 1, ..., 10$.

Test Scenario 5:

- Configuration 1 (N is equal to the number of sources needed to reach 85% of the link rate)
- peak rates R_i:
    - R_i < 1% of L, with probability 0.3
      (Min R_i = 100 kbps = 0.006% of 149.76 Mbps)
    - 1% of L <= R_i < 2% of L, with probability 0.2
    - 2% of L <= R_i < 5% of L, with probability 0.2
    - 5% of L <= R_i < 10% of L, with probability 0.15
    - 10% of L <= R_i < 25% of L, with probability 0.15.

In all the above test scenarios, the simulation run length is at least 2.5 seconds. All Type 1, Type 2, Type 3, and Type 4 sources have its first cell generated at simulation time t = T_i seconds, where T_i is the reciprocal of the corresponding constant cell rate of sources of type i.

5. Measurements

The simulation studies will at least include the following measurements:

- The measurements taken at MP1 measurement point for Configuration 1 (Figure 1), and at MP1, MP2, MP3 measurement points for Configuration 2 (Figure 2):
    - CDVT distribution
    - Cell Transfer Delay distribution (Cell Transfer Delay is defined as the time elapsed since the cell is generated.)

- The measurement taken at the intermediate system:
    - Queue size distribution at the intermediate system.

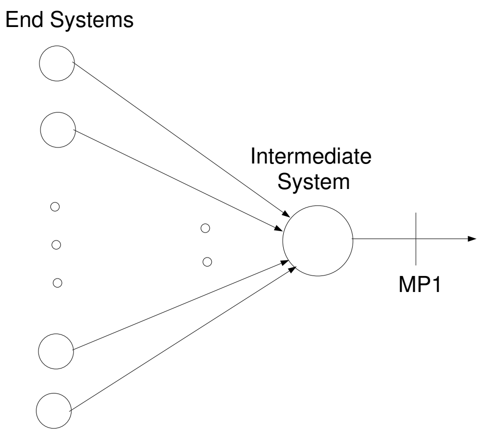

Figure 1. Configuration 1.

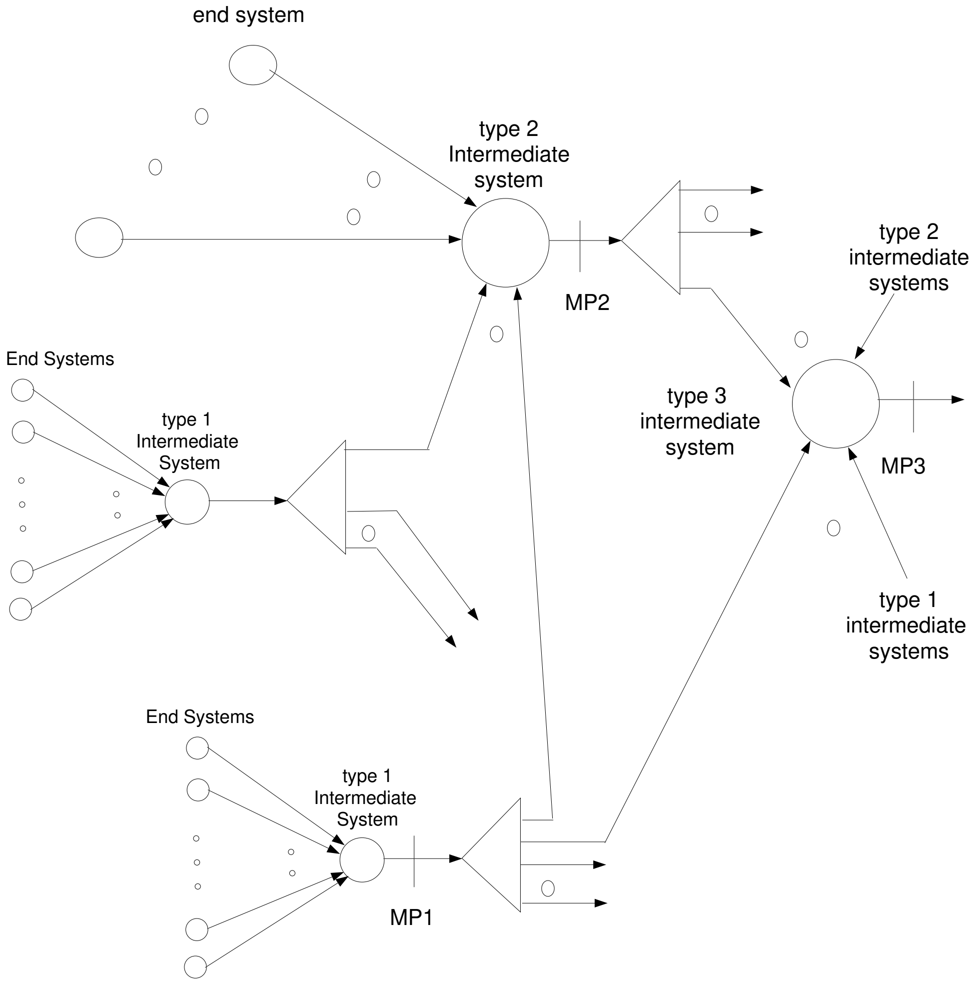

Figure 2. Configuration 2.