

SIMULATION OF SNMPv3 TRAFFIC FLOW METER MIB USING ARENA SIMULATION MODELLING SOFTWARE

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ABSTRACT

Simple Network Management Protocol version 3 is an extension of earlier versions addressing security and administration features of SNMP. SNMPv3 has additional features like different message format and defines new management information bases (MIB) for security, configuration, notification, view-based access control and proxy forwarding. Simulation of SNMPv3 traffic flow meter MIB has been carried out using ARENA Simulation Modelling Software. RFC 2064 (Traffic Flow measurement meter MIB) design is the basis of this simulation. This traffic flow meter can be designed for SNMPv3 network management system to monitor and control all network devices. From the simulation results estimation of the traffic flow parameters like packet arrivals, user usage level, availability of network workstation and ensuring authentication and privacy of users of network management system is carried out.

Keywords: SNMPv3, ARENA Simulation, RFC2064, RTFM, Network Management.

1. Introduction

SNMP is an acronym for Simple Network Management Protocol. It was introduced in the year 1988. SNMPv1 and SNMPv2 emerged as successful standards but they lacked in security features [1]. SNMPv3 was introduced by the Internet Engineering Task Force (IETF) which included security features like authentication, encryption and privacy and a new administrative framework as defined in RFC2271-2275 [2].

One of major enhancements in SNMPv3 is the security feature. A Number of problems faced with regard to security in earlier versions were eliminated. SNMPv3 keeps all security related information local to the host on which SNMP runs. Any modification in security parameters needs to be sent by agent. Two main security subsystems were included in SNMPv3, they are User Based Security Model (USM) and View Based Access Control (VBACM) [1] [2].

Both version 1 and version 2 of SNMP had a community name. Community defines the managerial access to variables which are read-only, read-write and write-only. Two main

community names mainly exist which are 'public' and 'private'. Through default communities communication is established between SNMP devices and systems. Changing the community name from public to private helps in denial-of-service attacks and probing. The community name can be obtained by a potential intruder by sniffing the packets that are going to SNMP agents. Some restrictions can be placed to overcome this process by using an access list which gives the rights for the SNMP manager from only those specified IP addresses in the list to query the agent [2]. Due to the above features SNMPv3 became very popular network management protocol standard widely adopted by many network management software vendors. Therefore it has been very important to analyse and study its features through simple simulation of certain aspects of this standard using ARENA software. This makes our work unique in comparison with other related work.

The rest of paper is organized as follows: Section 2 presents the integration of network management and ARENA simulation software. Section 3 describes the RTFM (Real-time Traffic Flow Meter) architecture and its implications on this model. Section 4 describes the simulation of SNMPv3 traffic flow meter MIB. Section 5 describes the verification of simulation run results through simple queueing analysis. Finally, section 6 concludes the paper.

2. Integration of Network Management and Arena

The Arena software package is mainly used for creating animated models and representing any system virtually. The Arena software package is based on the SIMAN simulation language. Arena supports all the types of applications and has about 60 inbuilt modules. It is a very useful tool for simulation of call centers, telecommunication queueing systems and manufacturing materials processes. Arena has five panels, with inbuilt modules to support specific application. They are *Block, Elements, Common, Support* and *Transfer*. Based on the layout of the simulation, modules can be picked up connected. All the information related to that particular module needs to be entered in to its dialog box. Animation is included with many modules. Therefore both simulation and

animation modeling processes can be done. A new approach to use ARENA to simulate network management operations is carried out. By making the right choice of available modules a simple network management system can be modeled and its operations can be simulated. It has been further extended for analysis of specific details like traffic flow, authentications, availability of network resources [3] [4] [5].

3. RTFM Architecture and its Implications on this Simulation Model

Internet usage accounting systems are one of the main problems faced in cost recovery systems and policy enforcement. The accounting system used should be a robust, scaleable and simple system that should support both increase in traffic as well as usage based cost recovery. All network management operations like fault isolation, traffic engineering and network planning should be supported by this system. Usage systems should be able to distinguish traffic based on service levels [6].

The IETF was established to standardize internet works and it has made a tremendous effort in solving internet accounting. The RTFM working group defined an architecture for traffic flow, which included SNMP MIB for traffic measurement and collection. RTFM uses a meter, which can be placed at a particular point on the internet to measure traffic through that point. The Meter is partitioned in to “flows” defined by a source and a destination address [6]. The main objective for the development of this architecture is to determine the amount of traffic flow in the network and also to determine its destination. This architecture also aims at creating a better path for the traffic to reach the destination. Collection of data about flow of traffic in the network, statistics about server load and network usage by individual (or) group of users can also be done [7].

The simulation model developed collects individual statistics for various users and maintains their records. User authentication is ensured

4. Simulation of SNMPv3 Traffic Flow Meter MIB

4.1 Model 1:

The simulation model shown in Figure 1 investigates the various network delays due to the lack of availability of resources in the network. These delays are mainly caused due to heavy traffic on the network and also due to overloading problems. The model collects the network statistics and acts as an SNMPv3 traffic flow meter MIB.

OBJECTIVE

One of the difficult network devices to be maintained is its workstation. Since users keep adding a lot of software and also do not care much about the virus protection services, managers

face a serious problem in maintaining these configurations and thus are prone to security risks [8]. All organizations have their own workstation policy and it is difficult to maintain these workstations as it is expensive and consumes a lot of time. To comply with the policy standards of particular organizations many vendors offer centralized auditing software. Managers can even update some programs remotely, which reduces time and money [8].

Modules used in this Simulation Model:

(a) Arrive Module: “The Arrive module is used to generate arriving entities to a model and may specify initial assignments to be made when the entity is created”[11]. It transfers the arriving entities to another station or module. Arrive module use involves the processing of entities entering the system. The various flow characteristics can be assigned with the help of assign options available. The mark time attribute is based on queue time. The arriving entities are routed to Station 1.

(b) Advanced Server: Advanced Server does the functions of Enter, Process and Leave modules by combining them into one module. An entity arriving at advanced server enters Station 1 and experiences some processing delay and is transferred to next station (Station 2). Queue, Animation, Count options are used for obtaining statistics of that particular station. Three advanced servers are used for three different stations. Station1 is connected to Station2, which is in turn connected to Station3.

(c) Depart Module: Depart module helps to collect statistics about all the three stations and then disposes the entity from the model. Depart module does the functions of Enter, Count, Tally and Dispose modules and combines them in to one module.

(d) Sets Module: “A Set is a group of similar elements that is referenced with a common name and a set index”[11]. Sets module consists of various member sets that can be used for various stations.

(e) Transporter Module: Transporter module transports entity from one station to other.

(f) Variable Module: Variable module defines the use of global variables.

(g) Network Link Module: “The Network Link module defines the characteristics of a guided transporter link (connection between intersections). Each link is composed of a beginning intersection, an ending intersection and one or more zones of equal length. The product of the number of zones and the length of the zones determines the total length of the link”[11].

(h) Simulate Module: Simulate model helps us to include the analyst name, number of replications and the length of replications for which the simulation runs.

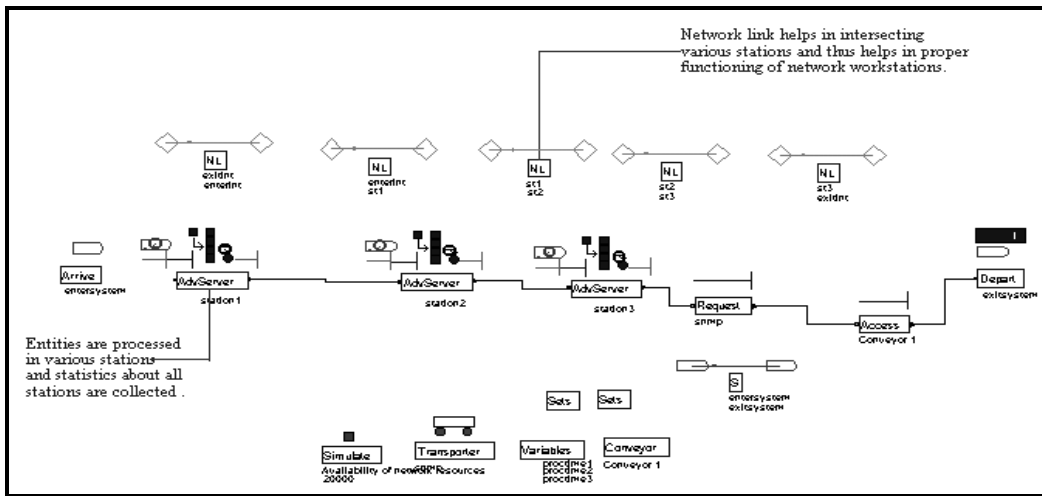


Figure1: Simulation model to determine availability of network resources [11]

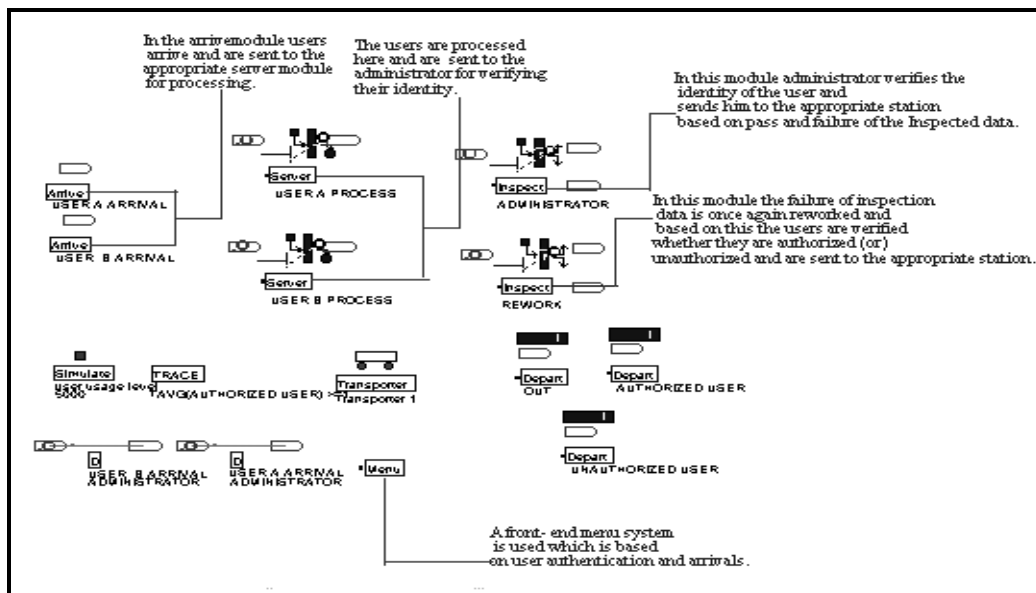


Figure2(a): Simulation model to determine user usage level and authentication [11]

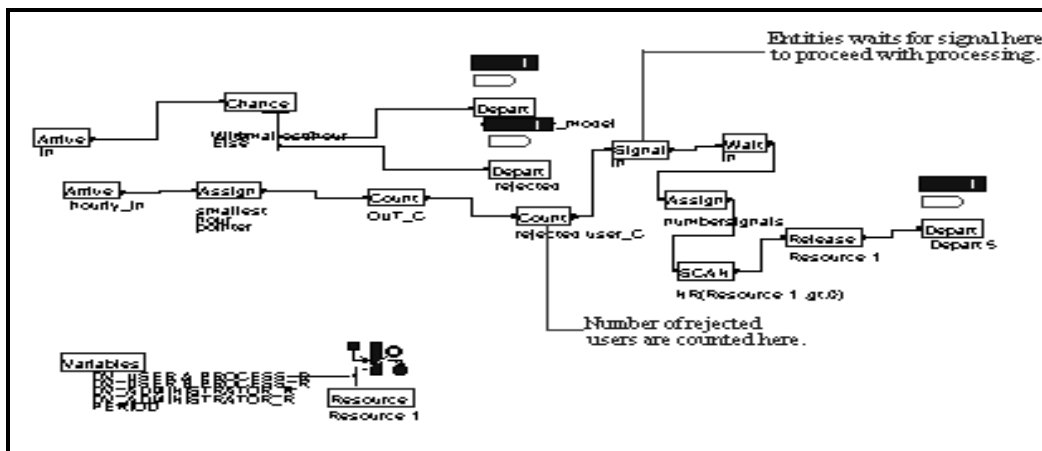


Figure2(b): Simulation sub model to verify access rights of users [11]

4.2 Model 2:

This simulation model in Figure 2(a) investigates the user usage monitoring, verification, and the role of network administrator in placing policy constraints on users.

OBJECTIVE

It is important that the users be included in the network design. It is up to the network administrator to decide what level of access should be given to users based on their requirements and acceptance criteria. This model describes the user activities and monitors their usage of network resources by having an individual statistics of all users. This is also a part of traffic flow characteristics based on user usage level which collects statistics about queue time, busy period and line down time when many users use the network simultaneously, causing a heavy traffic pattern.

(a) Arrive Module: Two arrive modules are used for two different users. USER A and USER B arrive in these modules and they are routed to appropriate servers for processing.

(b) Server Module: USER A and USER B arrive in this station for processing and they are sent to the administrator for verifying their identity.

(c) Inspect: Entities arrive here after processing for inspection by the administrator. Two different options exist based on pass or failure of the data. The data is routed to the appropriate station OUT (station name in the model) or Rework (station name in the model) based on their verification. Once the entities arrive in Rework station their authorization is verified. Failure on inspection of the data makes that particular user to be unauthorized. Then the entities pass to appropriate depart modules where statistics are collected and entities are disposed.

(d) Transporter and Distance Module: Transporter and distance modules are inter-related as they help in transportation of entities that arrive to appropriate Inspect module for verification of user identity.

(e) Menu Module: “The Menu module is used to develop a front-end menu system for a simulation model”[11]. Multiple Menu modules may be placed together to incorporate multiple levels of menus, depending upon the number of user options desired. In this model, menu options are based on the user arrivals and authentication.

Explanation of Sub-Model used in the simulation model 2

The simulation model shown in Figure 2(b) helps us to count the number of rejected users. Figure 3 describes the variables used in model with preset values.

(a) Arrive Module: Entities arrive here and are transferred to Chance module for checking if they meet some requirements for that particular entity to get processed.

(b) Chance Module: Entities arrive in this module and they are assessed against certain conditions and if the condition is met they enter the system, otherwise they are rejected.

(c) Assign Module: The Assign module allows the assignment of a value to a user-defined variable. When an entity arrives at an Assign module, the assignment value or state is evaluated and is assigned to the variable or resource specified.

(d) Count Module: Count module helps in counting the number of entities arriving in the model and also counts the number of rejected users. When an entity arrives at the Count module, the counter is changed by the increment value specified. The final value of a count is presented as part of the simulation output at the end of each replication.

(e) Signal Module: “The Signal module sends a signal value to each Wait module in the model and releases the maximum specified number of entities”[11]. Once the signal code is sent the wait module receives the signal and starts processing the entities.

(f) Wait Module: The Wait module holds an entity until a signal is received. Entities arriving at the Wait module are placed in a queue, if specified, until a signal sent by a Signal module is received. After receiving the signal it releases the entities.

(g) Assign Module: The Assign module helps in evaluating the state of entities arriving and assigning them to the resource specified.

(h) Scan Module: The Scan module helps in placing conditions on the entities that arrive, only if the condition is satisfied entities are allowed to proceed.

(i) Release Module: The Release module is used to release units of a resource that an entity previously has seized. The Release module may be used to release individual (simple) resources or may be used to release resources declared in a set.

(j) Depart Module: Depart module helps to collect statistics about all the stations and then disposes the entity from the model. It does the function of Enter, Count, Tally, and Dispose by combining in to one module.

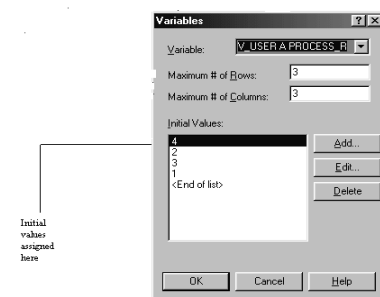


Figure 3: Variables in ARENA with initial values.

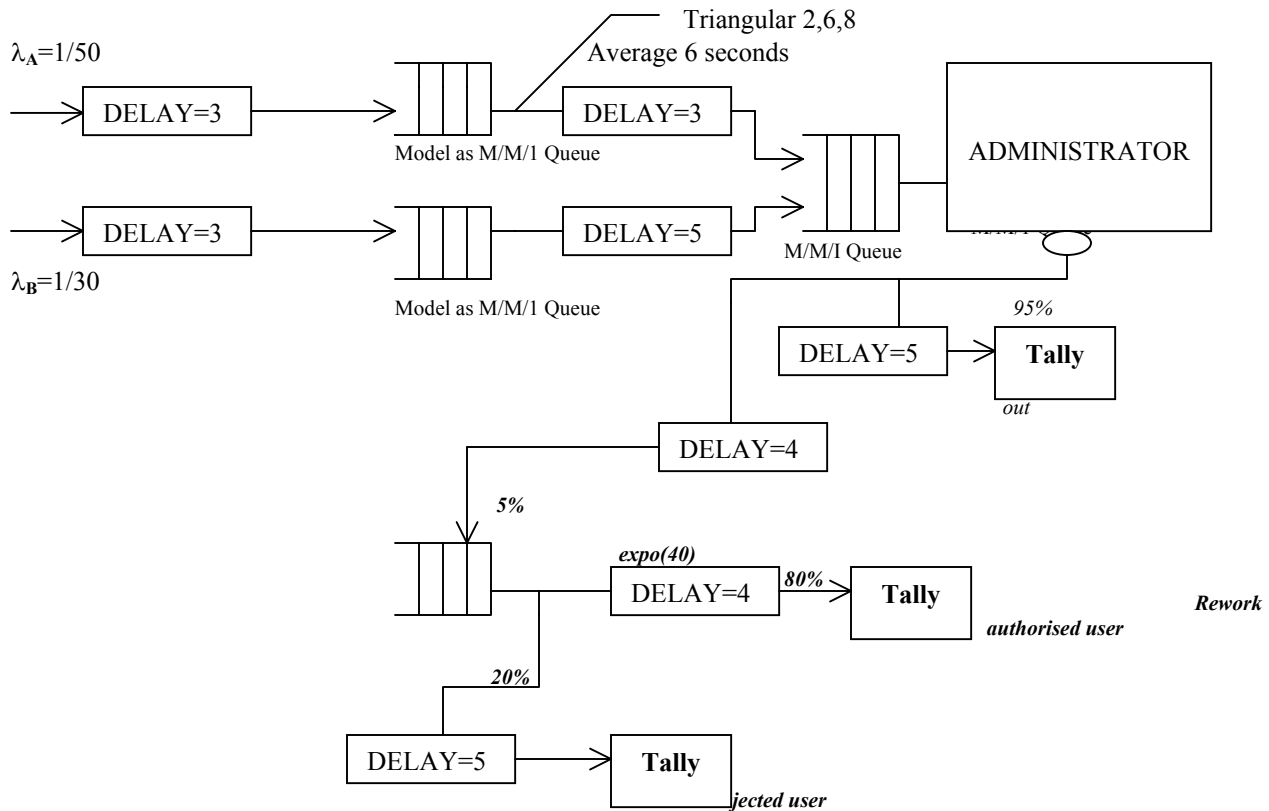


Figure 4: Analysis Model for the Verification of Simulation Results[9]

5. A Simple Queueing Analysis for the Verification of Simulation Results

The simulation model used 5000 seconds. The analysis model is shown in Figure 4. This model uses simple averages, over 5000 seconds for the simulation to generate 100 User A's (5000/50) and 166 User B's (5000/30). Of all the User A's that manage to propagate through the queue, 95% will experience a propagation delay of $3+3+5=11$ seconds (not the total delay, as the second queue has a utilisation greater than one). User B entities, are a different matter. Here the arrival rate is, on average (Poisson process), one entity every 30 seconds. The service rate of the queue is also, on average, 30 seconds. This queue will therefore have a utilisation equal to one. The queue for the Administrator will have the contributions of User A and User B pushing its utilisation greater than one. Thus it is expected that these two queues would start to grow without bound. We can thus say, that on average a User A or User B entity will be sent to the next process every 30 seconds (the average service time of an entity in service at the Administrator queue). This system should reach steady state quite quickly, so we can say that the queue produces a packet every 30 seconds after the propagation delay of the shortest packet (here most likely a User A packet with the first entity taking about 12 seconds). Thus from about the 42 second onwards the Administrators queue should produce an entity every 30 seconds, on average. Thus during the simulation the Administrator should produce about 166 entities. Due to

further propagation delays not all of these will be processed by the time the simulation finishes (with ARENA you can wait till all entities are processed but this was not done for the simulation). It is highly likely that two or more entities will still be in the pipeline and / or rework queue (which adds an average delay of 41 seconds). Thus, about 160 entities will proceed to one of the Tallies through the queue. Of these 160 entities, the Administrator will accept 95% or 152. The measured simulation value from Table 2 to the OUT_C Tally is 150. This shows good agreement with this simple analysis. The other 5% or 8 entities are sent through the pipeline (suffering a further propagation delay of 5 seconds before arriving at the Rework queue) to be processed. It takes, on average 41 seconds for the rework to occur. At this queue 80% or 6 entities are sent onto the Authorised User Tally. This shows good agreement with the AuthorisedUser_C Tally, which measured 7 entities in this category. The last 2 entities are unauthorised and suffer another propagation delay of 5 seconds before being tallied. The simulation showed a UNAUTHORIZED_USER_C tally of 2 entities which agrees with the calculated value.

| Identifier | Count | Limit |
|---------------------|-------|----------|
| Rejected user_C | 8 | Infinite |
| enter_the_model_C | 4929 | Infinite |
| UNAUTHORIZED USER_C | 2 | Infinite |
| Depart 5_C | 7 | Infinite |
| OUT_C | 150 | Infinite |
| AuthorizedUser_C | 7 | Infinite |

Table 2: Simulation Results for user usage level and authentication

| Identifier | Count | Limit |
|--------------|-------|----------|
| station2_C | 6 | Infinite |
| station3_C | 6 | Infinite |
| exitsystem_C | 1 | Infinite |
| station1_C | 6 | Infinite |

Table 3: Simulation Results for availability of network resource

Clearly, some discrepancies do occur in the simulation results due to warm-up period and replication length. Thus, the theoretical and simulation results are verified through very simple queueing analysis [9][12].

6. CONCLUSION AND FUTURE WORK

To familiarize with SNMPv3 and its characteristic for network management is usually seen as a complex task. But ARENA simulation software could become a useful tool to understand the basics of any network management. A simulation model has been created to represent SNMPv3 Traffic Flow Meter characteristics. This simple model can be used to estimate traffic flow characteristics like packet arrivals, availability of network resources and authentication and privacy of users[10]. This definitely is a new and simple alternative approach to study network management protocols. It is also possible to verify simulation results by using simple queueing theory principles and therefore the validity of the results achieved is extremely reliable. The need for policy based network management that helps network administrators to set policies and effectively manage network resources has been identified. The simulation model developed also helps us to understand the importance of policies which determine who will have access to network resources and when those resources will be available. More detailed research about ARENA and how it could be used to model a policy based network management that would allow efficient usage of

network resources by having user usage level identification and improved bandwidth management would be interesting to work on in the future.

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