AINE ADVANCED IP NETWORK EMULATOR

Satellite communications, earth observation, navigation and positioning and control stations

Indra reserves the right to modify these specifications without prior notice.

**Highlights**

- Modular design based on blocks with well defined input/output interfaces.
- Distributed architecture: complex models can be easily distributed into several hardware platforms.
- Extensive library of functional blocks available to build network models: delay, queues, bottlenecks, BER...
- Flexible and extensible: new emulation model blocks can be included in the library.
- Portability: implementation that allows efficient use of multiprocessor platforms.
- Includes specific DVB-S/RCS networks impairments and protocols emulation.
- Runs on GNU/Linux x86 platforms.
- Remote configuration, monitoring and control through Java based GUI and XML configuration files.

**AINE characteristics**

- Plot monitoring results in real-time.
- Times of emulation events and alarms.
- Flexable storage of monitoring results to files.
- AINE is available at three different editions: Entry, Pro and Lab, with engineering and technical support services.

**Extensible and feature-rich blocks library**

- Generic packet handling blocks.
- Traffic classifier, ToS marker, TTL decrement, traffic conditioning blocks (token bucket), PFC (priority), leech, rate and packet error rate, bandwidth limitation (leaky bucket) and queuing emulation.
- Network monitoring blocks.
- Bandwidth and speed interfaces.
- Platform scalable from 8 kbps to 10 Gbps.
- GNU/Linux kernel 2.6 x86.
- Java-based GUI.
- XML files.
- C/C++.
- IP, Ethernet.
- Native POSIX Threads Library (NPTL).
- Scalable.
- Distributed.
- Internal: UDP/IP with configurable profiles.
- External: end-user applications and bulk traffic generation tools: iperf...
- Emulator timers resolution: 1 ms (Linux kernel resolution).
- Number of results per graph: Scalable.

**Extensible and rich functional blocks library**

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AINE ADVANCED IP NETWORK EMULATOR

The advantage to know the performance of real applications over an IP network before launch

Overview

The real network is modeled through a set of connected emulation blocks that pass packets from one to another introducing specific impairments or measuring certain parameters, e.g., bandwidth, delay, queue sizes...

Emulation models are based on a set of KOC and are remotely, interactively and controlled from any standard PC, using a Java-based client GUI.

Success stories

Success stories I

AIME was used to emulate AmerHis system C2P, dynamic bandwidth allocation and packet prioritization to allow in-factory evaluation of the impact of dynamic bandwidth assignment techniques in the services offered by Indra AmerHis gateway: Internet access (web browsing) and VoIP.

Success stories II

The AIME modelled the DVB-S/S2 system and all DAMA related aspects of the DVB-S/RCS system with one DVB-S Hub and up to 51 terminals. The network model was executed on a standard PC and the tests to the forward link.

Success stories III

The AINE provided in-depth validation of the proposed cross-layer techniques and algorithms. AINE was used to verify the performance of new algorithms in realistic conditions.

Introduction

New applications and communications services deployed nowadays are more and more within the so-called "multimedia and IP technology" concept. That paradigm implies using the same network layer (IP) for all types of communications: data, voice and video.

Emulation at IP layer is a very cost effective way to validate applications performance via satellite. Therefore, at the end of the network design or before launching the system, an IP network emulator allows to test, analyze, refine and optimize the IP behavior within the satellite network.

Applications

Advantages

- Cost-effective validation of application performance
- Real-time simulation of network behavior
- Testing and optimization of network protocols
- Evaluation of network performance under various conditions
- Testing of new applications and services

Disadvantages

- Limited to IP networks
- May not accurately simulate real-world network behavior

Use cases

- Testing and validation of new applications
- Optimization of network protocols
- Testing network performance under different conditions
- Preparing for real-world deployment

Applications

- Interactive broadband DVB-S/RCS OBP communication system (AmerHis)
- IP-friendly cross-layer optimization of adaptive satellite systems (xLayer)

Success stories

- AIME was used to emulate AmerHis system C2P, dynamic bandwidth allocation and packet prioritization to allow in-factory evaluation of the impact of dynamic bandwidth assignment techniques in the services offered by Indra AmerHis gateway: Internet access (web browsing) and VoIP.
- The AIME modelled the DVB-S/S2 system and all DAMA related aspects of the DVB-S/RCS system with one DVB-S Hub and up to 51 terminals. The network model was executed on a standard PC and the tests to the forward link.

Additional information on the usage of AINE at AQS and in other ESA projects available at: https://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=28656
**Introduction**

New applications and communications services and protocols are more and more within the so-called "multimedia and IP technology" concept. That paradigm implies using the same network layer (IP) for all types of communications: data, voice, and video.

Emulation at IP layer is a very cost effective way to validate applications performance via satellite. Therefore, it is the final parameter to be studied before the actual system is deployed. Simulating the bandwidth, delay, queue sizes, and packet losses of real satellite networks can be done using a network emulator.

**AINE ADVANCED IP NETWORK EMULATOR**

The advantage to know the performance of real applications over an IP network before launch.

**Overview**

The real network is modeled through a set of connected simulation blocks that pass packets from one to another introducing specific impairments or measuring certain parameters, e.g., bandwidth, delay, queue sizes.

Emulation models can focus on a set of KPIs and be remotely instantiated and controlled from any standard PC, using a Java based client GUI.

**Success stories I**

AINE was used to emulate AmerHis C2P, dynamic bandwidth allocation and packet prioritization to allow in-factory evaluation of the impact of dynamic bandwidth assignment techniques in the services offered by the Indra AmerHis gateway: Internet access (web browsing) and VoIP.

**Success stories II**

AINE modelled the DiffServ architecture and all DAMA related aspects of the DVB-S2 system with up to 51 terminals. The network model was executed on two dedicated servers and the results confirm the forward link.

**Success stories III**

The emulation provided in-depth validation of the proposed cross-layer optimization techniques and algorithms. AINE was used to verify the performance of new algorithms in realistic conditions.

**Applications layer QoS in DVB-S/RCS systems (AQoS)**

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=27802

The objective of this project was to provide an overall network performance characterization of DVB-S2 and DVB-RCS downlink for a transparent system. Several mappings between DVB-S2 services (types A, B, and C) and DVB-RCS service types were evaluated.

**Applications layer QoS in DVB-S/RCS systems (xLayer)**

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=28656

The goal of the project was to investigate how cross-layer information can help upper layers to take advantage the adaptive physical layer present at DVB-S2. AINE was used to evaluate the different proposed techniques with real TCP/IP protocol stacks.

**Interactive broadband DVB-S/RCS OBP communication system (AmerHis)**

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=7923

AmerHis gateway terminals were used to validate AmerHis system with dynamic bandwidth allocation and packet prioritization to allow in-factory evaluation of the impact of dynamic bandwidth assignment techniques in the services offered by the Indra AmerHis gateway: Internet access (web browsing) and VoIP.
Introduction

New applications and communications services design and development are more and more within the so-called "multimedia and IP technology" concept. The paradigm implies using the same network layer (IP) for all types of communications: data, voice and video. Emulation at IP layer is a very cost-effective way to validate applications performance via satellite. Therefore at the final development stage it is realistic to test the application behavior and its performance at lab, thus allowing to avoid unforeseen and unwanted behaviors of real satellite networks.

Applications 

The advantage to know the performance of real applications over an IP network before launch.

Success stories I

AINE was used to emulate AmerHis 'C2P' system. Dynamic bandwidth allocation and packet prioritization to allow in-factory evaluation of the impact of dynamic bandwidth assignment technique in the services offered by Indra AmerHis gateway: Internet access (web browsing) and VoIP.

Success stories II

AIME modelled the DiffServ architecture and all DAMA-related aspects of the DVB-S/RCS system with one DVB-S Hub and up to 51 terminals. The network model was executed on a desktop PC and allowed to test the forward link.

Success stories III

AIME was used to evaluate AmerHis 'C2P' dynamic bandwidth allocation and packet prioritization. The modem was executed on a dedicated dual processor server. AINE allowed the client to test a new architecture and to evaluate the expected QoS.
Indra reserves the right to modify these specifications without prior notice.

**AINE**

**ADVANCED IP NETWORK EMULATOR**

**Highlights**
- Modular design: based on blocks with well defined input/output interfaces.
- Distributed architecture: complex models can be easily distributed into several hardware platforms.
- Extensive library of functional blocks available to build network models: delay, queues, bottlenecks, BER...

**AINE characteristics**
- Extensible and feature rich blocks library
- Satellite networks specific blocks
- Generic packet handling blocks
- Network monitoring blocks
- Extensible and feature rich blocks library

**Extensible and feature rich blocks library**
- Generic packet handling blocks:
  - Traffic classifier: filter traffic, FLOW, fragment, traffic conditioning blocks (token bucket, FIFO, store delay, store and queue, random packet dropping, leaky bucket) and queueing.
- Network monitoring blocks:
  - Bandwidth probe, packet time stamping and packet delay metering.

**Summary**
- Indra reserves the right to modify these specifications without prior notice.
- AINE is available at three different editions: Entry, Pro and Lab, with engineering and technical support services.
- AINE can be executed on customer hardware or remotely accessed to Indra Data Center.

**Characteristics**
- Scalable:
  - Bandwidth and speed:
  - Interfaces:
  - Platform:
  - Monitoring and control:
  - Configuration:
  - Traffic generation:
  - Network monitoring:

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**Highlights**

- Modular design based on blocks with well defined input/output interfaces.
- Distributed architecture, complex models can be easily distributed into several hardware platforms.
- Extensive library of network blocks available to build network models: delay, queues, buffers, bandwidth, etc.
- Extensible and customizable: new emulation model blocks can be included in the library.
- Platform independent implementation that allows efficient use of multiprocessor platforms.
- Includes specific DVB-S/RCS networks impairments and protocols emulation.
- Runs on GNU/Linux and Windows platforms.
- Remote configuration, monitoring and control through user-based GUI and XML configuration files.

**AINE characteristics**

**Interfaces**

- Serial (Ethernet) non-blocking multi-threaded.
- User space: RDRAM, 1GB internal.
- Network: Ethernet 10/100/1000/10G.
- Processor: Intel Xeon 3.6GHz.
- Operating system: GNU/Linux (Debian).

**Modular design**

- Distributed architecture: complex models can be easily distributed into several hardware platforms.

**Extensible and feature-rich blocks library**

- Satellite networks specific blocks:
  - L2 emulation: encapsulation of IP packets into lower layer MPEG and ATM cells.
  - DAMA algorithms: emulation of terminal logon and logoff process. DAMA Agent and DAMA Controller messages exchange and terminals dynamic bandwidth assignment emulation.

**Generic packet handling blocks**

- Traffic classifier, ToS marker, TTL decrement, traffic conditioning blocks (token bucket), FIFOs, delay on error rate and packet error rate (bursty) and packet-owning emulation.

**Network monitoring blocks**

- Bandwidth probe, packet time stamping and packet delay monitoring.

**Applications**

- Telecommunication: for network planning, capacity planning and network optimization.
- Satellite communication: for system integration and interference analysis.
- Transport: for congestion control and network management.
- Mobile: for call admission control and traffic engineering.

**AINE characteristics**

- Ethernet in promiscuous mode.
- Host scalable from 8 kbps to 10 Gbps.
- GNU/Linux kernel 2.6 x86.
- Java-based GUI.
- XML files.
- C/C++.
- IP, Ethernet.
- Native POSIX Threads Library (NPTL).
- Distributed.
- Internal: UDP/IP with configurable profiles.
- External: end-user applications and bulk traffic generation tools: iperf.

- Emulator timers resolution: 1 ms (Linux kernel resolution).
- Scalable.

**Constraints**

- Network bandwidth and speed:
  - Interfaces:
    - Platform:
      - Network:
        - Processing speed: x86.
  - Protocols:
    - IP, Ethernet.
  - Emulator programming language (core):
    - C/C++.
  - Protocols supported: Ethernet, ATM, IP, TCP, UDP, ICMP.
  - Monitoring and control:
    - Java-based GUI.
  - Configuration:
    - User space.
  - Traffic generation:
    - Internal UDP/IP with configurable profiles.
    - External end-user applications and bulk traffic generation tools: iperf.

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