LIP Laboratory
ENS-Lyon - France

Session Awareness Issues for Next Generation Cluster based Network Traffic Load Balancing Frameworks

Narjess Ayari, Denis Barbaron, FT R&D – LANNION, France

Laurent Lefèvre, Pascale Primet, INRIA / LIP, France

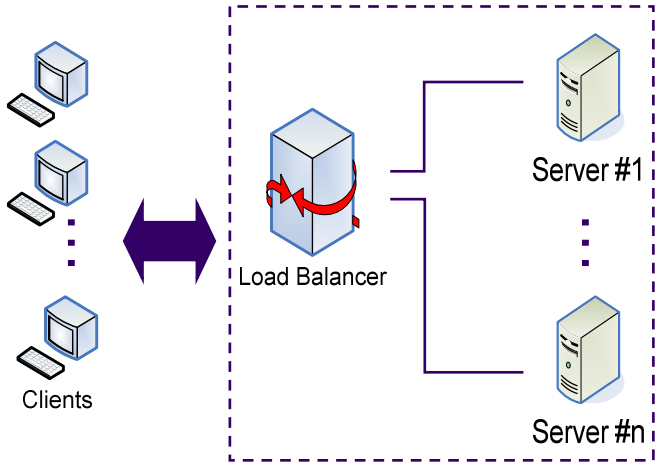
The fifth ACS/IEEE International Conference on Computer Systems and Applications
AICCSA 2007 – Amman, Jordan, May 13-16, 2007

Agenda

- Context
- Network traffic load balancing
- Session aware network traffic load balancing
- The requirements of NGN cluster based load balancing frameworks
- Conclusion & perspectives

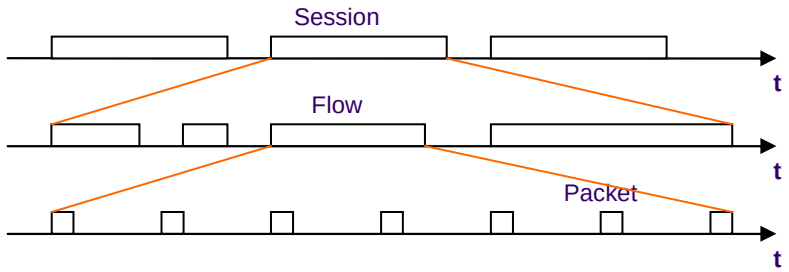
Context 1/2

- **Clusters are a set of networked servers which**
  - Offer the same single system image to clients while providing additional processing capabilities
  - Improve the scalability and the availability of the rendered service
- **Operators are replacing single servers by clusters of servers**



Context 2/2

- How to efficiently spread the offered network traffic in a cluster of servers while preventing the interruption and the QoS degradation of the rendered service?
- A special focus on the requirements of multiple flow based sessions
  - A session is defined as an association between two communicating end points
  - It can span over single or over multiple flows
    - NGN services
      - *Video streaming, Voice over IP, etc.*
    - Familiar services
      - *File transfer, etc.*



Network traffic load balancing

The approaches 1/2

Stateless versus stateful engines

- Stateless
  - Less latency versus
    - *Unfair throughput*
    - *Unavailability and session unawareness*
- Statefull
  - More resource consuming (memory & CPU) versus
    - *Means to achieve fairness and session awareness while distributing the offered traffic*
    - *Means to detect and react to failures*

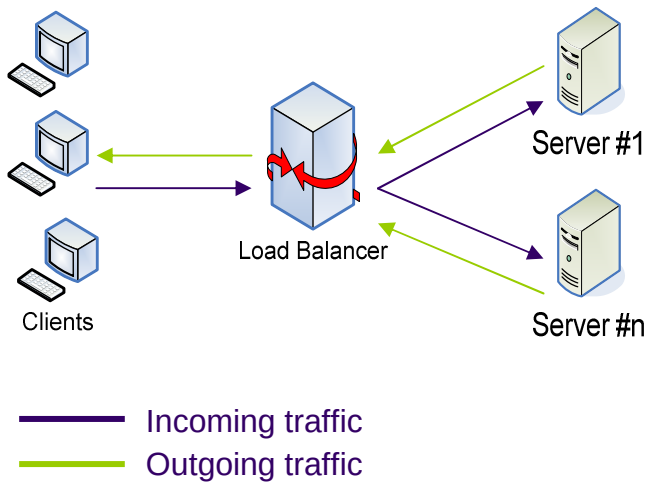
Network traffic load balancing

The approaches 2/2

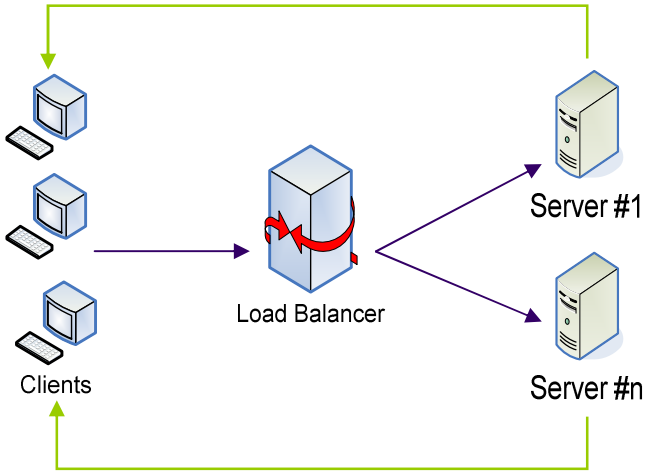
One way versus two way based architectures

- Limited throughput and scalability issues when wasting the cluster entry point resources with the processing of the outgoing traffic

Two way architectures



One way architectures



Network traffic load balancing

The mechanisms 1/8

Network traffic load balancing falls into

- Flow aware engines
  - Provides flow level integrity
    - *Packet double rewriting*
    - *Packet forwarding*
    - *Packet tunnelling*
- Application aware engines
  - Uses DPI to provide application level integrity
    - *TCP Gateway*
    - *TCP Splicing variants*
    - *TCP handoff variants*

Network traffic load balancing

The mechanisms 2/8

Packet double rewriting

- NAT like operations
- Assumes that the cluster head as well as the cluster nodes share the same private network
- Suffers performance limitations
  - Scalability
- due to
  - The double processing overhead
  - Two way architecture based

Network traffic load balancing

The mechanisms 3/8

Packet forwarding

- Performs a link layer encapsulation of each incoming datagram
- The outgoing traffic will be directly forwarded to the clients
- Applies only to servers clustered within the same local network
- Assumes that the dispatcher statically maintains in-cluster ARP associations

Network traffic load balancing

The mechanisms 4/8

Packet tunneling

- Assumes that the entry point to the cluster as well as each node within the cluster supports tunneling
- Performs a network level encapsulation of each incoming datagram
- Applies to servers networked in different LANs
- Assumes that the entry point to the cluster as well as each node within the cluster supports tunneling

Network traffic load balancing

The mechanisms 5/8

Application level load balancing involves more steps

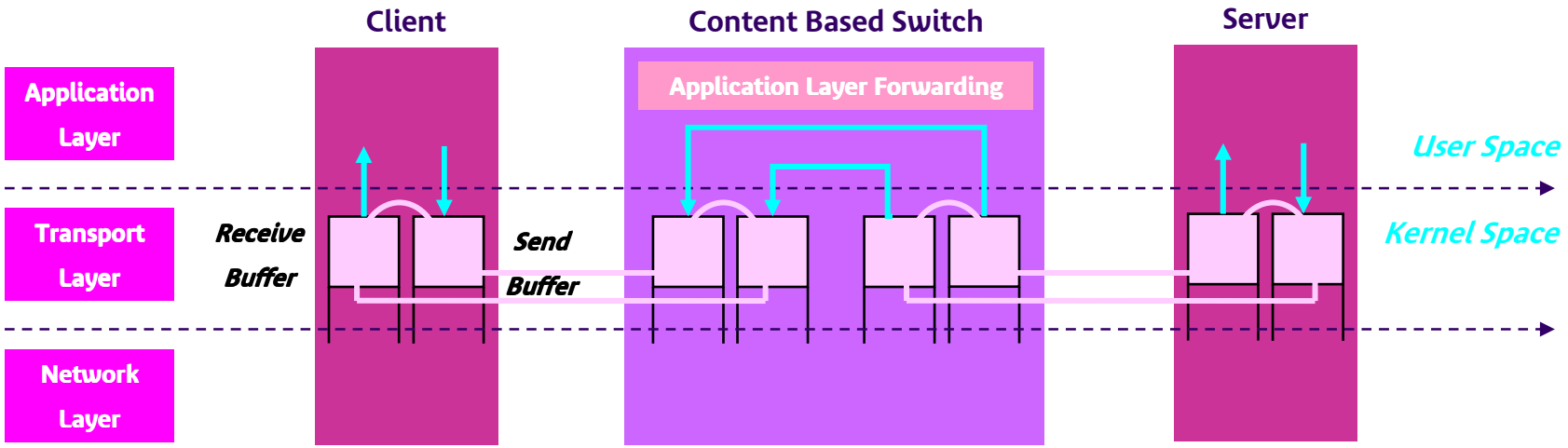
- The traffic is forwarded in almost four steps
  - A connection between the client and the dispatcher is first established
  - Data is buffered for content inspection
  - Session states are established or updated
  - A cluster node is chosen and the traffic is forwarded to that node

Network traffic load balancing

The mechanisms 6/8

TCP Gateway

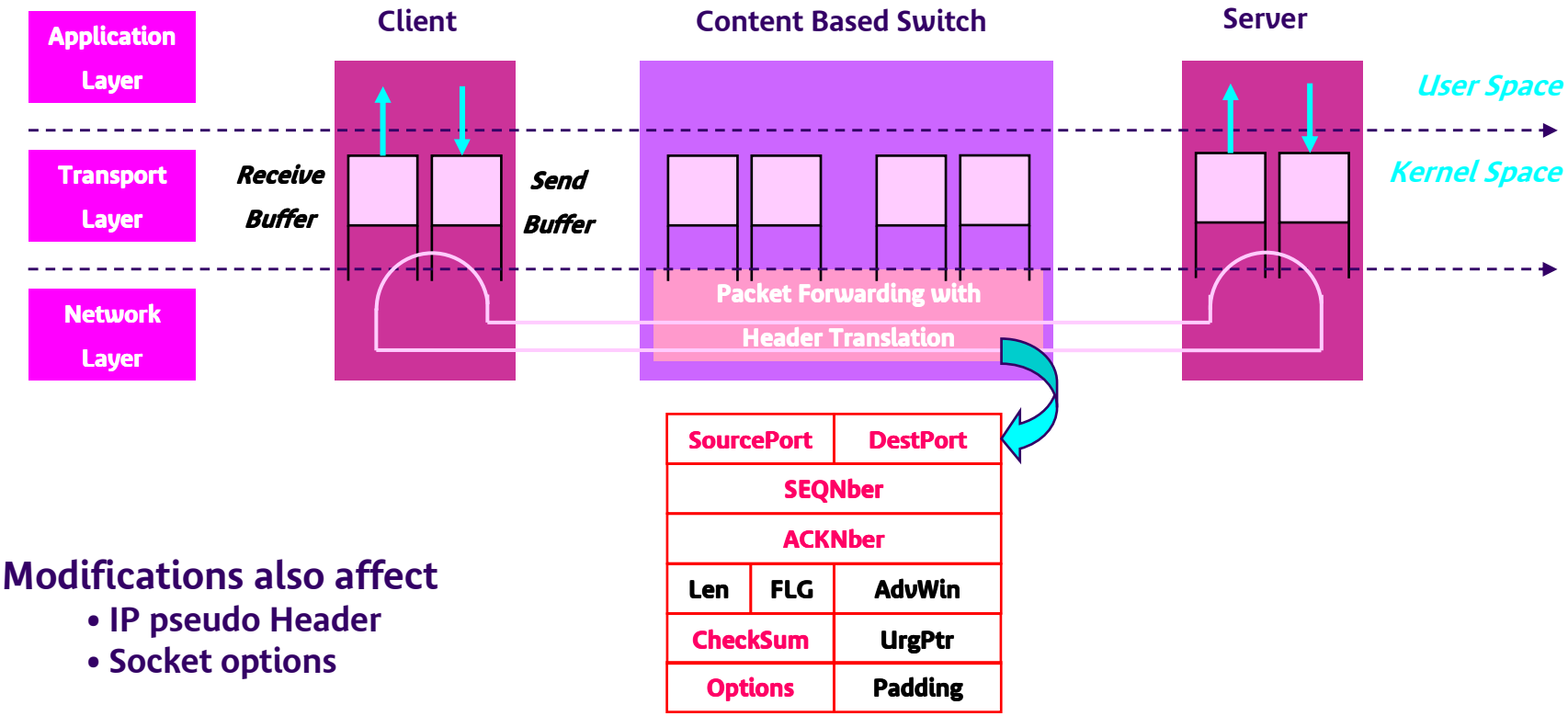
- Cost effective
  - Multiple copies and context switching



Network traffic load balancing

The mechanisms 7/8

TCP Splicing



- Modifications also affect
  - IP pseudo Header
  - Socket options

Network traffic load balancing

The mechanisms 8/8

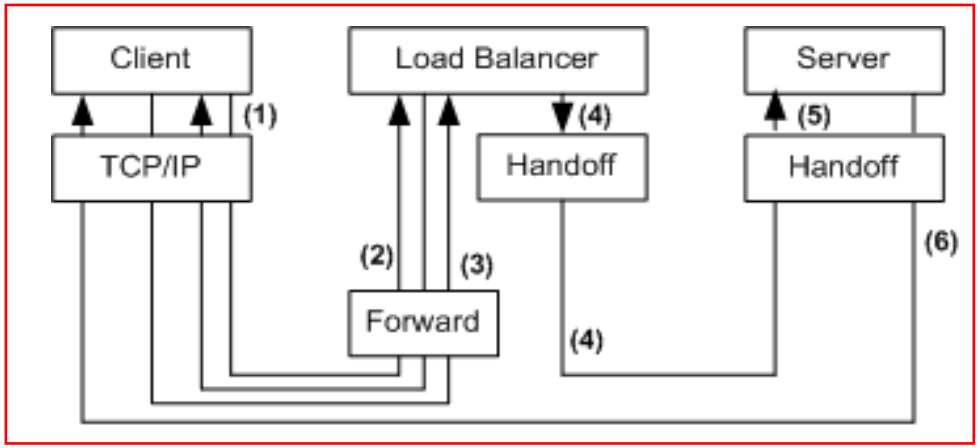
TCP handoff

- Migrates the TCP connection from the front end to the back-end node using a Handoff protocol

Magic Nber	ConnMagic
Conn_Info	

Magic Nber	ConnMagic
Ack Msg	

– *The connection is created at the node without going through the three Way handshake procedure.*



Why session aware network traffic load & balancing?

The session integrity issue

- Recalling that user level sessions can span over multiple flows
  - How to apply the same processing to flows pertaining to the same session?
- Basic transport level load balancing fails to achieve session integrity for multiple flow based services
  - Client persistency can 'force' session integrity but leads to unbalanced resource allocation among the cluster nodes

How do DPI helps in achieving session awareness

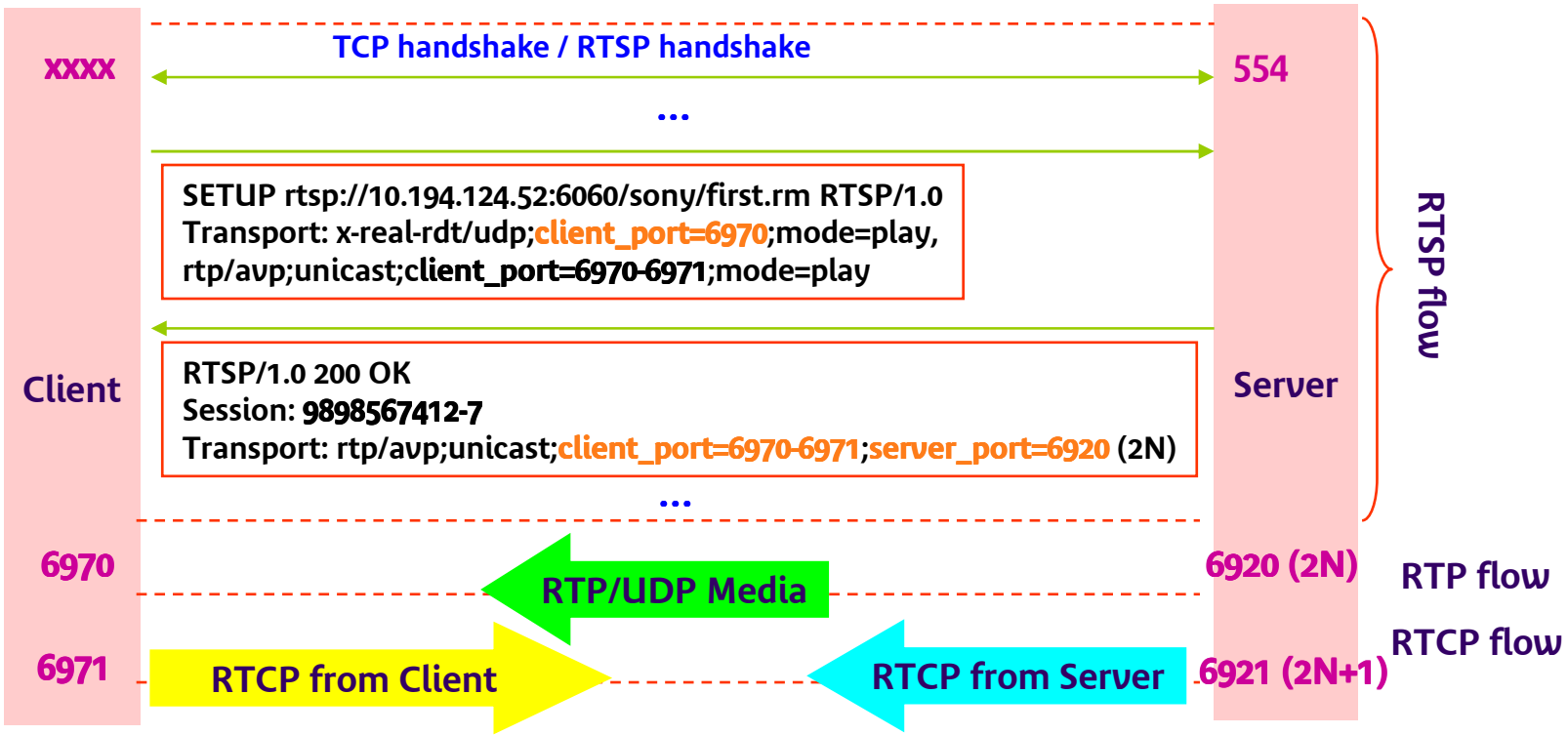
A unicast streaming media use case

Can be built upon an RTSP/RTP/RTCP association

- RTSP is used to establish the signaling flow
  - Control commands (DESCRIBE, SETUP, PLAY, TEARDOWN, etc.) are transported over the RTSP channel
  - The media flow identifiers are negotiated on the control channel
- RTP and RTCP are used for the data and control data exchange

DPI for session awareness

A unicast streaming media use case



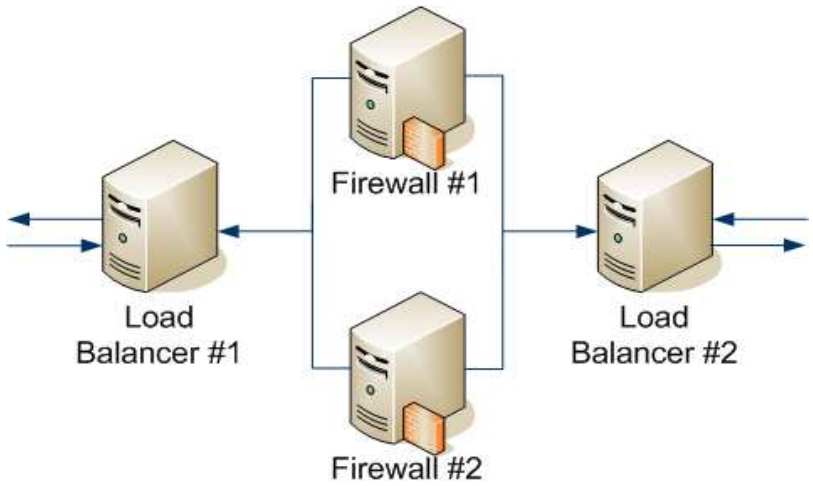
DPI for NAT & firewall traversal

NAT traversal issues

- How to scale servers when clients or servers are behind NAT devices?

Firewall traversal issues

- How to scale firewalls while avoiding the interruption of the legitimate sessions?
  - Involved flows use non standard ports



The requirements of NGN cluster based load balancing frameworks

- **Performance**
  - Improved throughput in terms of number of sessions completed per unit of time
  - Improved scaling factor inside the cluster
    - The system throughput grows as a function of the number of the processing servers inside the cluster
- **High availability**
  - The continuous processing of
    - the new incoming sessions
    - the already established sessions

  in case of failure of
    - the legitimate entry point to the cluster
    - the legitimate processing server inside the cluster

Key features for NGN C-LB Frameworks

- **Adaptive and session aware processing of the offered network traffic to the cluster of servers**
  - Awareness of the usage and availability of the cluster resources
  - Awareness of the session level constraints for any processing of the offered network traffic
    - Load balancing
    - Admission control
    - High availability
    - etc.

Conclusion and Perspectives

- We questioned the appropriateness of flow aware load balancing in a cluster of servers
- We stated the requirements of NGN cluster based load balancing architectures in terms of
  - Performance
  - High availability
- We proposed an NGN architecture of IP traffic offered to a cluster of servers
  - Adaptive and session aware processing (European PATENT)
  - Provides means to avoid the interruption of the already flows when the legitimate server goes down (European PATENT)
- Our short term objectives focus on
  - Evaluating the session aware processing provided within this framework
    - Admission control,
    - Load balancing,
    - High availability.

Thanks

Any Questions?

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