High Availability for the design of stateful networking equipments

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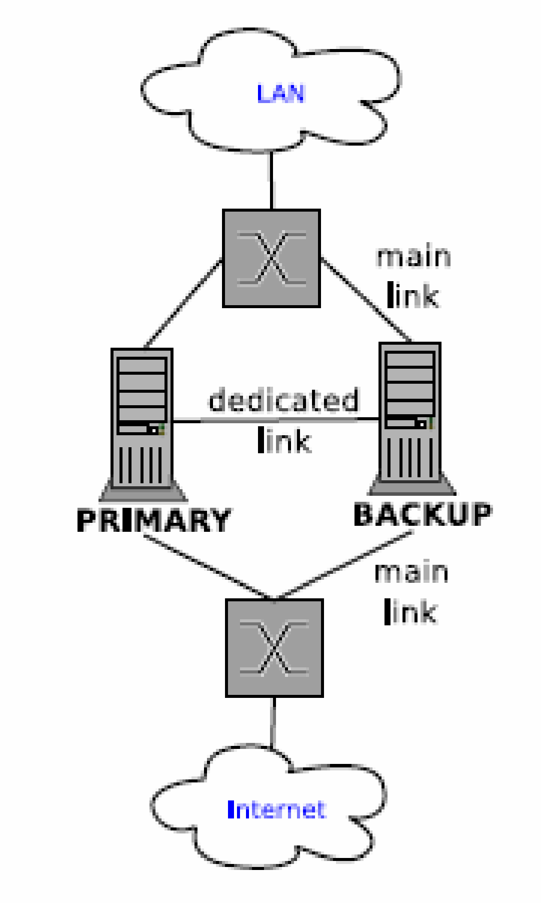
Outlines

- Starting point
- Problems & Limitations
- Example
- Our Contribution: Architecture
- Scenarios
- Conclusions
- Future Works

Starting point

- Networking equipments like routers, firewalls, proxies… introduce Single Point of Failures (SPOF) in the network schema
- High Availability (HA) protocols: redundancy + health checking. They ensure continued working service

Starting point: HA basics



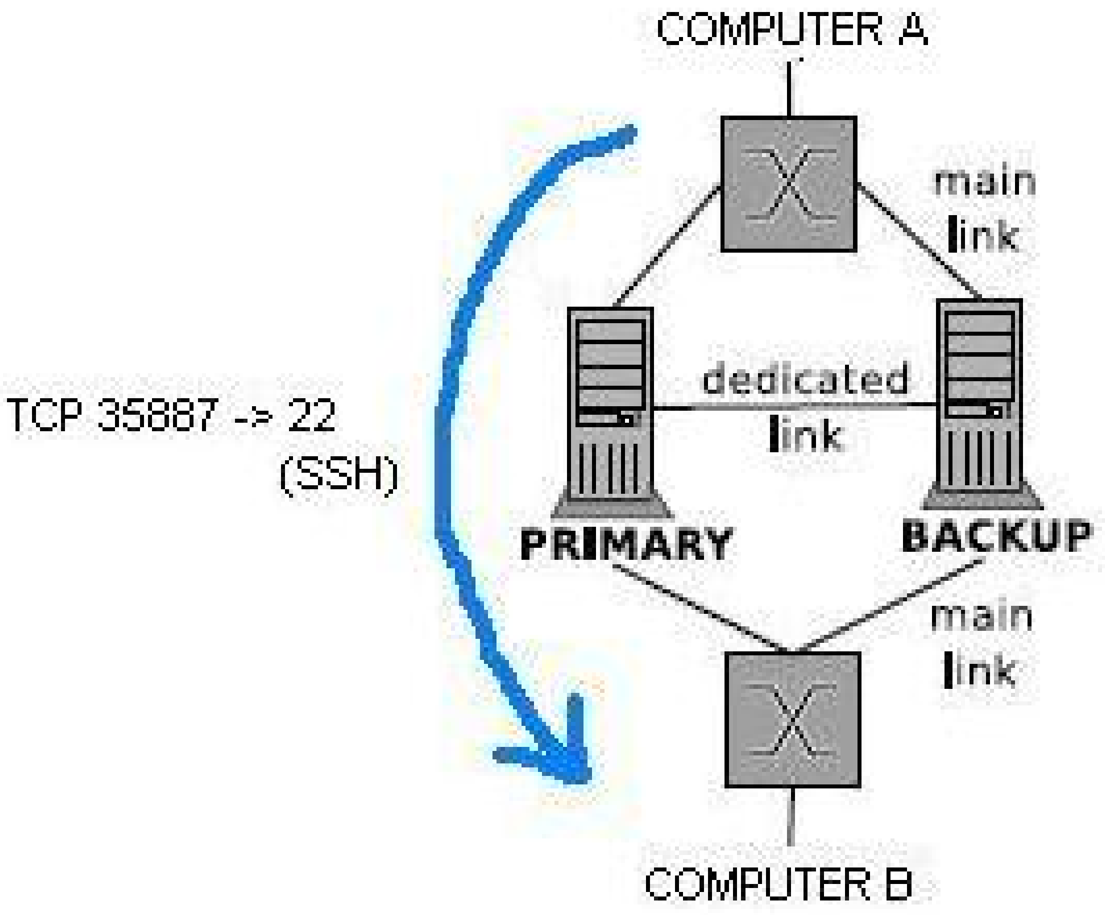
Problems & Limitations

- Current HA protocols are **static**: don’t cover specifical aspects of the running services
- The **dynamic** nature of some services deployed on critical machines makes this approach insufficient

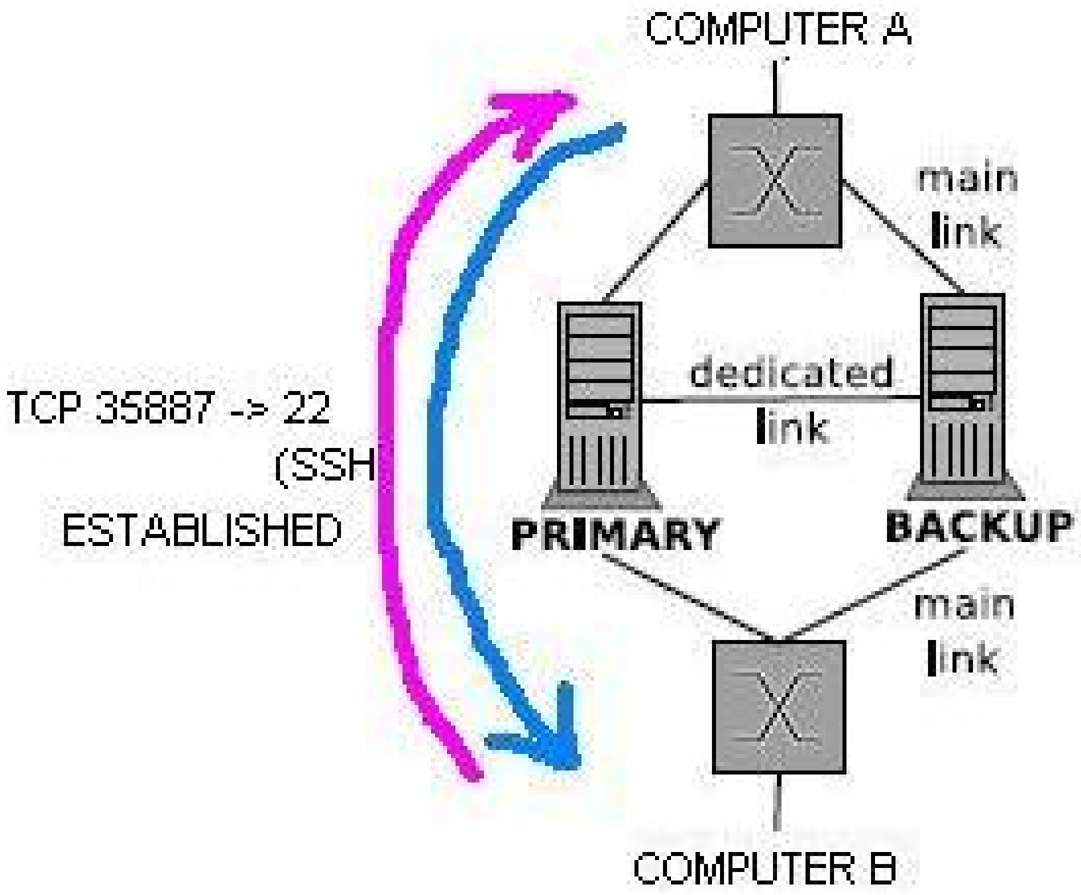
Example

- **Linux Connection Tracking System:** subsystem that keeps in memory information about the state of the connections going through the firewall in order to perform stateful filtering

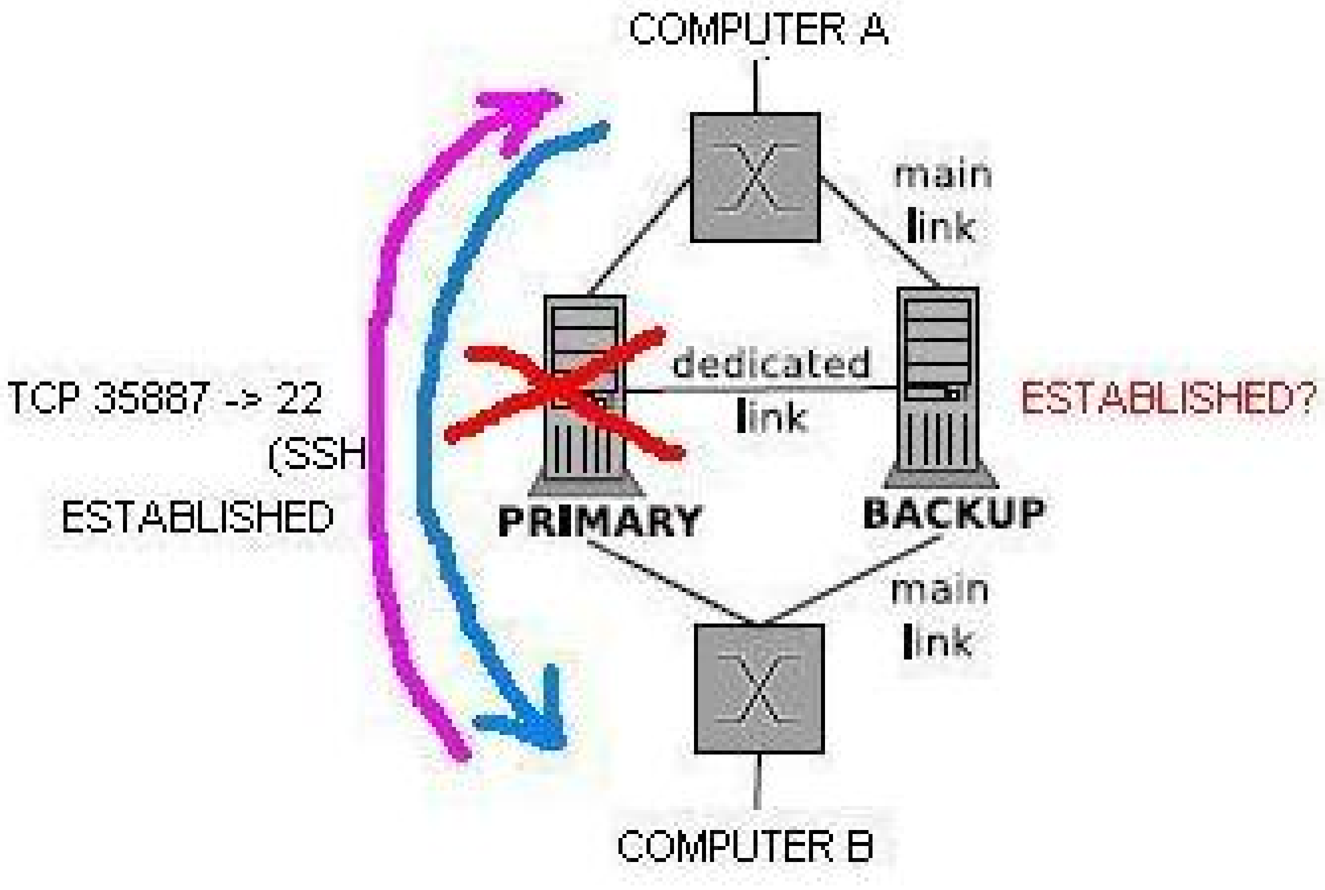
Example


COMPUTER A
main
link
TCP 35887 -> 22
(SSH)
dedicated
link
PRIMARY
BACKUP
main
link
COMPUTER B

Example (2)


COMPUTER A
main link
dedicated link
PRIMARY
BACKUP
main link
COMPUTER B
TCP 35887 -> 22
(SSH
ESTABLISHED

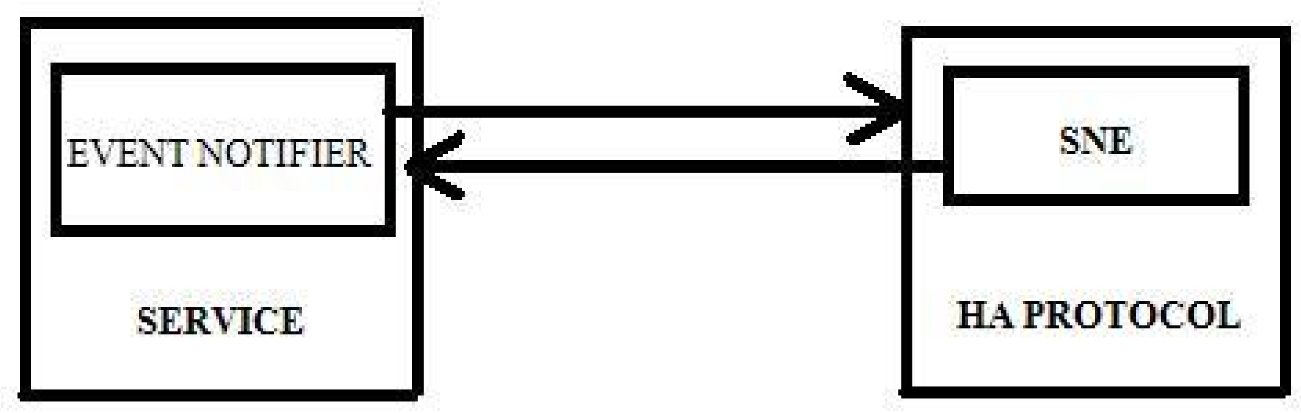
Example (3)


COMPUTER A
main
link
dedicated
link
TCP 35887 -> 22
(SSH
ESTABLISHED
PRIMARY
BACKUP
ESTABLISHED?
main
link
COMPUTER B

Our contribution

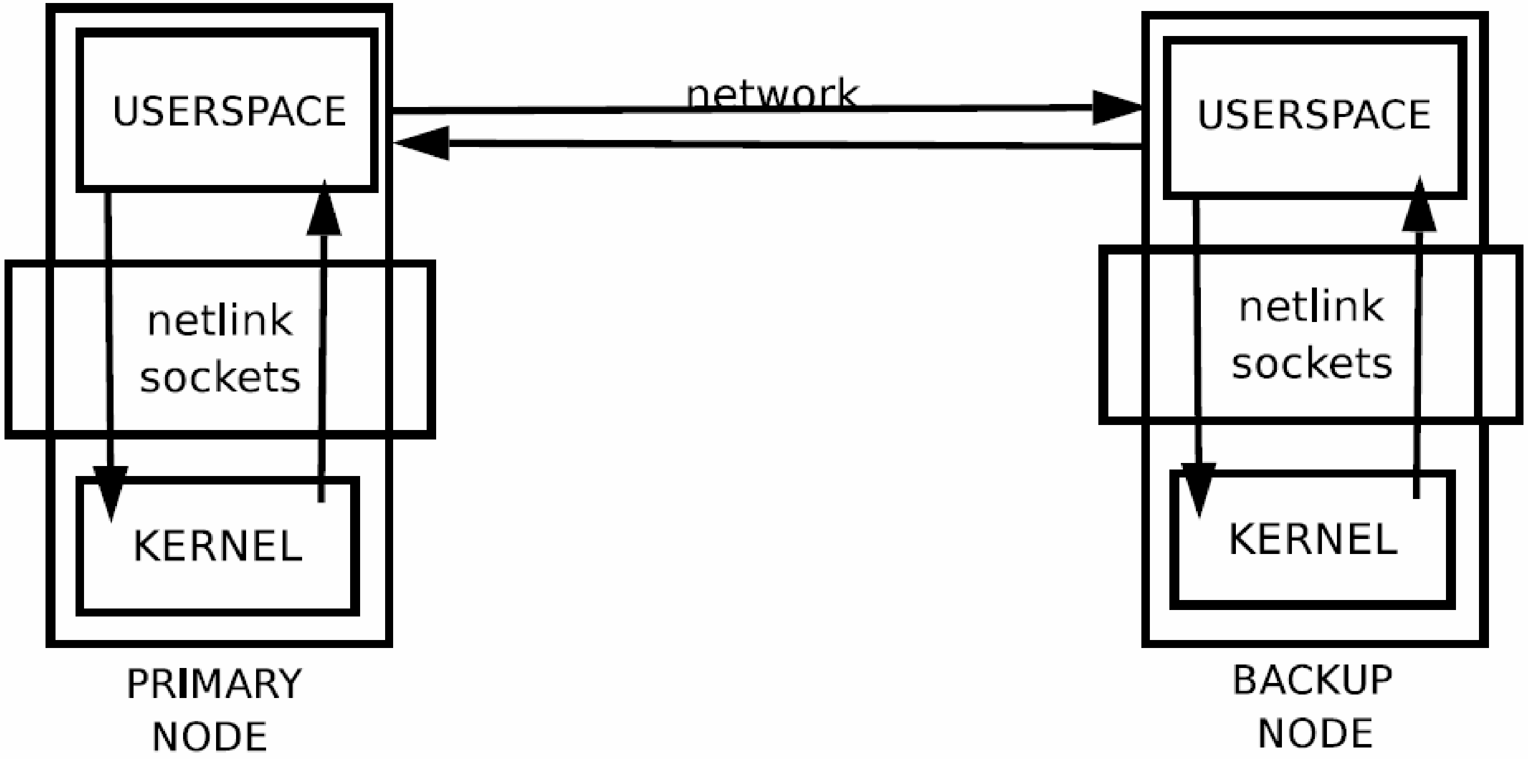
- We define: Architecture to ensure the availability of stateful networking equipments
- We provide: Add-on library (SNE) to extend current HA protocols: it covers the dynamic nature of the deployed services (https://svn.netfilter.org/)

Architecture



- Event Notifier: sends events that can be listened by the SNE library

Architecture



Events

- NEW: it contains information about a new connection that has been established.
- UPDATE : any critical information about a connection have changed
- DESTROY: this event occurs if a connection is closed

Level of event notification

- strong: notifies every update in current connections
- weak: only notifies crucial messages (new, destroy)
- incremental: transfer the messages periodically

Actions

- Set of actions provided by the SNE library (sockets):
  - Create, update and destroy entries that represents a given operation in the current service
  - Restart the service: resynchronization
  - Listen to events

Scenarios

- We solve a set of problematic scenarios:
  - Primary fails
  - Backup node fails and it comes back to life again
  - Backup node fails and remains dead
  - Former primary node comes back to life
  - Backup lost communication with Primary

Conclusions

- HA protocols ensure continued working services but don’t guarantee the success of current operations
- We provide an architecture to extend HA protocols and solve the current limitations
- Experimentation and Evaluation

Future work

- Integration with intelligent equipments: programmable switch, active nodes
- Synchronization protocol
- Active-active settings: resources are scarce
- Scenarios with multiple failures

Questions

Thanks for your attention