MultiPath TCP : Linux Kernel Implementation

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http://mptcp.info.ucl.ac.be
Current situation

- Mobile devices can connect to the Internet via different interfaces
  - 3G
  - WiFi

- Data-centers have a large redundant infrastructure
TCP is used for 95% of the Internet communications
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TCP identifies connections by the 5-tuple
Current situation

- TCP is used for 95% of the Internet communications
- TCP identifies connections by the 5-tuple

A single TCP connection cannot be used across different interfaces.
Mobile devices should connect to the Internet by using all their interfaces.

Data-centers should use their redundant infrastructure in the most efficient way.

Dual-Homed Servers
MultiPath TCP (short MPTCP)

- MPTCP allows a single data-connection to use several interfaces simultaneously.
- Allows failover from one interface to another (e.g., mobile client).
- Increases the bandwidth due to resource pooling.
- Better load-balancing due to fair coupled congestion control.
Linux Kernel MultiPath TCP

- About 10000 lines of code in the Linux Kernel
- Lots of performance evaluation in different research-papers.
- **Live-Demo** of MPTCP at the end of this presentation.
- Implementation freely available at [http://mptcp.info.ucl.ac.be](http://mptcp.info.ucl.ac.be)
MultiPath TCP - The Protocol

Application Layer

standard Socket API

Transport Layer

MultiPath TCP

TCP subflow
TCP subflow
TCP subflow

Network Layer

WiFi
3G
Wired

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Establishing a connection

Application Layer

standard Socket API

Transport Layer

Connection Establishment
Is the Peer MPTCP-Capable?

Network Layer

TCP subflow

Master subsocket
Establishing a connection

MultiPath TCP - The Implementation

- **Application Layer**: standard Socket API
- **Transport Layer**: MultiPath TCP
- **Network Layer**: Creating new subflows

**Master subsocket**
- TCP subflow

**Slave subsocket**
- TCP subflow
- TCP subflow
Sending packets over MultiPath TCP
Receiving packets over MultiPath TCP

![Diagram of MultiPath TCP implementation]

- **Application Layer**: standard Socket API
- **Transport Layer**: Meta-socket, MultiPath TCP
  - **Meta-socket**:
    - send-queue
  - **MultiPath TCP**:
    - receive-queue
    - ofo-queue
- **Network Layer**:
  - **Master subsocket**
    - TCP subflow
    - ofo-queue
  - **Slave subsocket**
    - TCP subflow
    - ofo-queue
  - **Slave subsocket**
    - TCP subflow
    - ofo-queue

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**Webpage**: [http://mptcp.info.ucl.ac.be](http://mptcp.info.ucl.ac.be)
Interconnected testbed with two separate paths at 1Gbps
MultiPath TCP - Performance Results

- Interconnected testbed with two separate paths at 1Gbps
- regular TCP can only use one single path

![Diagram showing MultiPath TCP and regular TCP with transfer size and ratio of requests per second]
Interconnected testbed with two separate paths at 1Gbps
regular TCP can only use one single path
MultiPath TCP uses both paths simultaneously
MultiPath TCP - Performance Results

- Interconnected testbed with two separate paths at 1Gbps
- regular TCP can only use one single paths
- MultiPath TCP uses both paths simultaneously

![Diagram showing performance results of MultiPath TCP vs. regular TCP](image-url)
### Use it!!!

- Compile the source yourself
- or Install from our apt-repository
- or Set it up on a virtualbox-image
- or Use it with user-mode-linux

### Contribute

- Integrate some missing features
- Optimize the code
- Refactoring the code
- Testing
Live-Demo!!!

FOSDEM
WiFi
3G
MPTCP
MPTCP-Proxy
http://mptcp.info.ucl.ac.be
Public Webradio

regular TCP
http://mptcp.info.ucl.ac.be
Download MPTCP, try it out, ask questions on the mptcp-dev list and contribute.

Thanks!!!