Multipath TCP and multipath routing

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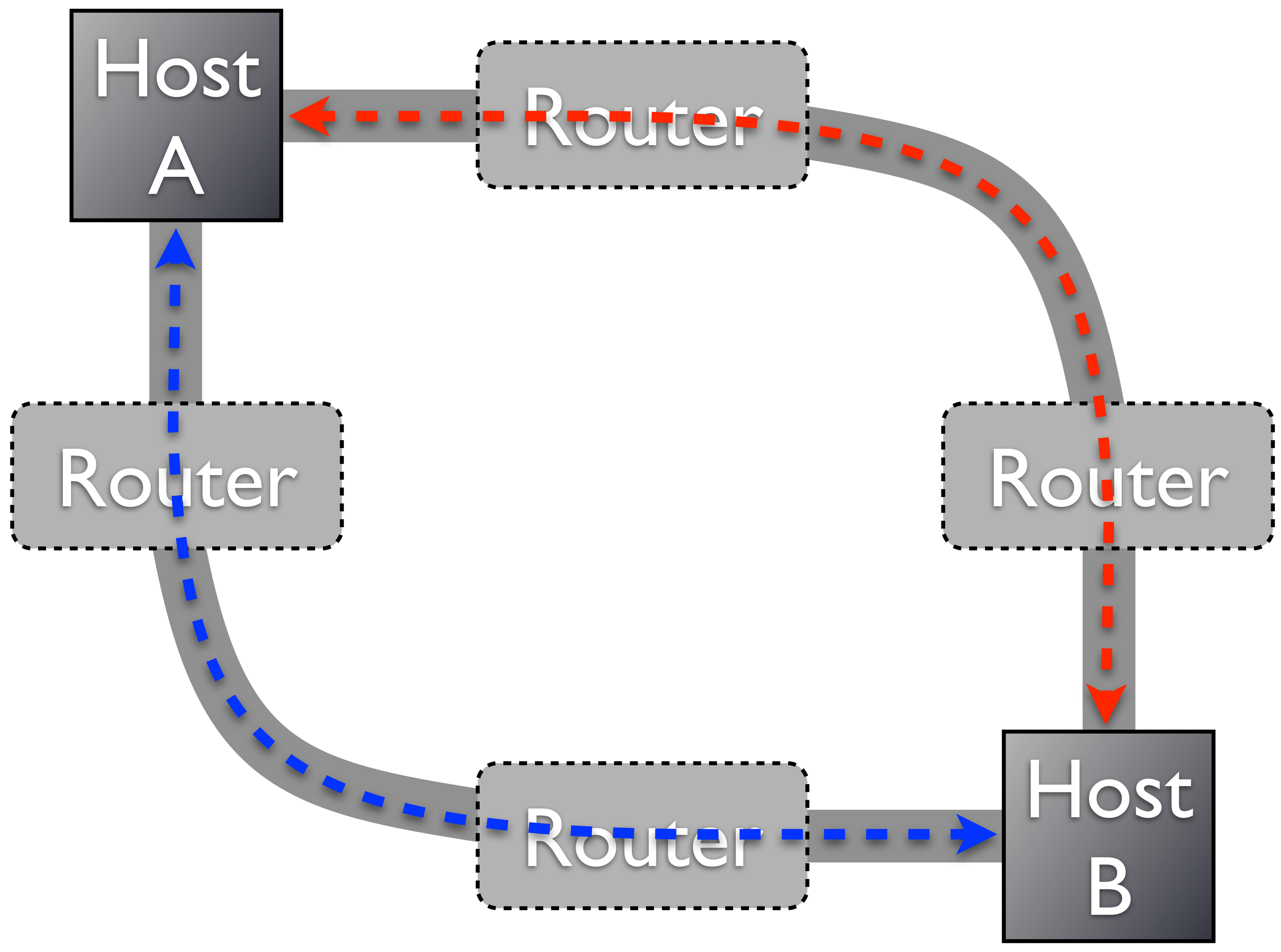
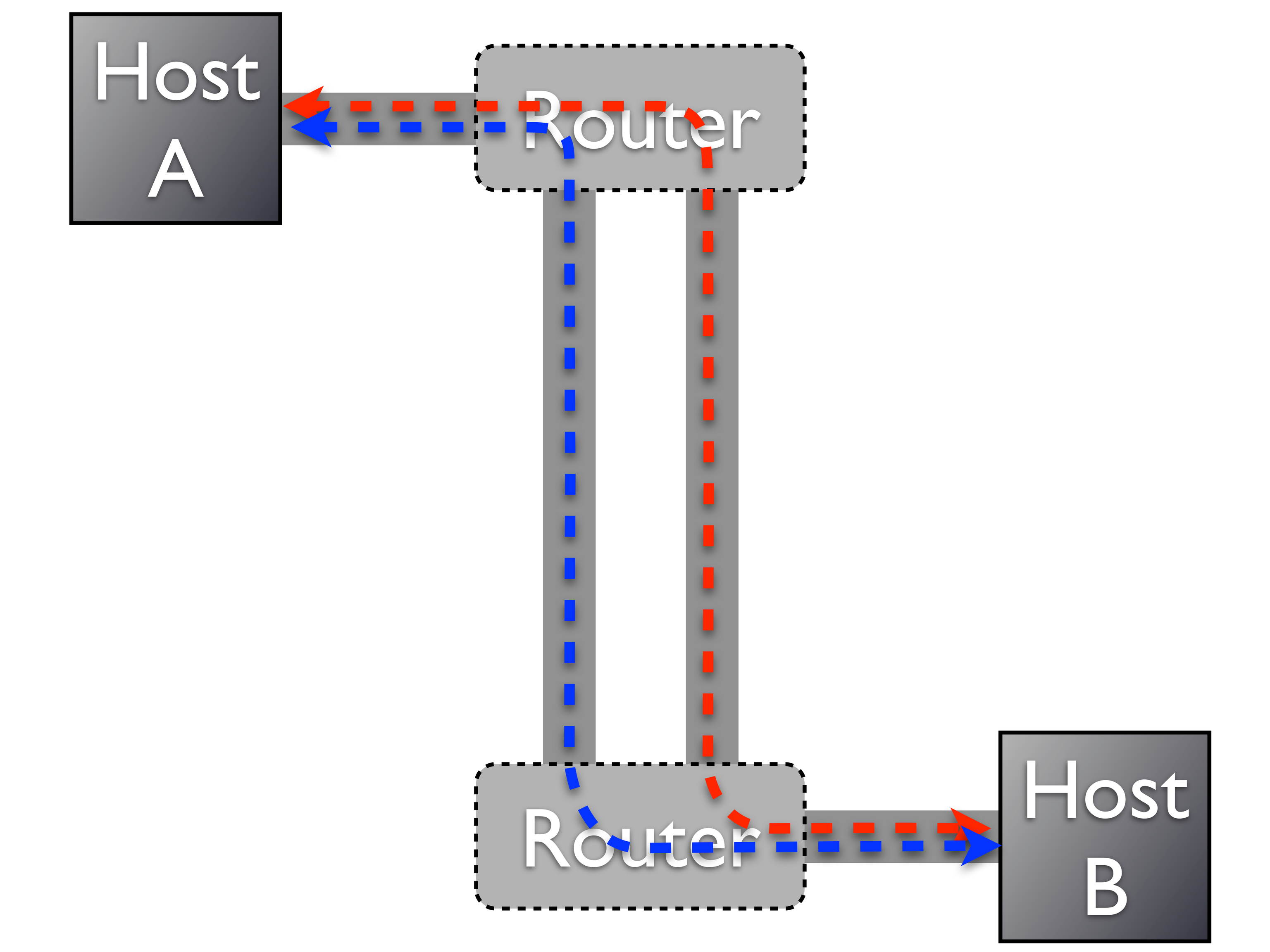
Introduction

Multipath TCP: make a normal TCP session flow over two or more paths at the same time:



In the above figure each multipath TCP host has two separate connections to the internet. However, this is rare. (Except with Wi-Fi + mobile 3G, but 3G is slow and more expensive, making it less useful for multipath.)

Another approach is to make use of parallel links that exist in the internet:



The benefit of multipath TCP is the ability to avoid busy (congested) parts of the network by moving traffic from busy to idle paths, increasing overall speeds.

Methods

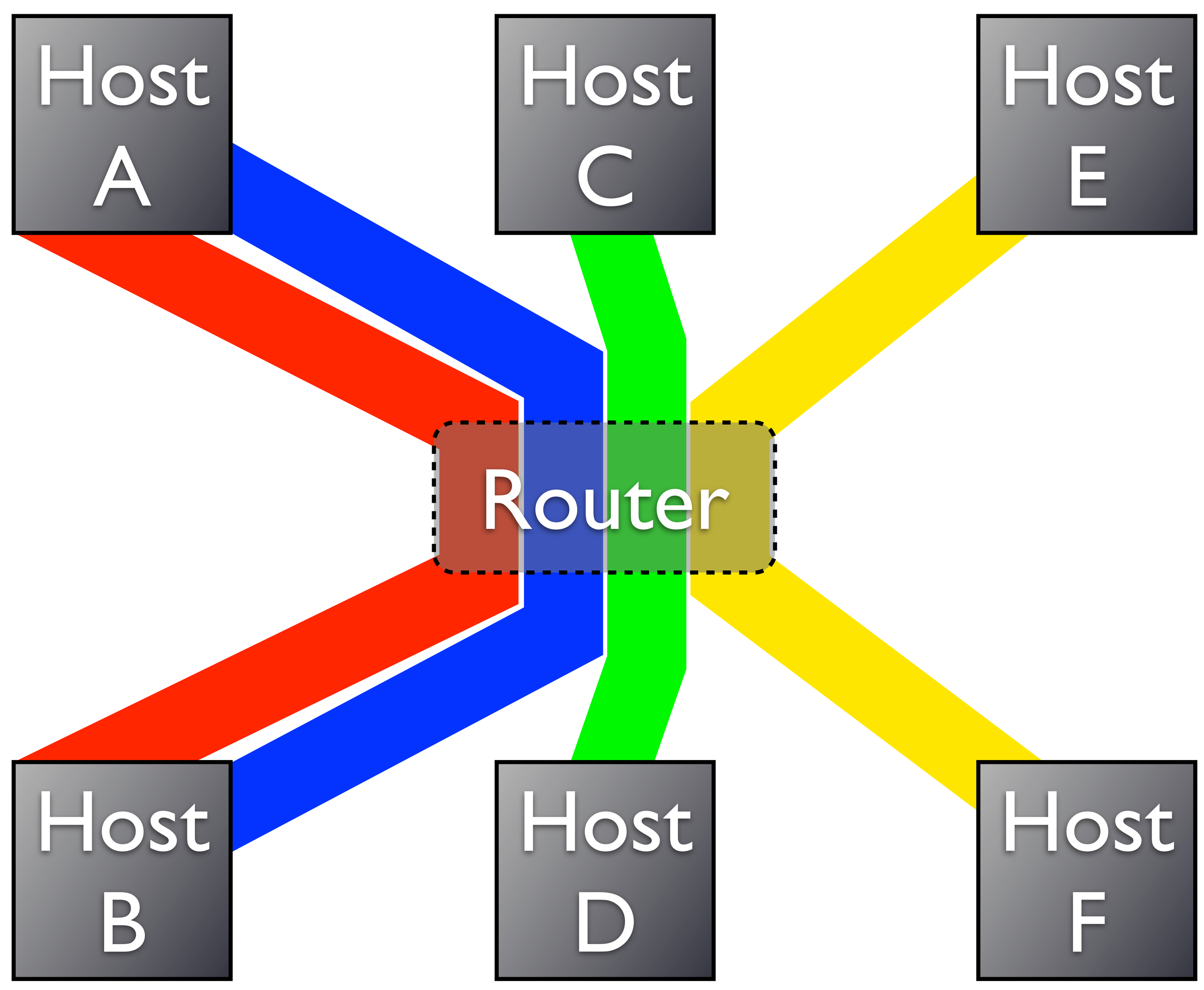
We initially analyzed the opportunities and challenges associated with multipath TCP.

There are two possible approaches:

- one-ended, where the sender is modified
- two-ended, where both sides are modified

The one-ended approach is easier to deploy but many limitations are imposed by the need to be compatible with the unmodified receiver. The IETF is now standardizing the two-ended approach.

One issue that the two approaches have in common is the need for multipath congestion control. Normal TCP adjusts its sending rate based on lost packets. Regular TCP congestion control on multiple paths means that multipath TCP uses up more network bandwidth than regular TCP. This is especially true when paths used by multipath TCP in fact share a bottleneck, leading to unfairness:



In the figure, each flow gets 25% of the bandwidth. This means that hosts A - B gets 50% of the bandwidth, twice as much as C - D or E - F.

We are currently working on measurements that will answer the question about how many parallel paths exist on the internet, so it's possible to evaluate how beneficial multipath TCP can be.

Reference

OmTCP: Increasing Performance in Server Farms; I. van Beijnum, A. Azcorra, M. Bagnulo; 2010 IEEE International Conference on Communications (ICC); Cape Town, South Africa, May 2010.