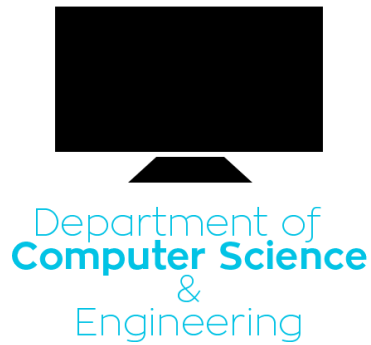
Mobility for Anonymity Networks

and performance improvements

Balagopal U

College of Engineering Trivandrum



Overview

1. Anonymous networks
2. Defining the parameters under study
3. Issues while adding mobility
4. Solutions to mobility
5. Latest development

Anonymous networks

Need for privacy on the web

Why is anonymity on the web a requirement?

- Identity protection for journalists and field agents
- Hide Personal Identification Information(PII)
- Prevent Profiling
- Protect sensitive corporate data

Introduction to Tor

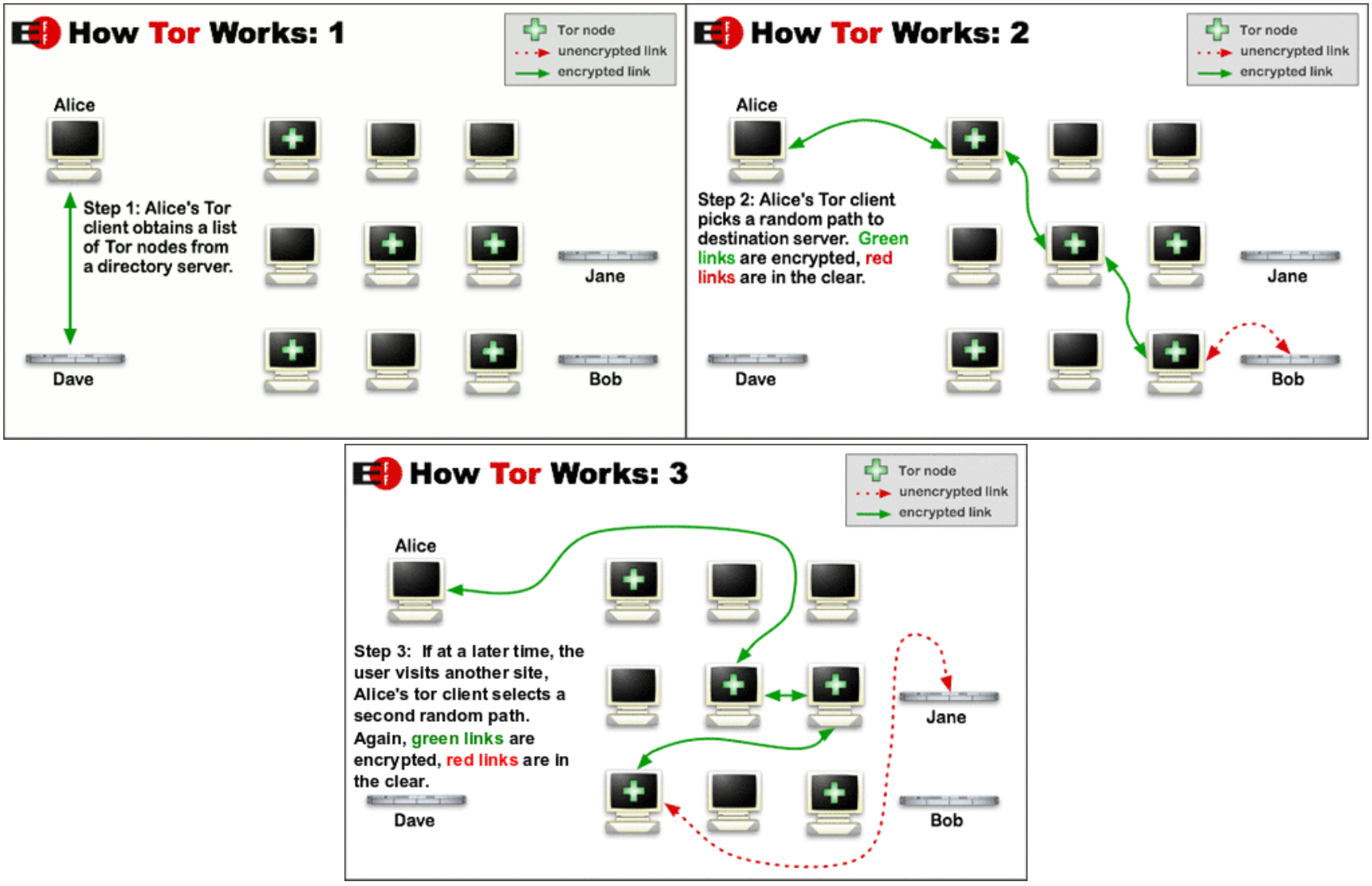
What is Tor?

- It is an anonymity network
- Originally started as a defense project by the United States Naval Research Laboratory.
- Uses a DISTRIBUTED OVERLAY NETWORK
- Functions using volunteer setup routers and TCP streams

Distributed Overlay Network

An overlay network is a computer network that is built on top of another network.

Working of Tor



Working of Tor

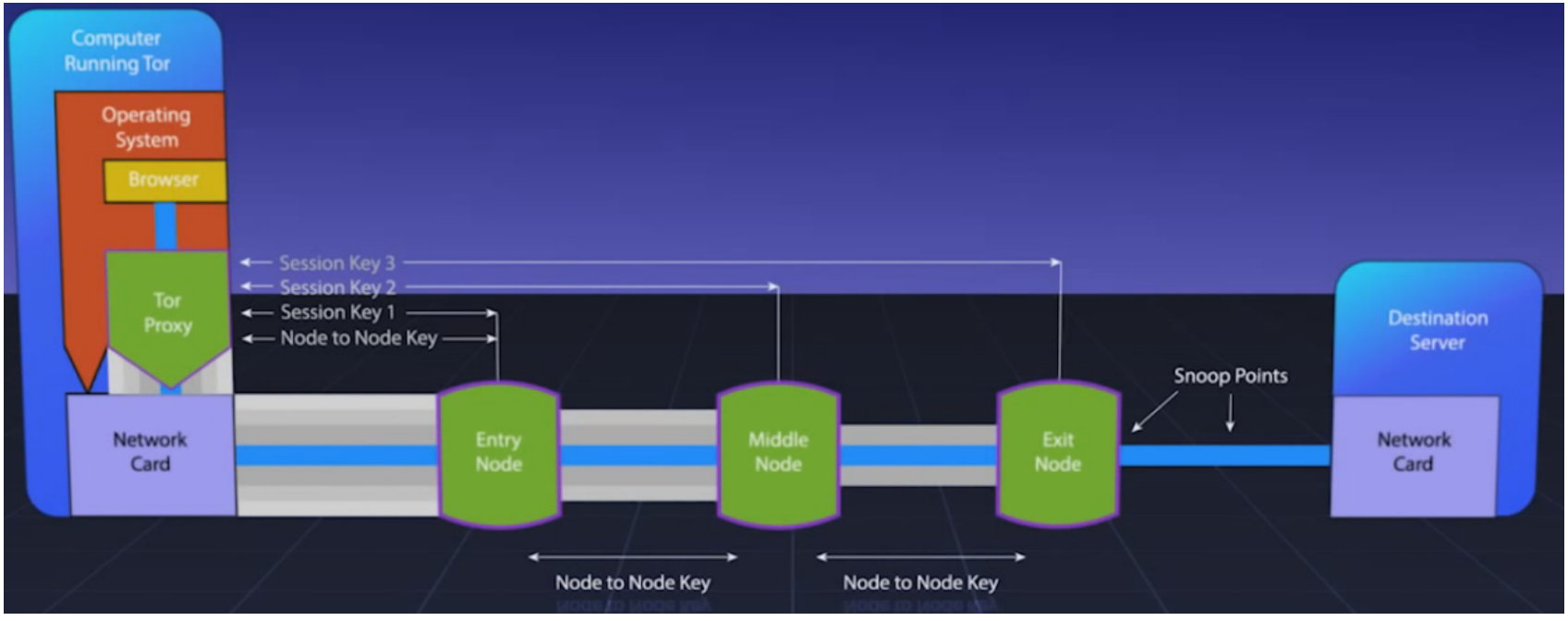


Figure: Establishing Connection and sending data

Need for Mobility

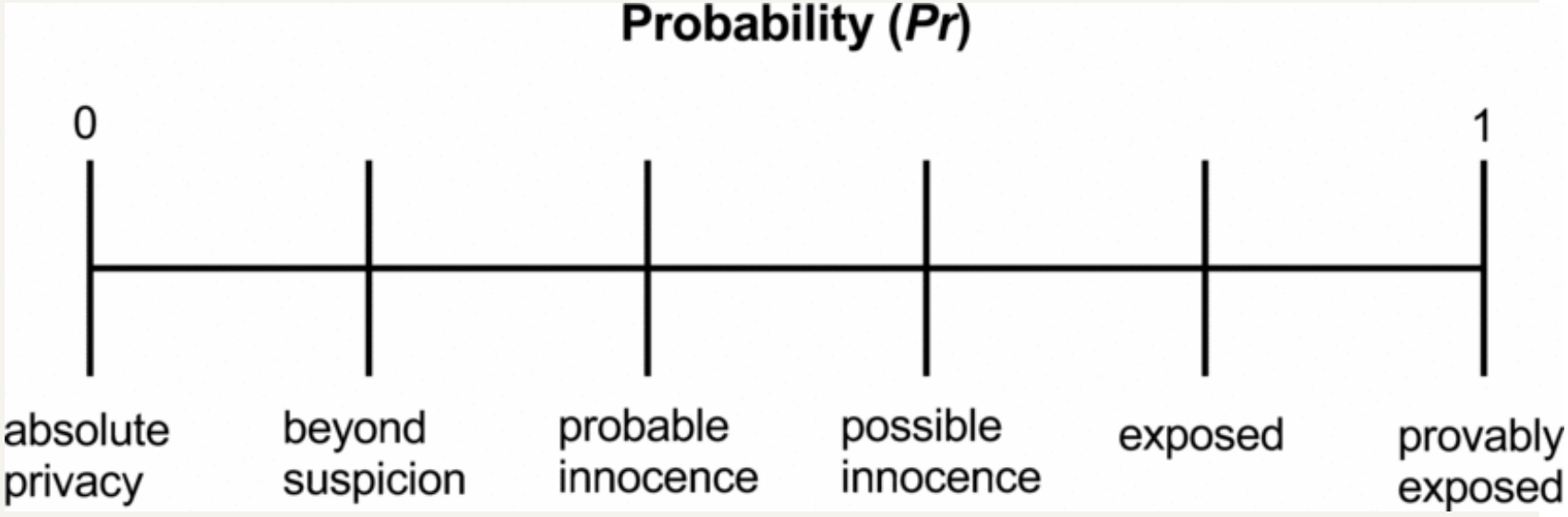
- Global smart phone users crosses 2 BILLION
- Increase in internet penetration
- Success of the Orbot app.It currently has 10 MILLION users on Android.

Defining the parameters under study

Anonymity

- Sender Anonymity
- Receiver Anonymity
- Unlinkability

Privacy



Mobility

The ability of the device to switch connections and maintain connectivity to the anonymous network as well.

Speed

The throughput or the number of bits send across the network. It is usually measured in Kbps.

Latency

The time taken for a packet of data to reach from sender to the receiver. It is usually measured in milliseconds.

Tools used in the study

There was a lack of a tool which could simulate both roaming and Tor networks

OMNET++

- Generic Simulator
- Widely supported by the scientific community

ExperimenTor

- Has its own toolkit,emulator and test bed
- Emulated Tor clients can run any applications such as web browsers or BitTorrent.

Issues while adding mobility

Issues when mobility comes into the network

Root cause

Tor was built for static clients.

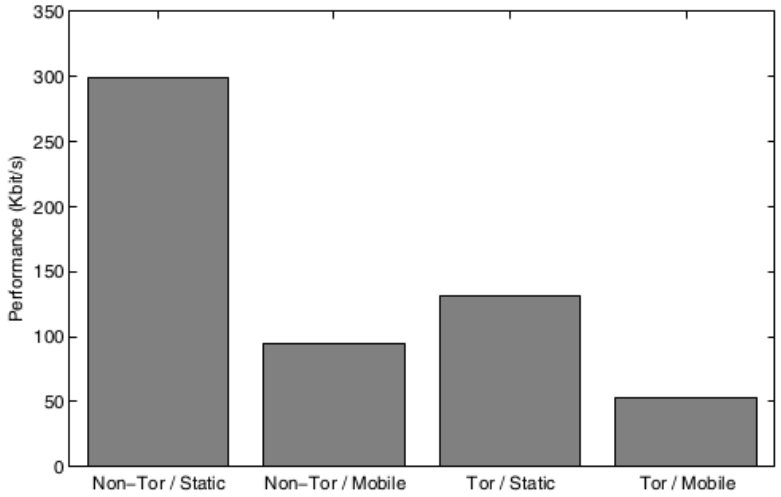
Effect on entire network

- 3 to 4% of orphaned data is left in-flight
- Increases congestion in Entry Guards

Issues when mobility comes into the network

Performance degradation

- Substantial reduction in speed when mobility comes into the picture
- 91% reduction in speeds at high mobility speeds



Effect on anonymity

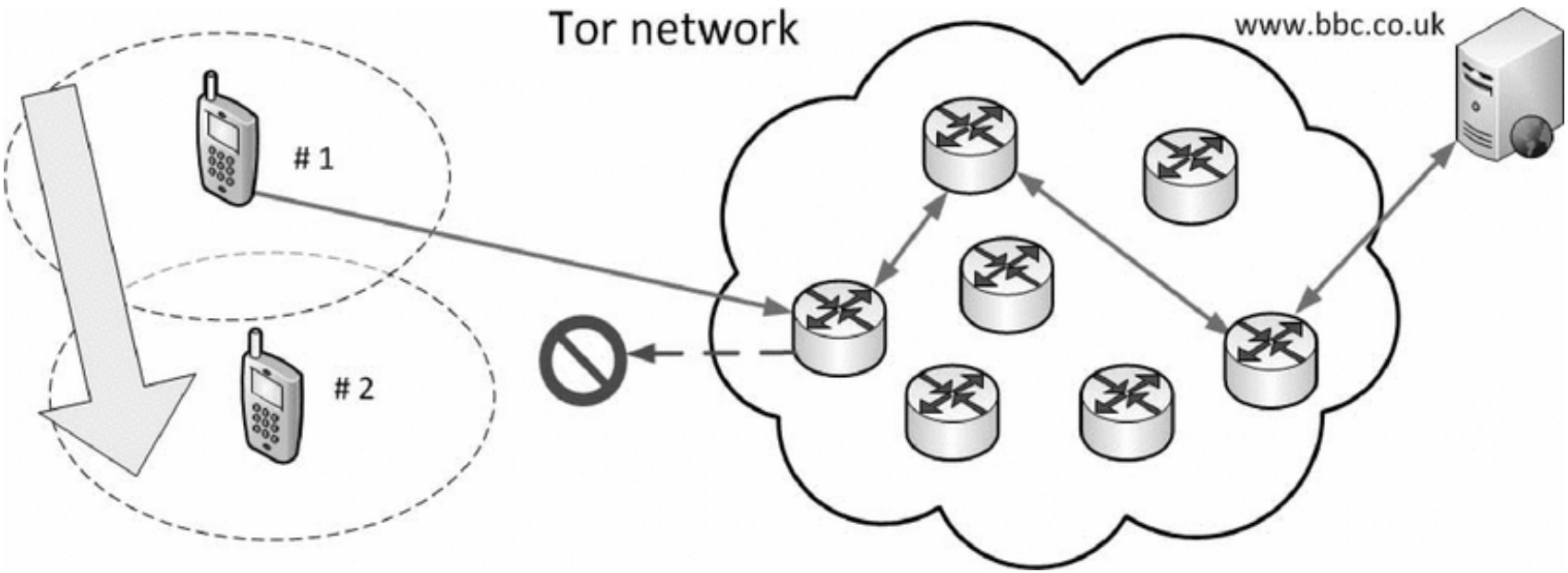
- The number of hops to the home station is more
- This increases chances of a compromise in identity and location privacy

Solutions to mobility

Achieving Mobility

Aim

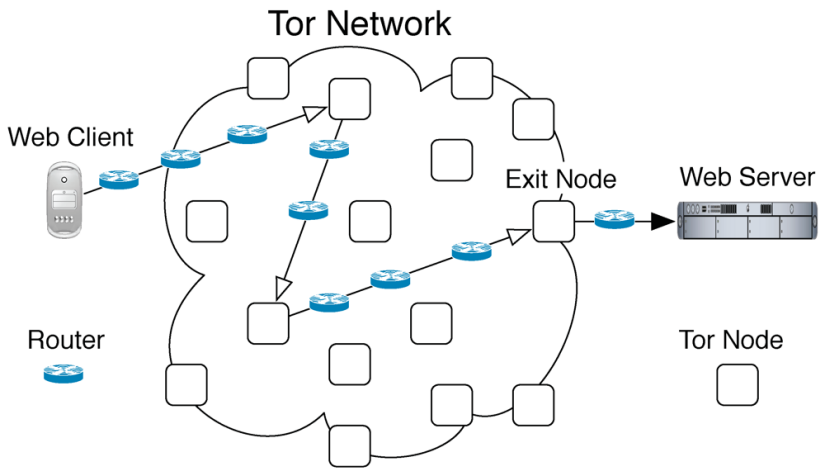
Redirect and resume data streams when there is a switch in connection and provide persistent connections while roaming.



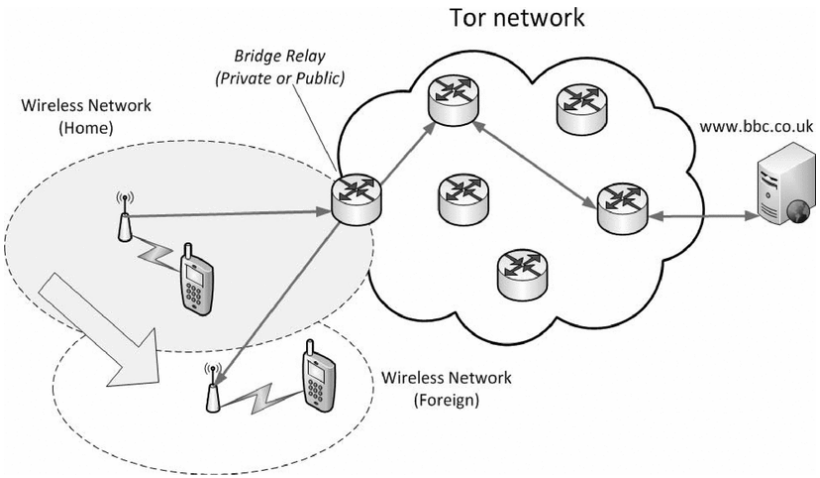
Possible solutions

Three possible approaches to achieve mobility

1. MobileIP based approach - uses a static home
2. Changes in Entry Guard - use stop/resume commands
3. Changes at Exit Router - use stop/resume commands based on CircuitID



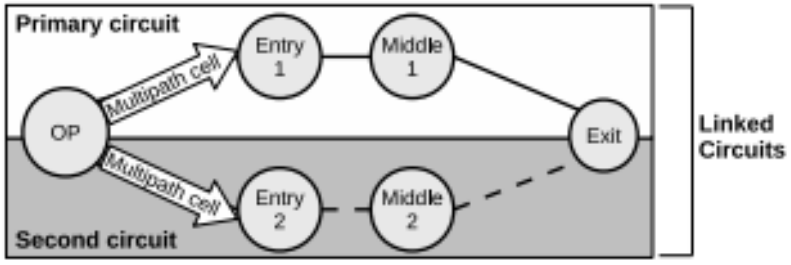
Use of Bridge Relays



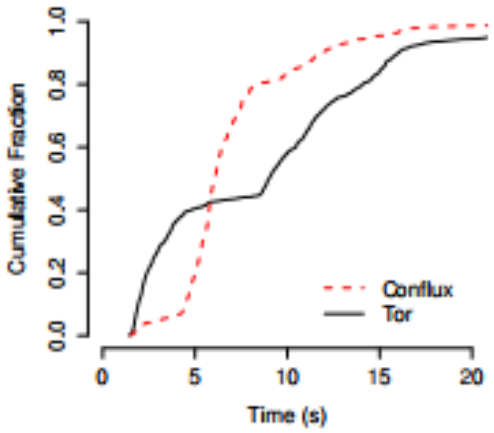
- Uses an EXPLICITLY TRUSTED third-party operator to maintain the Entry Guard
- Provides persistent connection to the Tor network by change in Entry Guard
- Improvement in speeds - comparable to STATIC TOR connection
- Links Tor Circuit ID and mobile IP

Use of multipaths

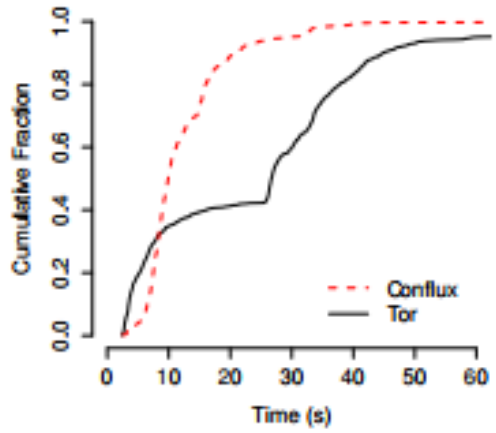
- Multiple parallel internal circuits are built
- Handles congestion as well
- Load balancing in turn contributes to anonymity
- One implementation of this is called CONFLUX



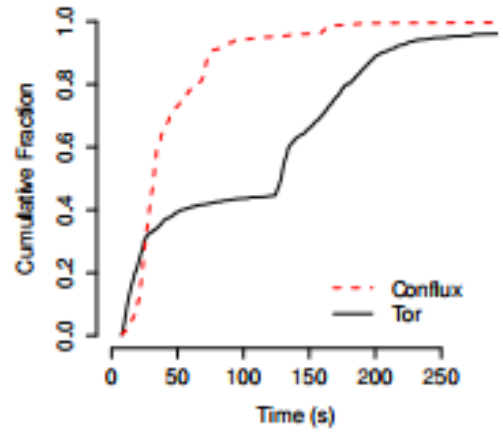
Performance improvements



(a) 300 KiB download time



(b) 1 MiB download time



(c) 5 MiB download time

- 75% improvement for large file downloads
- 80th percentile of data loads in under 2 seconds resulting in a smaller PERCEIVED WAITING TIME
- Does not introduce any new security vulnerabilities

Latest development

News

Jan 21,2016 | TechCrunch Report

- The Tor Project Raised Over 200,000 dollars From Its First Crowdfunding Campaign
- Aims to reduce its dependence on US Government for the funding

April 22,2016 | TechInsider Report

- More than one million people are now connecting to Facebook through the Tor
- Aims to reduce its dependence on US Government for the funding

Research

PETS 2016
The 16th Privacy Enhancing Technologies Symposium
July 19 – 22, 2016
Darmstadt, Germany

@PET_Symposium

Organizer

TECHNISCHE UNIVERSITÄT DARMSTADT

Upcoming Research

- SELFRANDO : Practical load-time randomization technique for the Tor Browser
- RIFFLE : Uses a new hybrid verifiable shuffle technique

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The floor is open for questions