ShareFile: Sharing Content Through Device-to-Device Communication

Daniel M. Reis
Theo S. Lins
José Marcos S. Nogueira
Vinícius F. S. Mota

UFOP
DECSI
DEPARTAMENTO DE
COMPUTAÇÃO E SISTEMAS

UFMG | ICEx
DEPARTAMENTO DE
CIÊNCIA DA COMPUTAÇÃO

DEPARTAMENTO DE INFORMÁTICA

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Outline

- → Introduction
- → Motivation
- → Goals
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- → ShareFile: Content Sharing
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  - ◆ Methodology
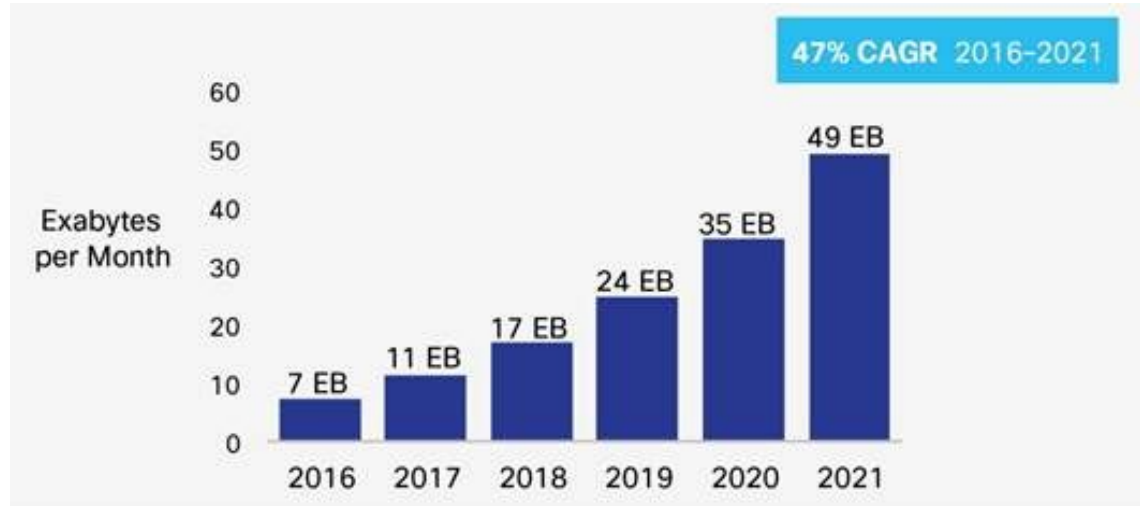 - ◆ Results
- → Conclusion and Future works

Introduction

Smart devices have become popular

+ Devices
+ Mobile applications

Introduction

+ Devices
+ Mobile applications

47% CAGR 2016–2021

Exabytes per Month

7 EB — 2016
11 EB — 2017
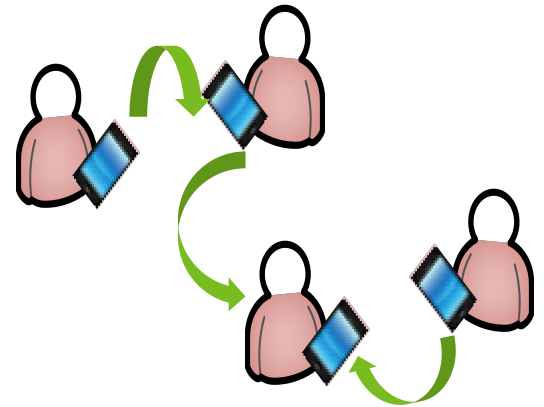17 EB — 2018
24 EB — 2019
35 EB — 2020
49 EB — 2021

Cisco visual networking index: Global mobile data traffic forecast update 2017

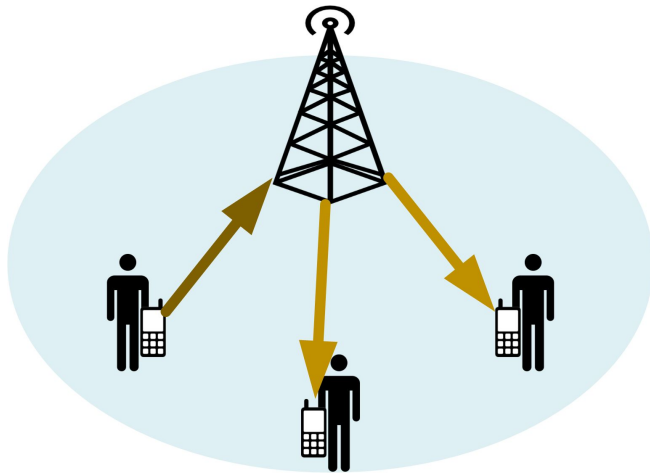= Exponential data consumption growing

Introduction

Device-to-Device network applications allow communication among them in infrastructure less scenarios.
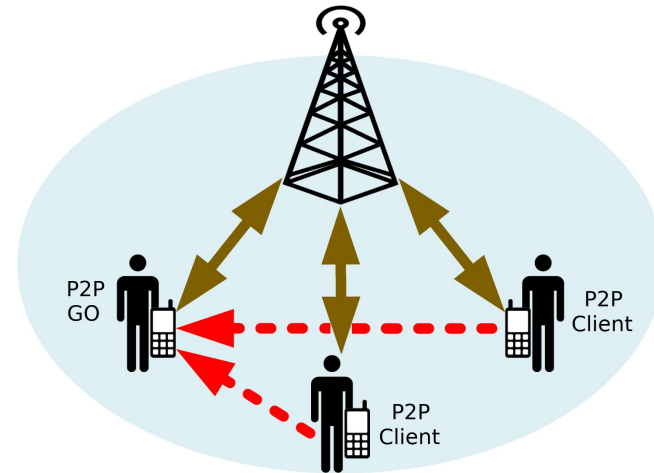
Introduction

Closer users could communicate directly

Infrastructure network X   **Device-to-Device**

Motivation

➔ Dozens of D2D solutions only evaluated through simulations

➔ Few real world D2D applications;

➔ Limits of D2D communication using Wi-Fi Direct;

➔ Content sharing:

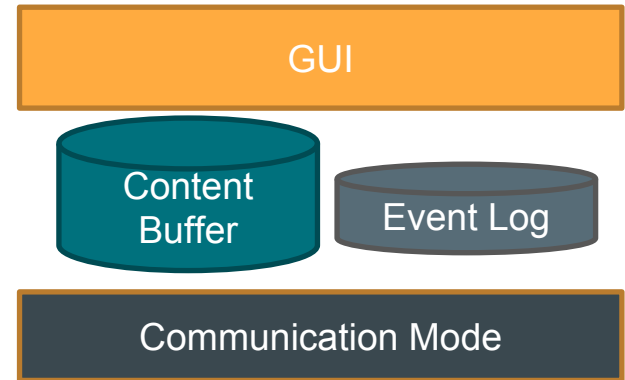D2D communication versus infrastructure network?

Goals

➔ Share content through multiples network interfaces

➔ Compare D2D communication performance against traditional

➔ Discuss limitations of D2D communication in devices already available in the market
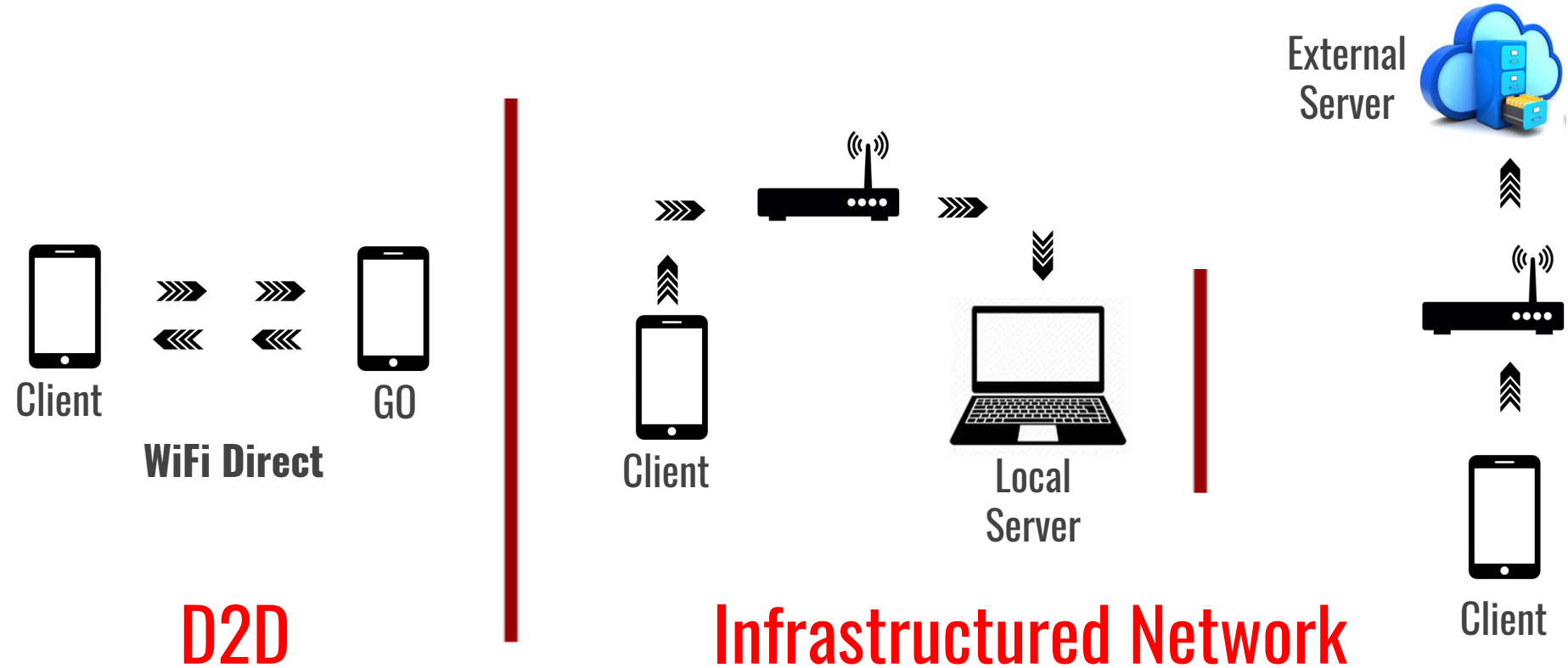
Related work

Reference	Description	Results
(Camps-Mur; Garcia-Saavedra; Serrano, 2013)	2 laptops Linux. Log wpa_supplicant.	Delay for detection and formation of groups <5s; Discovery phase = higher energy consumption; - Bandwidth = + power consumption.
(Yao; Zhang; Song, 2015)	Wi-Fi Multihop: 6 smartphones - Android. Each device has a routing table (neighbors that it sees).	Proof of concept without performance evaluation.
(Asadi; Mancuso, 2017)	Hybrid architecture: Network infrastructure creates groups of devices and devices from each group communicate via Wi-Fi Direct.	Small groups achieve higher data rate and lower delays.
(Mao et al., 2017)	Social network mobile for devices Android. 3 devices Android.	Wi-Fi Direct can achieve a data rate of up to 4MB/s on average.

ShareFile

➔ A tool for content sharing based on three communications mode

➔ It logs all network events

➔ friendly user interface (GUI)

➔ Available on *Google PlayStore* goo.gl/gwEC3d

GUI

Content Buffer

Event Log

Communication Mode

ShareFile: Communication modes

External
Server

Client

GO

WiFi Direct

Client

Local
Server

Client

D2D

Infrastructured Network

ShareFile: D2D -WiFi Direct

Device A (GO)

Device B (Client)

Searching

Reply

Request connection

Connection ack

Data transfer

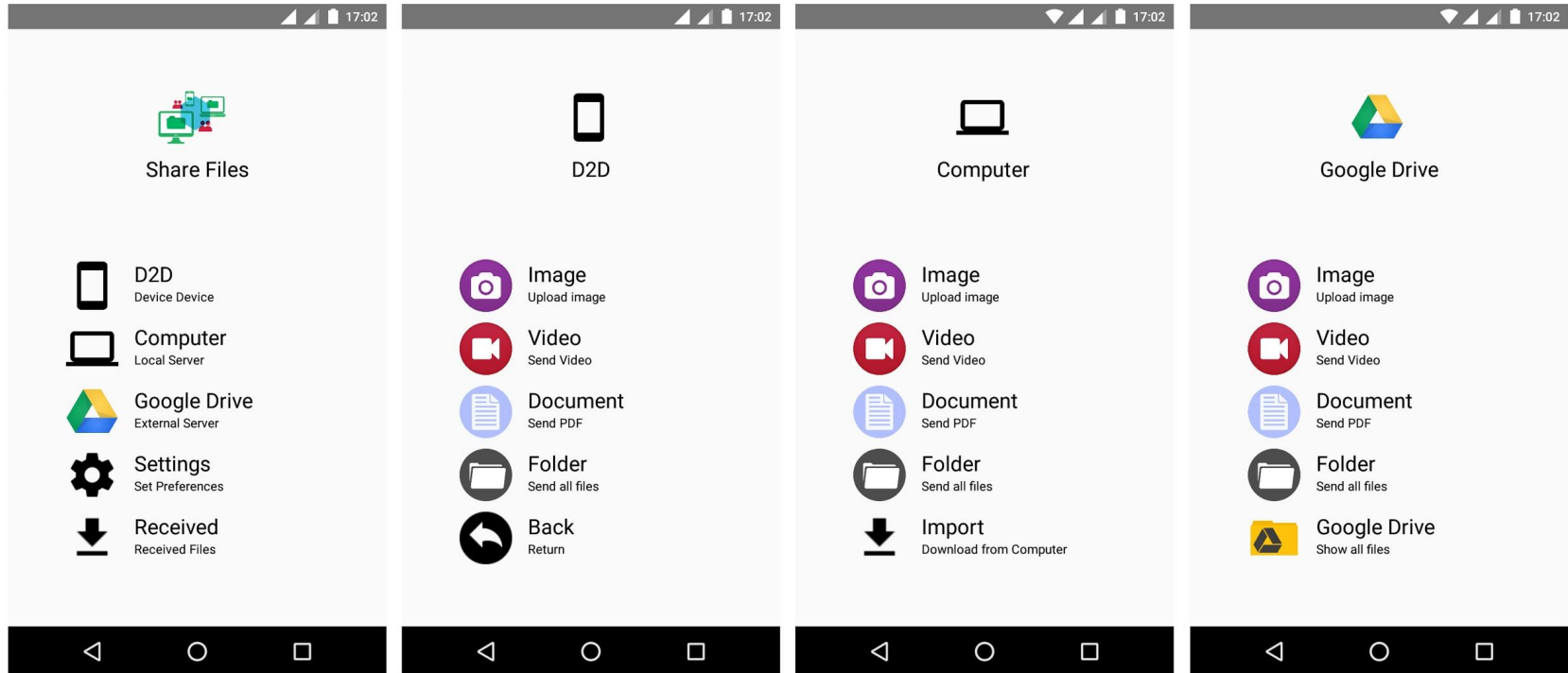Request disconnection

Finalize group

ShareFile: GUI Snapshots

Share Files

- D2D — Device Device
- Computer — Local Server
- Google Drive — External Server
- Settings — Set Preferences
- Received — Received Files

D2D

- Image — Upload image
- Video — Send Video
- Document — Send PDF
- Folder — Send all files
- Back — Return

Computer

- Image — Upload image
- Video — Send Video
- Document — Send PDF
- Folder — Send all files
- Import — Download from Computer

Google Drive

- Image — Upload image
- Video — Send Video
- Document — Send PDF
- Folder — Send all files
- Google Drive — Show all files

ShareFile: Event LOG

Timestamp and log all network events

➔ Searching
➔ Connection request
➔ Disconnection
➔ Device type - (GO, CLIENT), address and name;
➔ Number of devices found in the search;
➔ Size of the file being transmitted.
➔ Send/receive files

Performance Evaluation

➔   Evaluate content sharing in the three communication modes

➔   D2D Metrics

◆   Search time for nearby GO devices
◆   Time to establish a connection (pairing)

➔   D2D and Infrastructure metrics

◆   Throughput

Performance Evaluation: Setup

➜ **D2D:** Two smartphones Motorola XT1069 16GB;

➜ **Local server:** One notebook Core I3 with 8GB of DDR3 RAM

➜ **External server:** Brazilian Web hosting service (LocaWeb)

15Mbps fiber optics Internet access

One modem Wi-Fi ZTE F660.
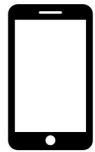
Evaluation: Methodology

➔ Send files 10x for each scenario: [0, 1, 3, 5, 10, 15] metros.

◆ 2200 transmissions in D2D (total = 55,21GB)

370 transmissions for each distance;
◆ 370 transmissions on the local server (total = 9.2GB);
◆ 370 transmissions on external server (total = 9.2GB);
Average RTT (servers) - Pings for 30s – before each file transfer.

➔ 60 D2D connections -> 10 for each distance;

Evaluation: file set

Total = 37 files (942,3MB)

| Type	Size
Image (png)	42.6KB; 59.2KB; 60.8KB; 60.9KB; 68KB; 76.5KB; 79.8KB; 84.5KB; 121.2KB; 828.9KB
Music (mp3)	3.2MB; 4.6MB; 4.7MB; 4.9MB; 5.7MB; 6.6MB; 7.2MB; 7.3MB; 7.6MB; 9.5MB
Doc (pdf)	104.5KB; 314.2KB; 396.2KB; 452.8KB; 560.4KB; 985.4KB; 1MB; 2.3MB; 3.3MB; 6.6MB
Video (mp4)	467.7KB; 589.4KB; 2.1MB; 7.6MB; 7.9MB
Disc (iso)	227MB; 617.8MB

Results

D2D: Searching time - Client to GO Device

D2D: Searching time - Client to GO Device

90% less than 450ms

D2D: Searching time - Client to GO Device
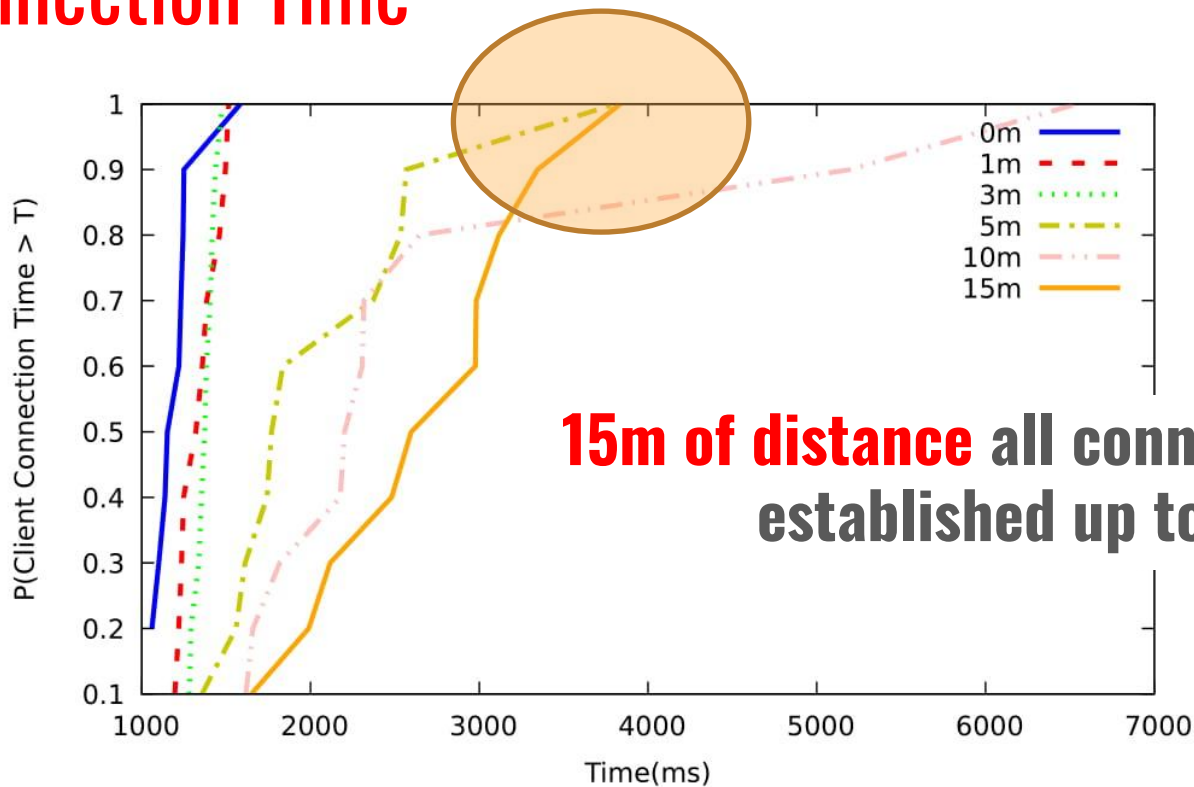

90% less than 1050ms
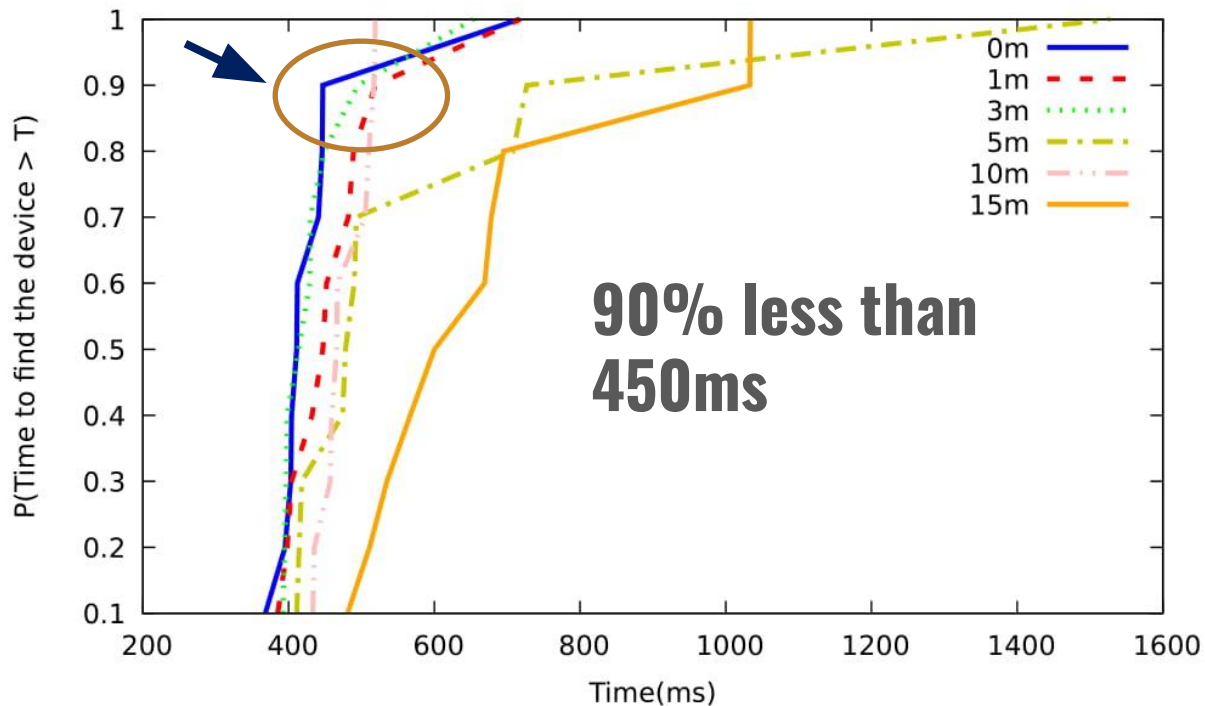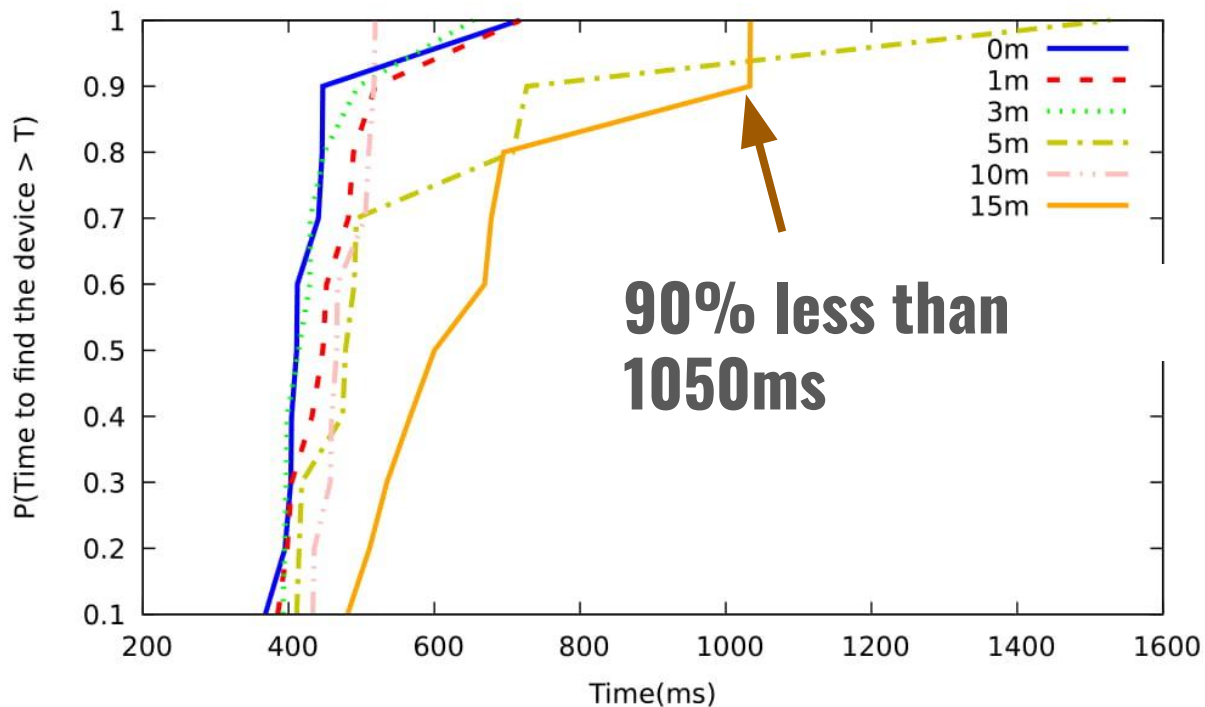
D2D: Connection Time
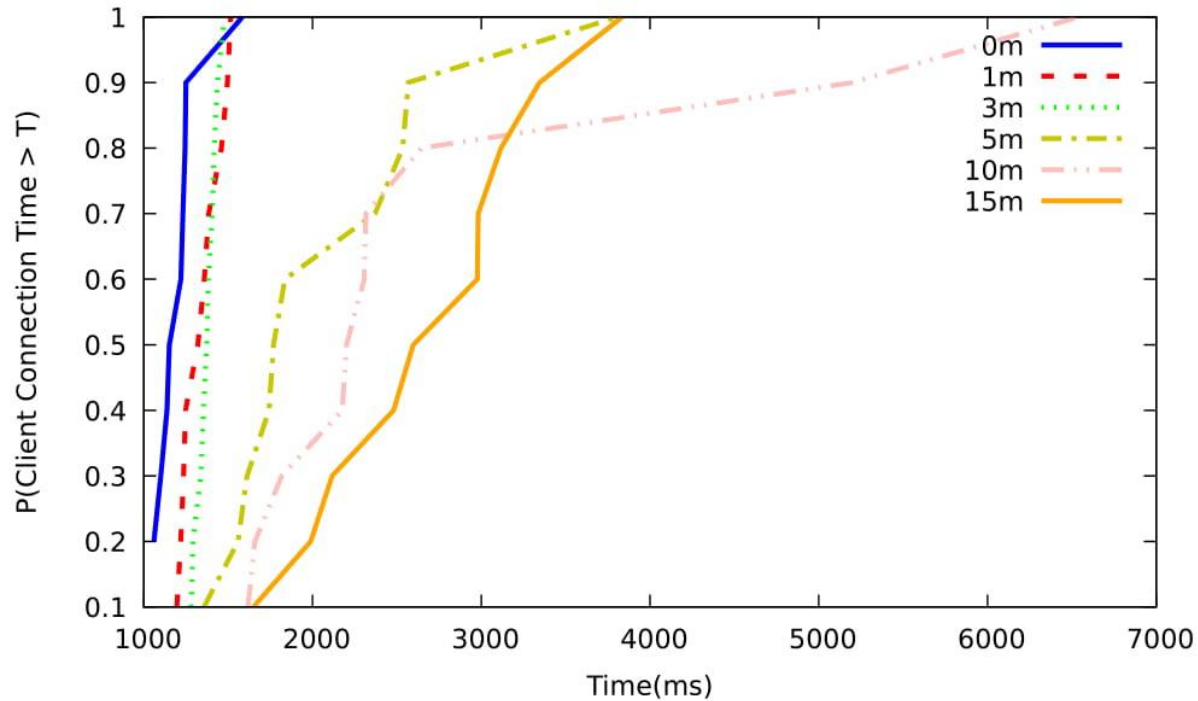
D2D: Connection Time
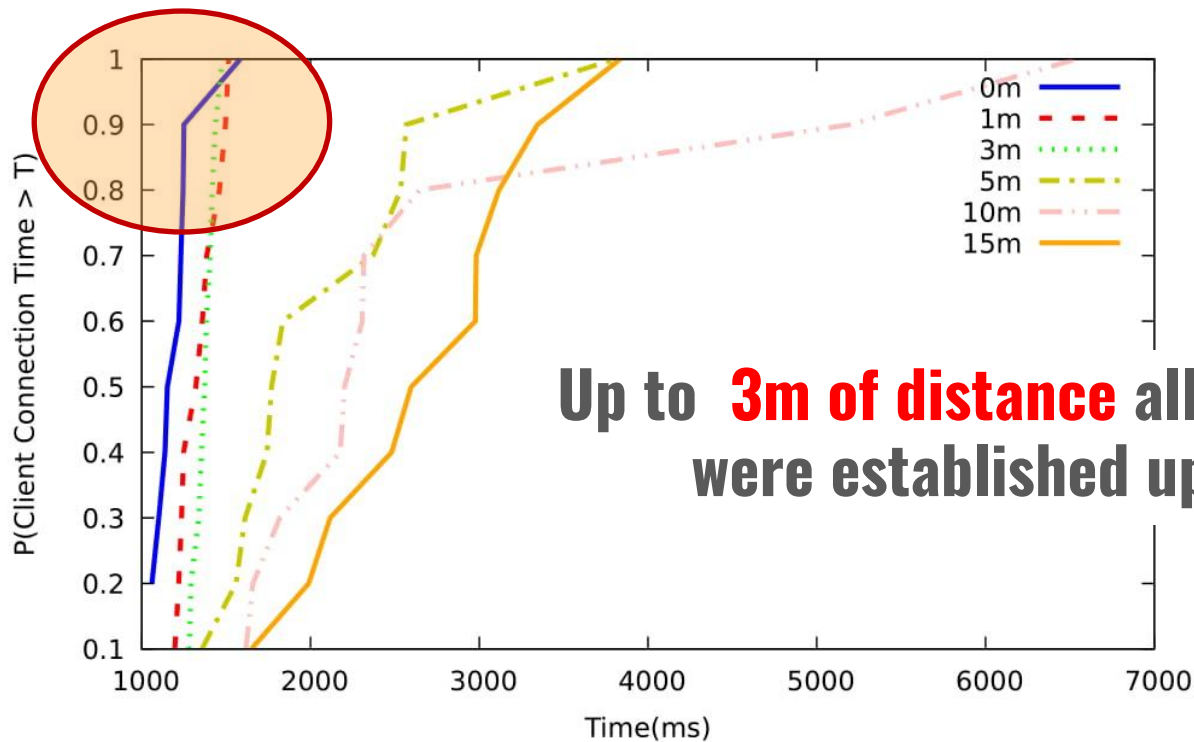
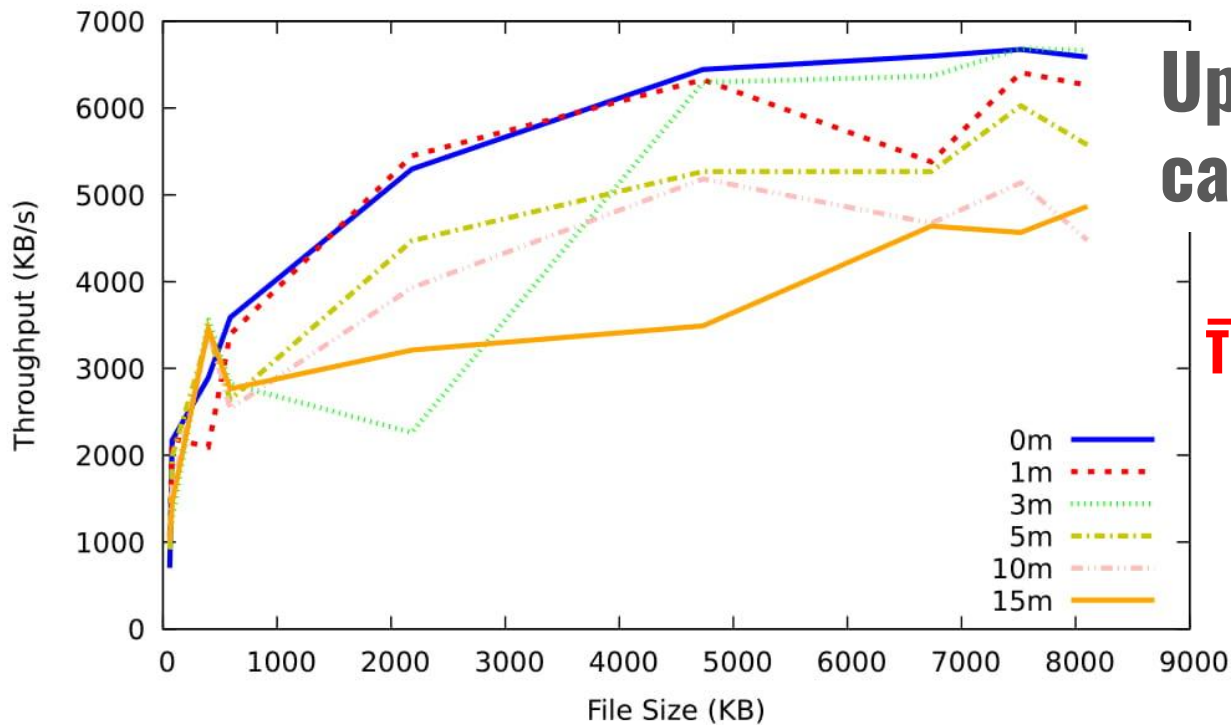Up to **3m of distance** all connections were established up to 1.5s

D2D: Connection Time

15m of distance all connections were established up to 3.5s
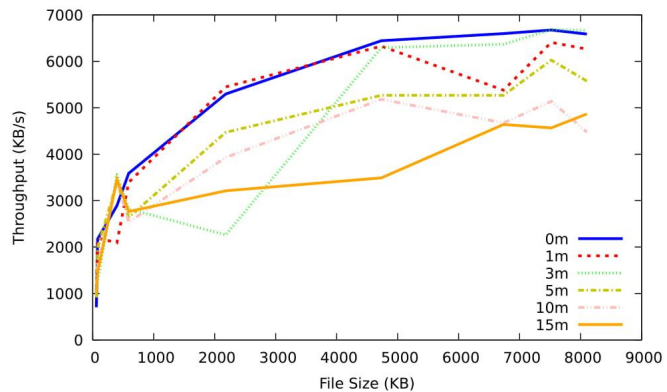
D2D Throughput

Up to 3m -> 75% of cases up to 6591KBps
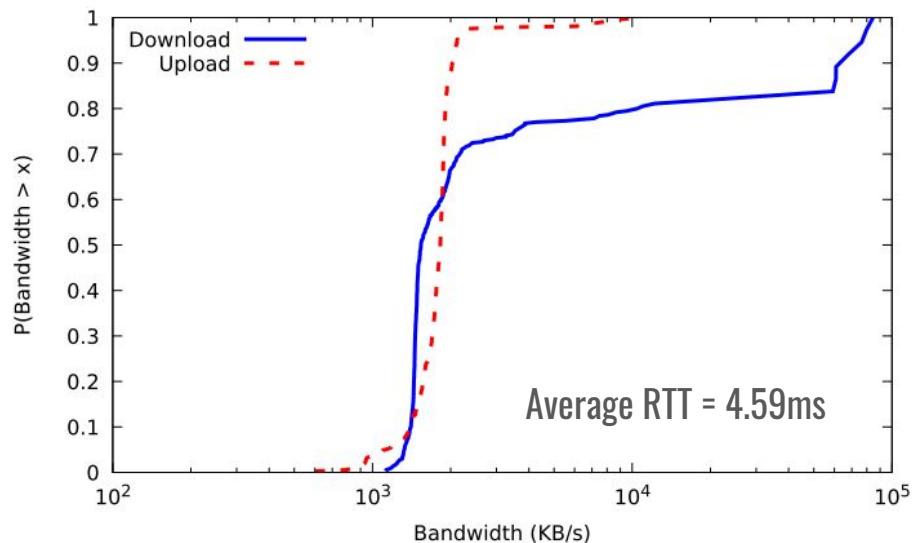
Throughput = 5008KBps

Results

Throughput

D2D

Average = 5008KBps

Local server

Average RTT = 4.59ms

Average Down Link = 14900KBps

Results

Throughput

D2D
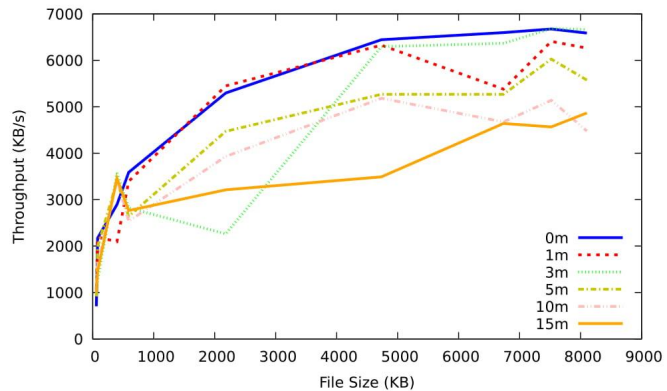
Average = 5008KBps

Cloud (External server)

Average RTT = 29.28ms
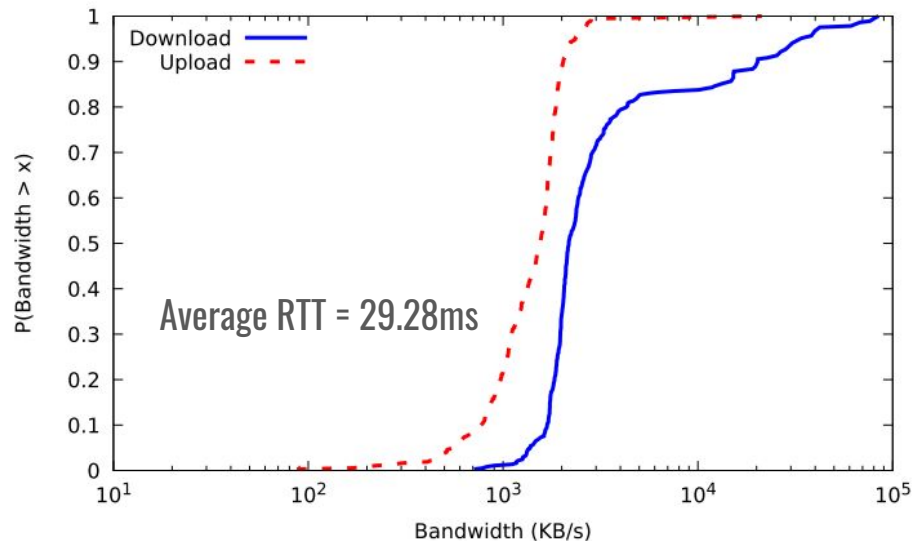
Average Down Link = 7900KBps

Challenges and limitations

➔ WiFi Direct must be better explored by developers

➔ Searching and connection times introduce delay

➔ Groups must be set manually in Android Devices (or users must

   have root access – not default)

➔ Privacy is always a concern

Conclusions

➔ **ShareFile** - a tool for content sharing
➔ **ShareFile** - also a tool to measure network performance

➔ In the **best case**, closer devices, network established up to **2s**
➔ In the **worst case**, network established up to **5s**

➔ **D2D** avg. throughput **achieves 63%** of the **cloud** throughput

➔ Public available on *Google PlayStore*
 goo.gl/gwEC3d

Thanks!

Daniel M. Reis	danielmartinsreis@gmail.com
Theo S. Lins	theo@decsi.ufop.br
José Marcos S. Nogueira	jmarcos@dcc.ufmg.br
Vinícius F. S. Mota	**vinicius.mota@inf.ufes.br**