Multipath TCP for Mobile Devices

Lars Eggert
Nokia Research Center

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Motivation

We need a more robust Internet than we can get from simply making better individual components

Most end hosts will be mobile, with multiple radios that can be used concurrently

Mobile applications are becoming more important & demanding

Users dislike flat batteries

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It's all about energy

Energy = features

Save it to spend it

Energy efficiency of network communication is of key importance

Goal: conserve device energy through Multipath TCP

Shift ongoing connections to the most energy-efficient radio for the current load

Maximize power save modes

WLAN "juggling" (very early idea)

Standard TCP is single-path

Consequence: all packets of a TCP connection flow between one IP address at one end and another IP address at the other end

Internet routing is destination based

All packets to a destination IP address follow one path through the Internet

Ergo: a TCP connection can only transmit along a single path through the Internet during its entire lifetime

(Modulo routing changes)

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So what's wrong with that?

Devices with multiple links to the Internet need to pick one at the beginning of the connection and stick with it

Cannot shift an established TCP connection to a "cheaper" access

Cannot do anything about outages or congestion along the one path

Cannot use the pooled bandwidth and redundancy of multiple paths

This is a real problem

Multipath TCP

"Layer 4 MIMO"

Allow one TCP connection to send data along multiple paths between the same two end systems

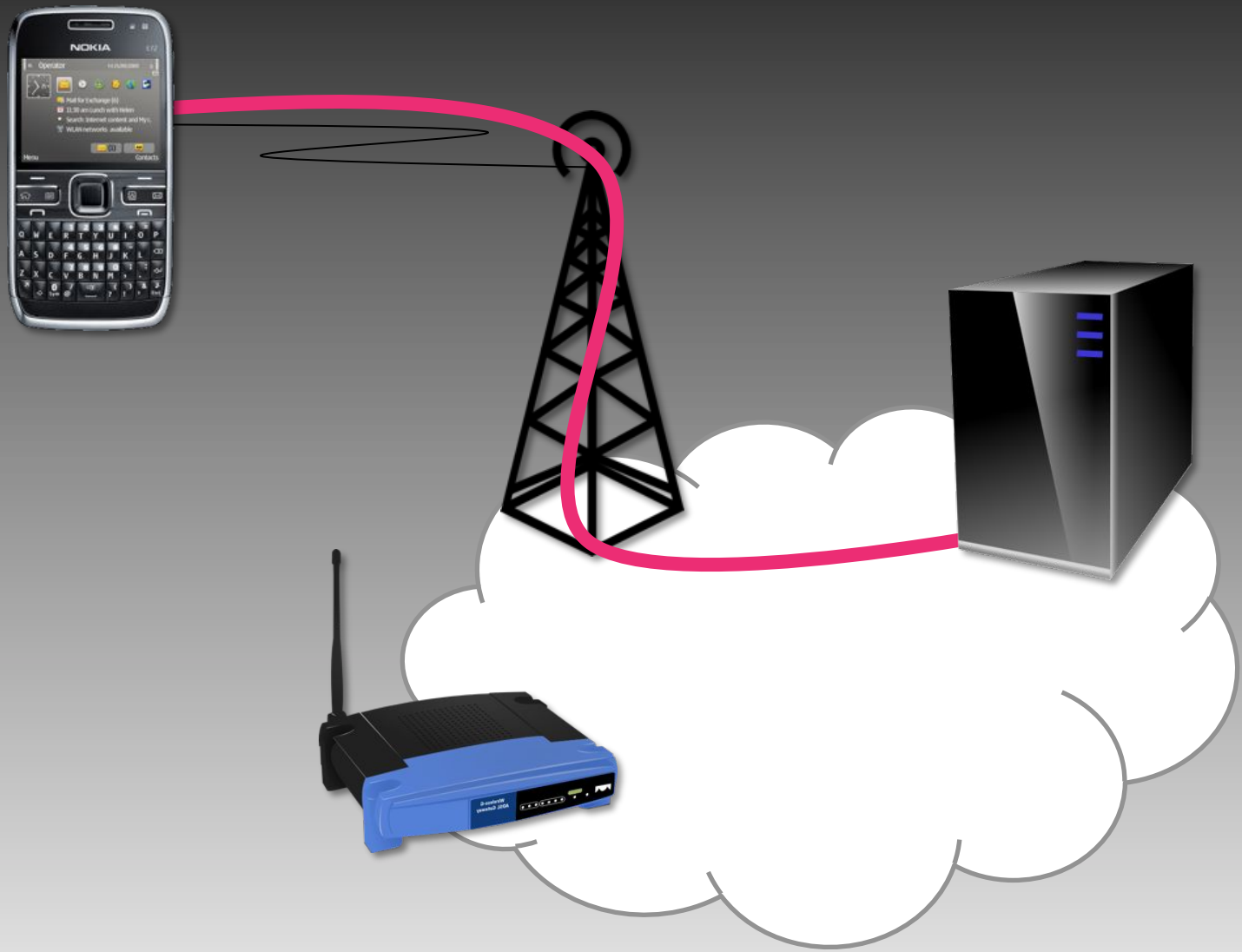
Concurrently, or changing over the lifetime of the TCP connection

Flexibility, Performance, Robustness

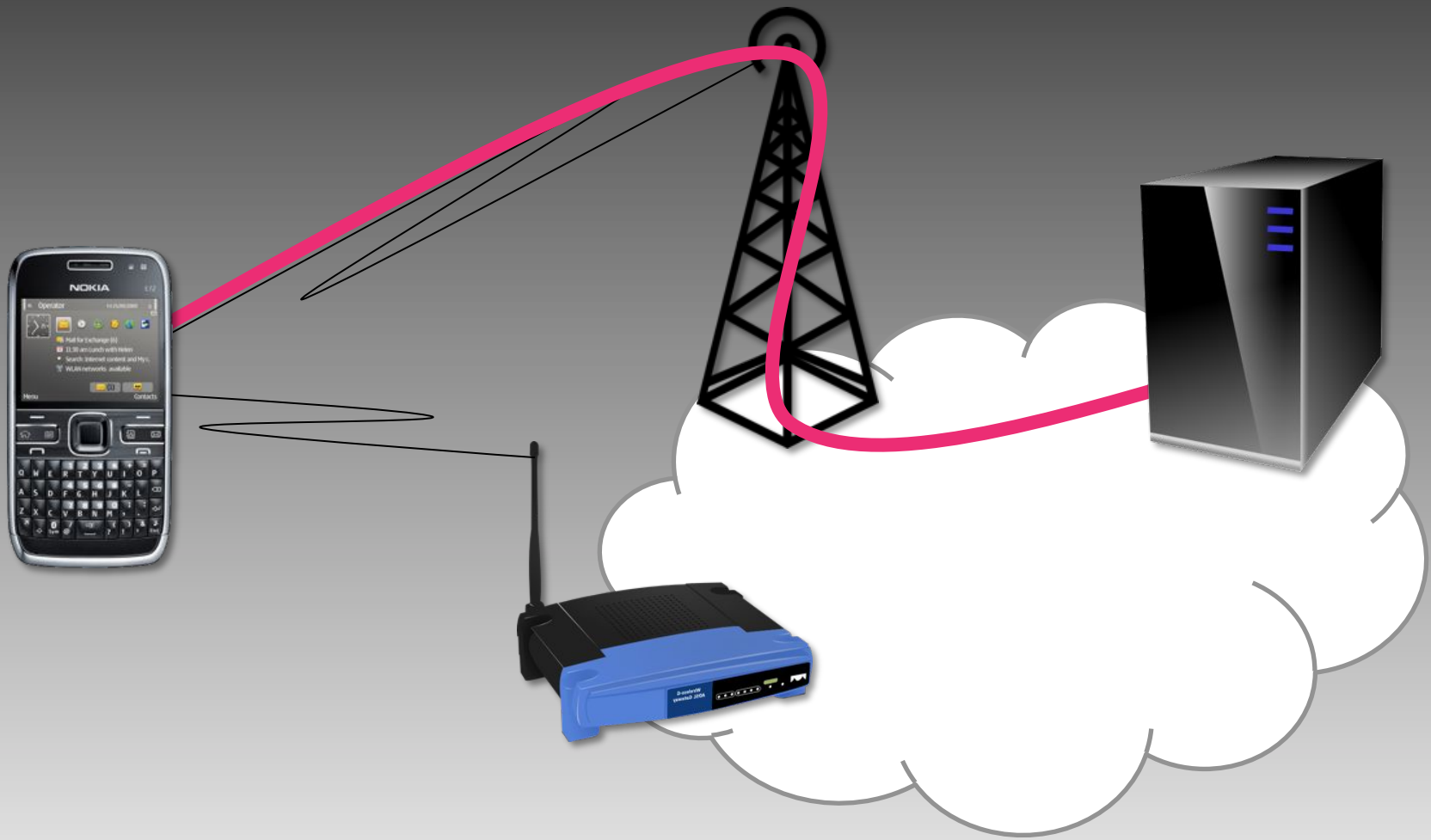
Fully backwards compatible

- Same socket API for apps
- Looks like standard TCP (+ options) to network

Illustration



Illustration



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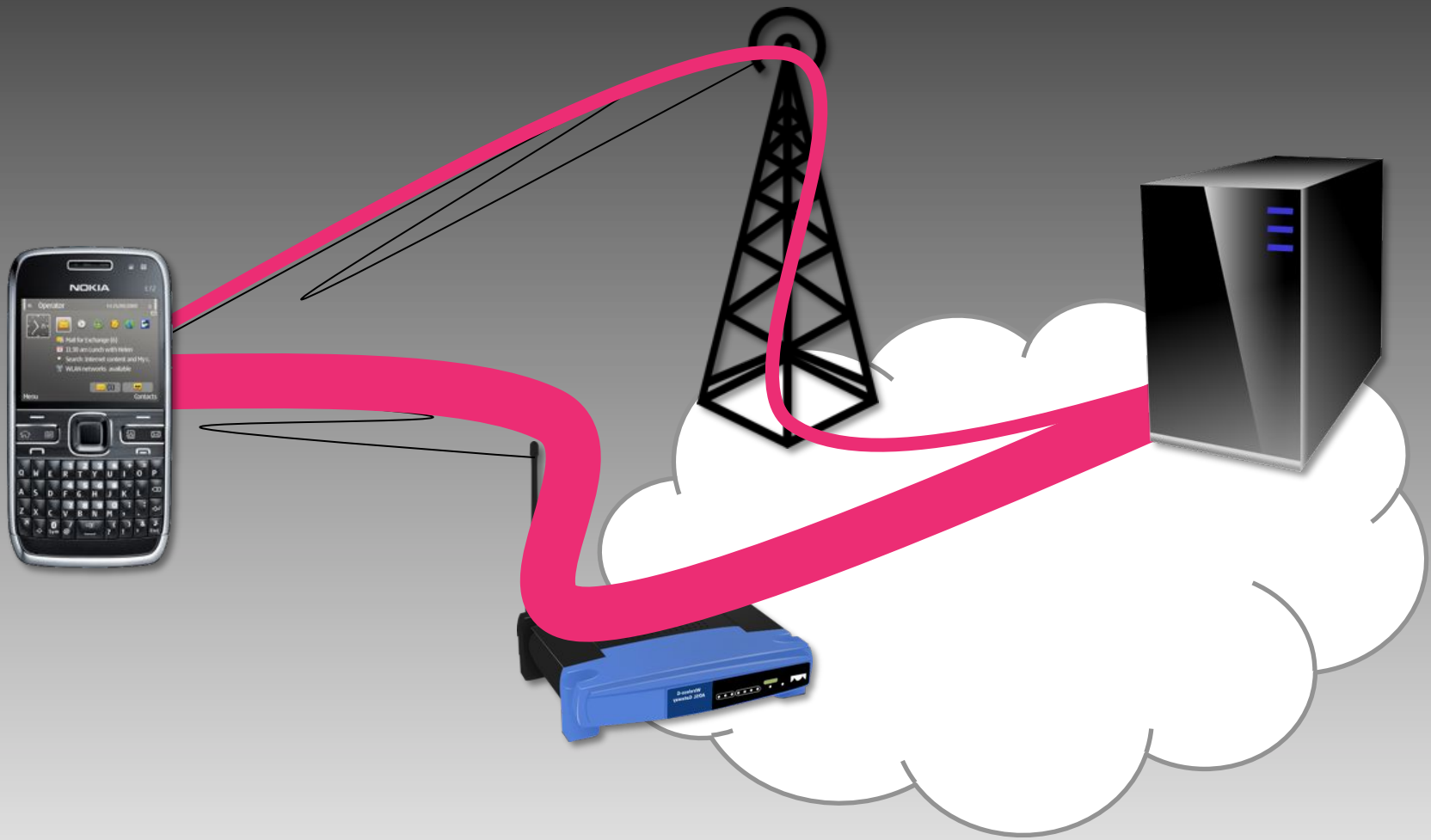

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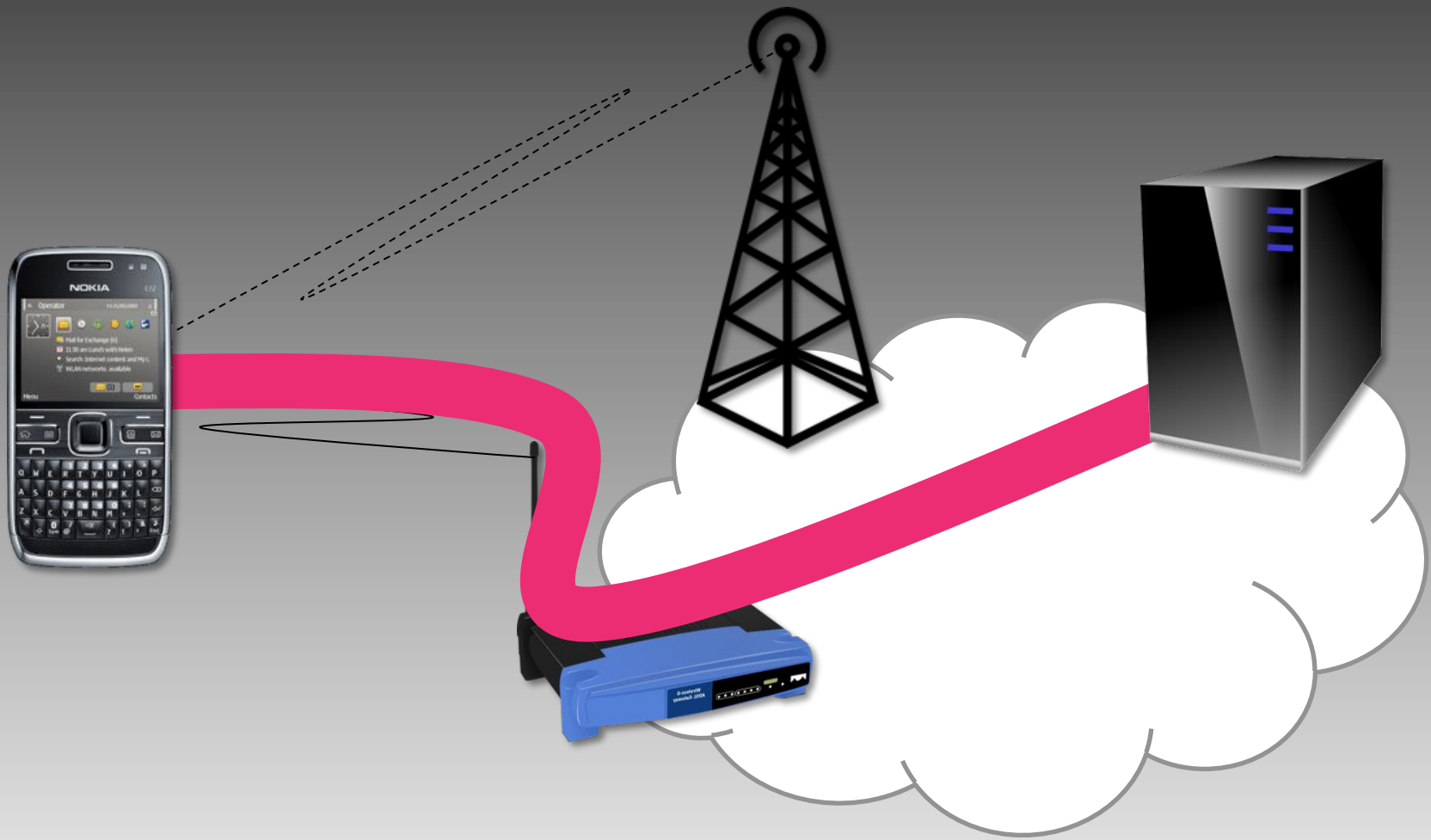
Illustration



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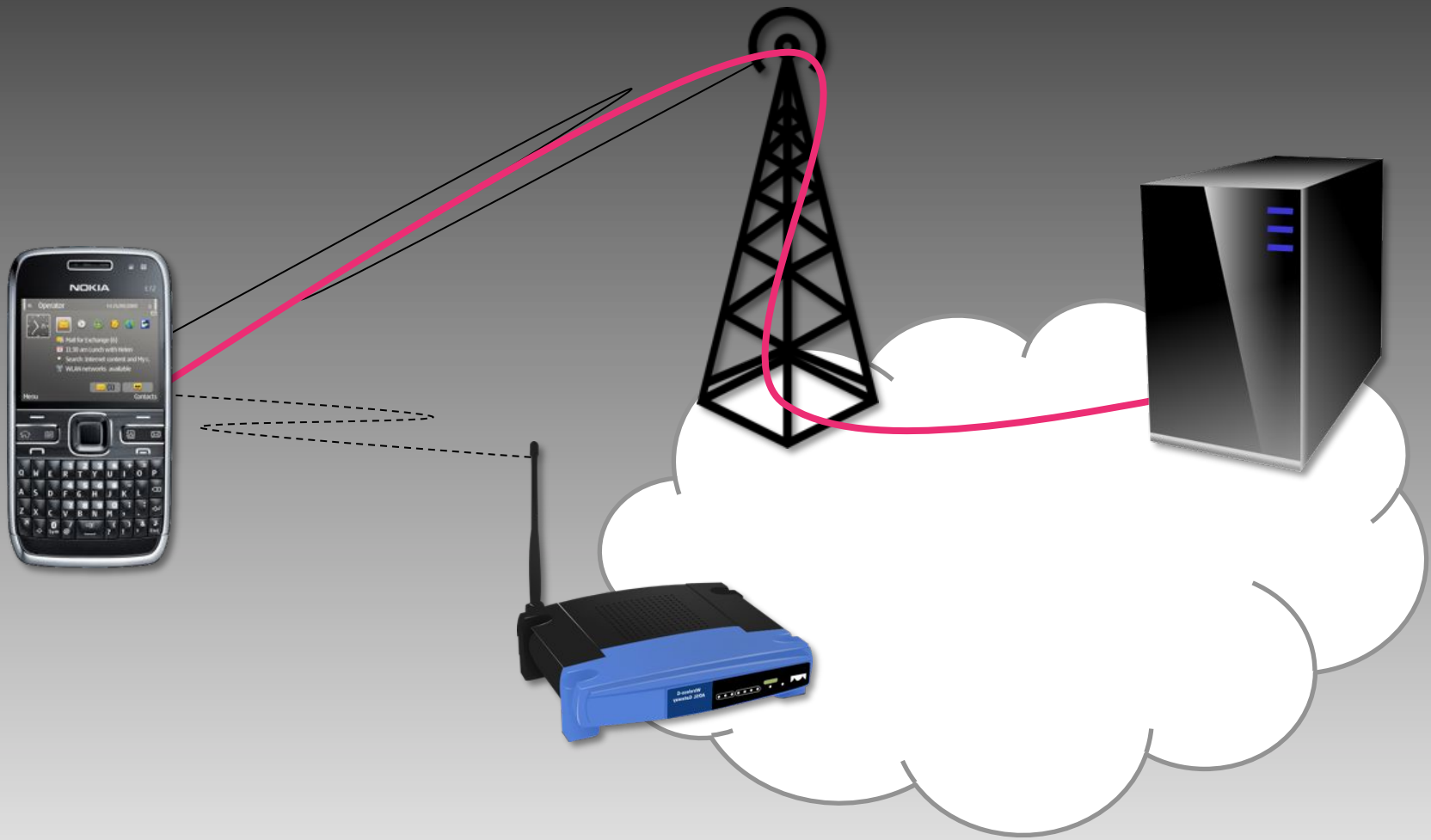

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Multipath TCP for mobile devices

It's mostly about the flexibility of shifting established connections between radios

And not so much about using aggregate capacity

Early indications show this can conserve energy when done smartly

Esp. attractive for "notification"-style connections (long-lived, low data rate)

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