



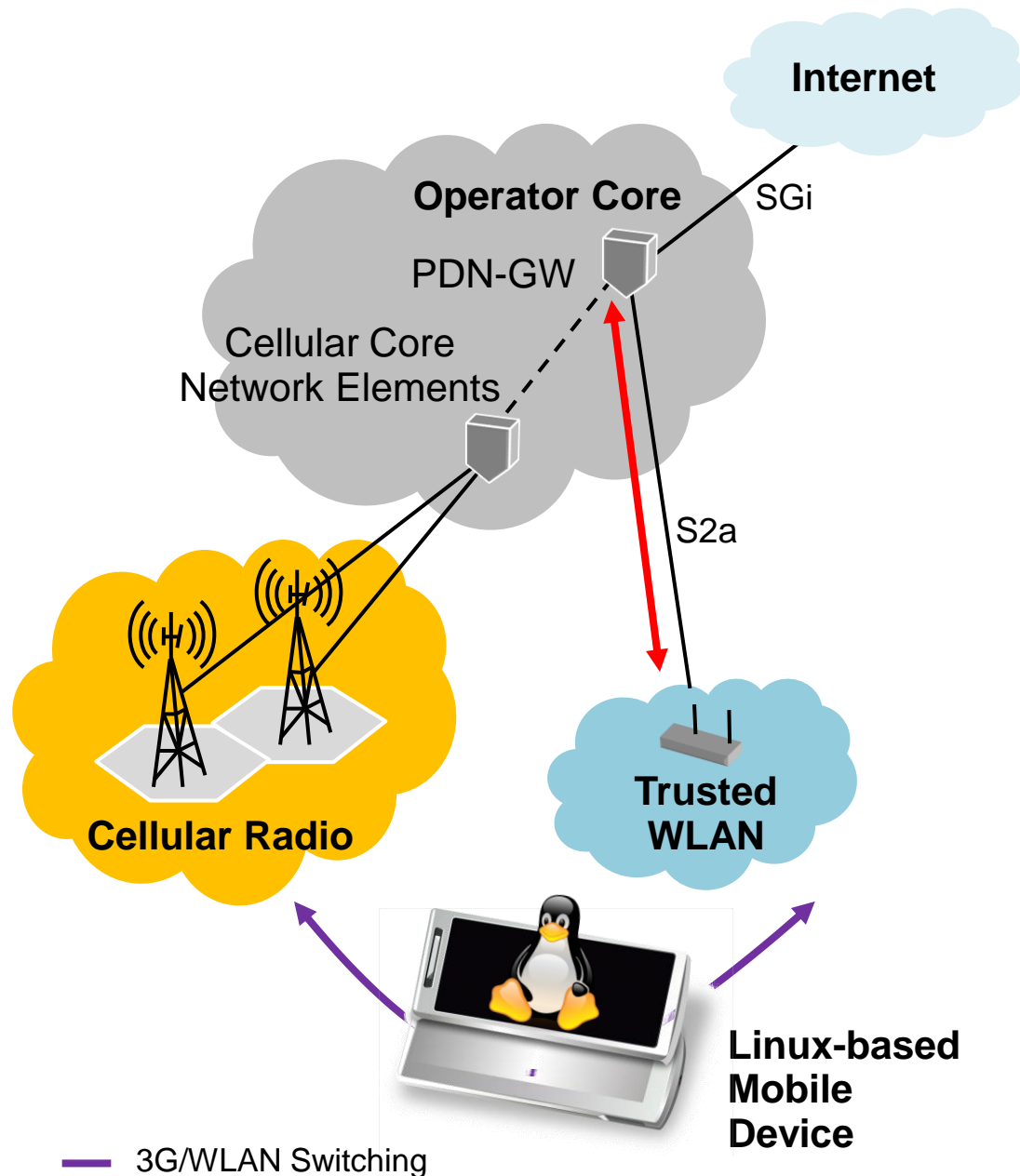
Implementing Automatic Handover Solutions for Linux-Based Mobile Devices

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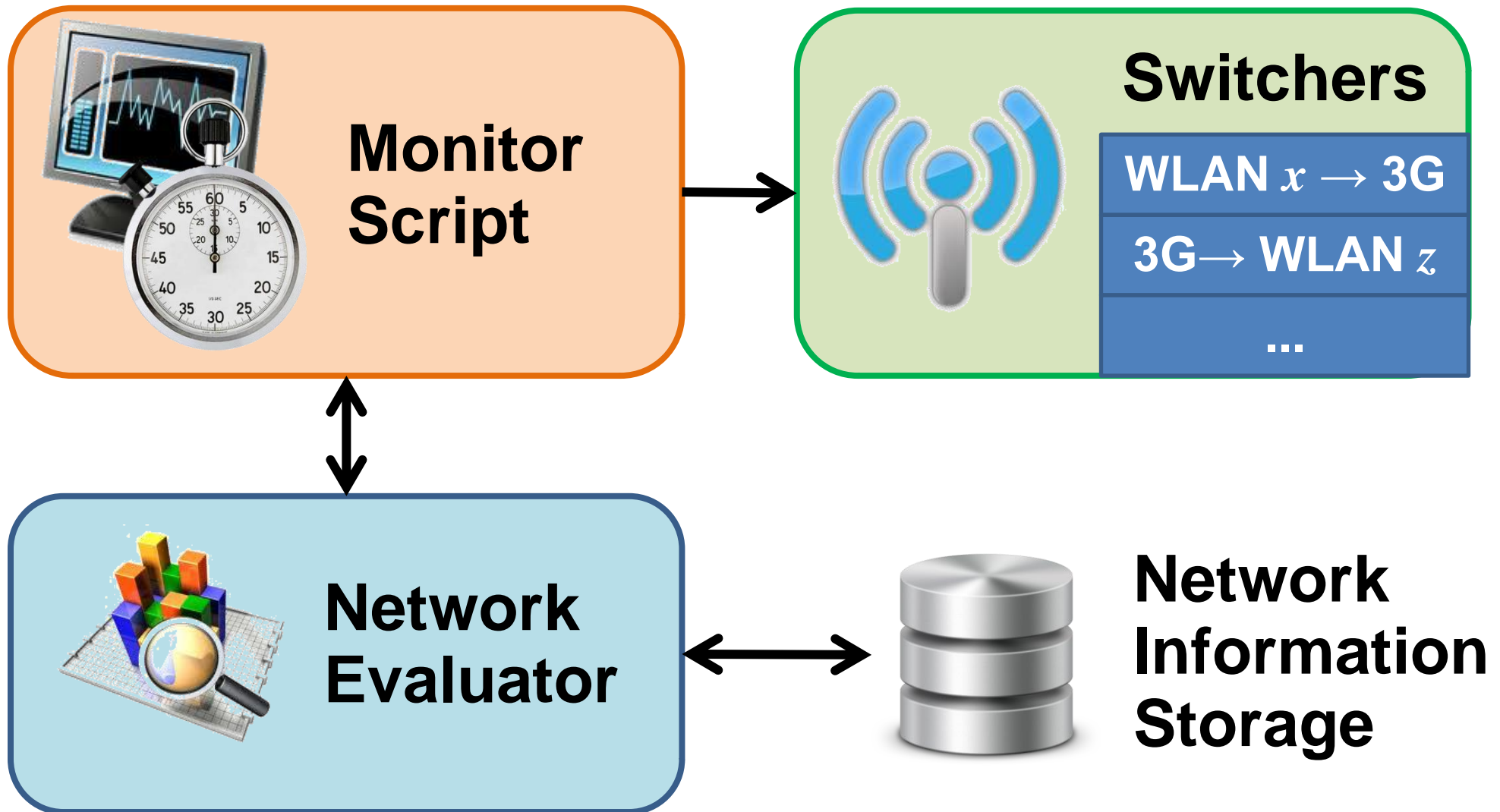
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Problem Statement

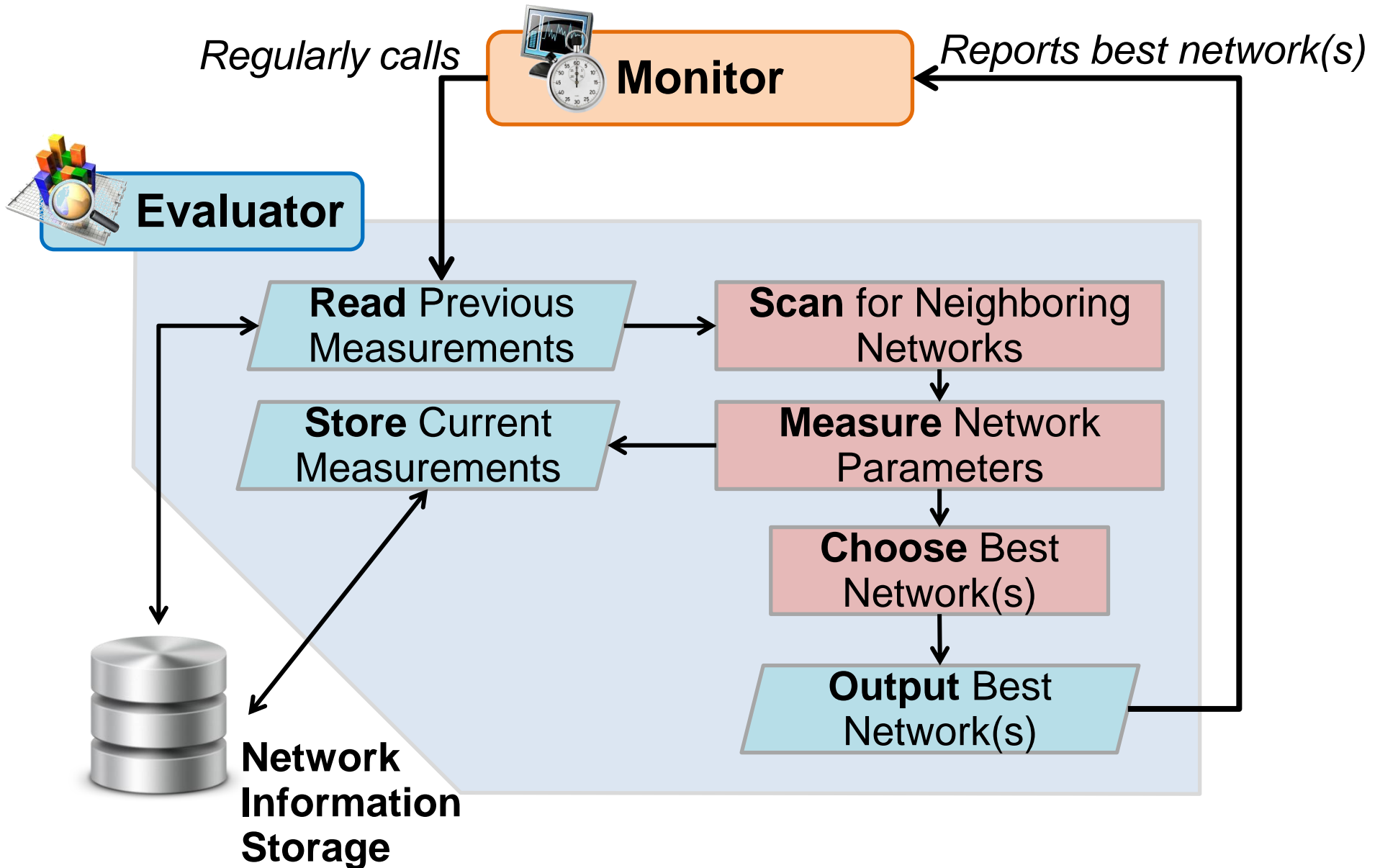


- Flexible **client-side** handover solution
- **Automatic** handover – no manual user intervention
- Must work on **Linux-based devices** with minimal adaptation
- Always choose **best WLAN (by some criteria)**

Core Components



Evaluator Control Flow



Framework Components



Persistence
(using *Google Protocol Buffers*)

Vote for Best Network



Measurement Series

Fixed Components



Scanners, which
detect networks



**Network Parameters &
Measurement Units**



Measurers, which
measure network
parameters



Evaluators, which
rank networks

Customizable Components
(default implementations provided)

Example: Signal Strength

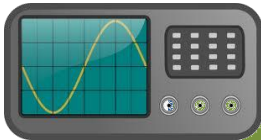


Goal: rank WLANs by received signal strength
(more is better)

4 Components Implemented in ~400 LOC:



WLAN Scanner (using *iwlist scanning*)



WLAN Measurer (using results from the scanner)

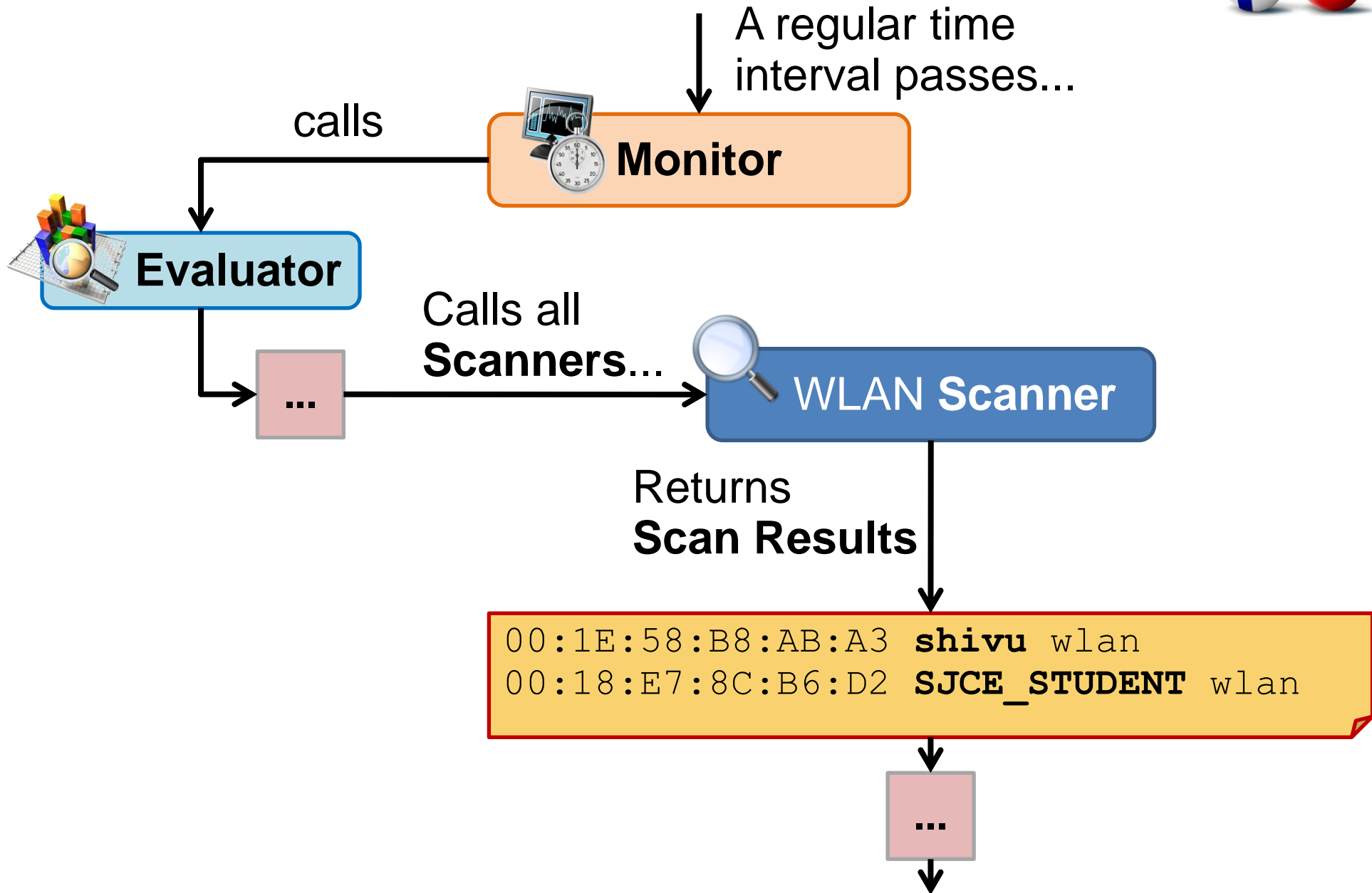


Parameter “Signal Strength” and
Measurement Units “dBm” and “%”



Signal Strength Evaluator. Network rank =
its signal strength in %.

Example: Signal Strength



Example: Signal Strength



WLAN Scanner returns
Scan Results

Network Type

Unique Network ID

```
00:1E:58:B8:AB:A3 shivu wlan
00:18:E7:8C:B6:D2 SJCE STUDENT wlan
```

Info from all
scanners
is **consolidated**

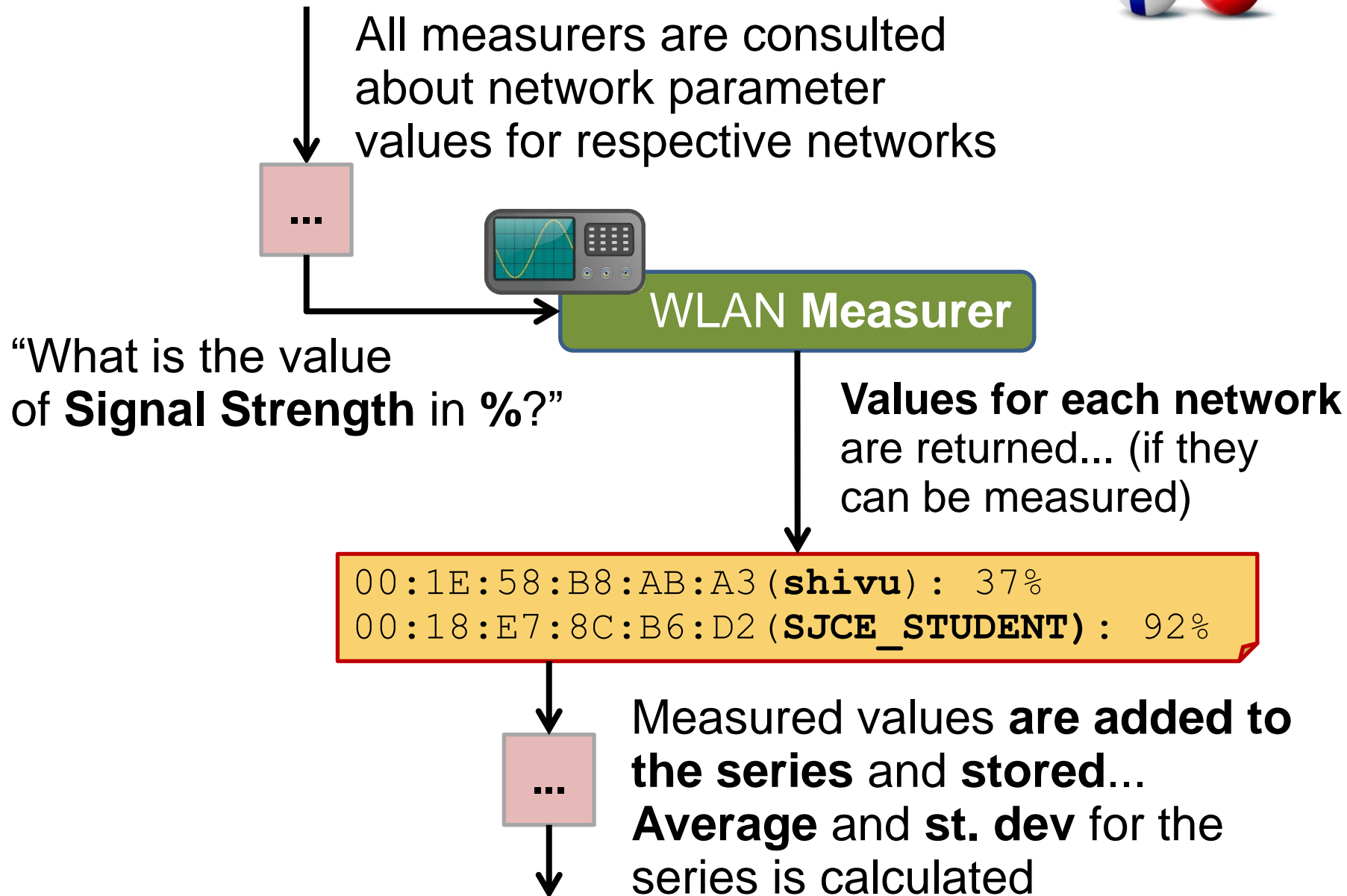
**Human-Readable
Network Name**



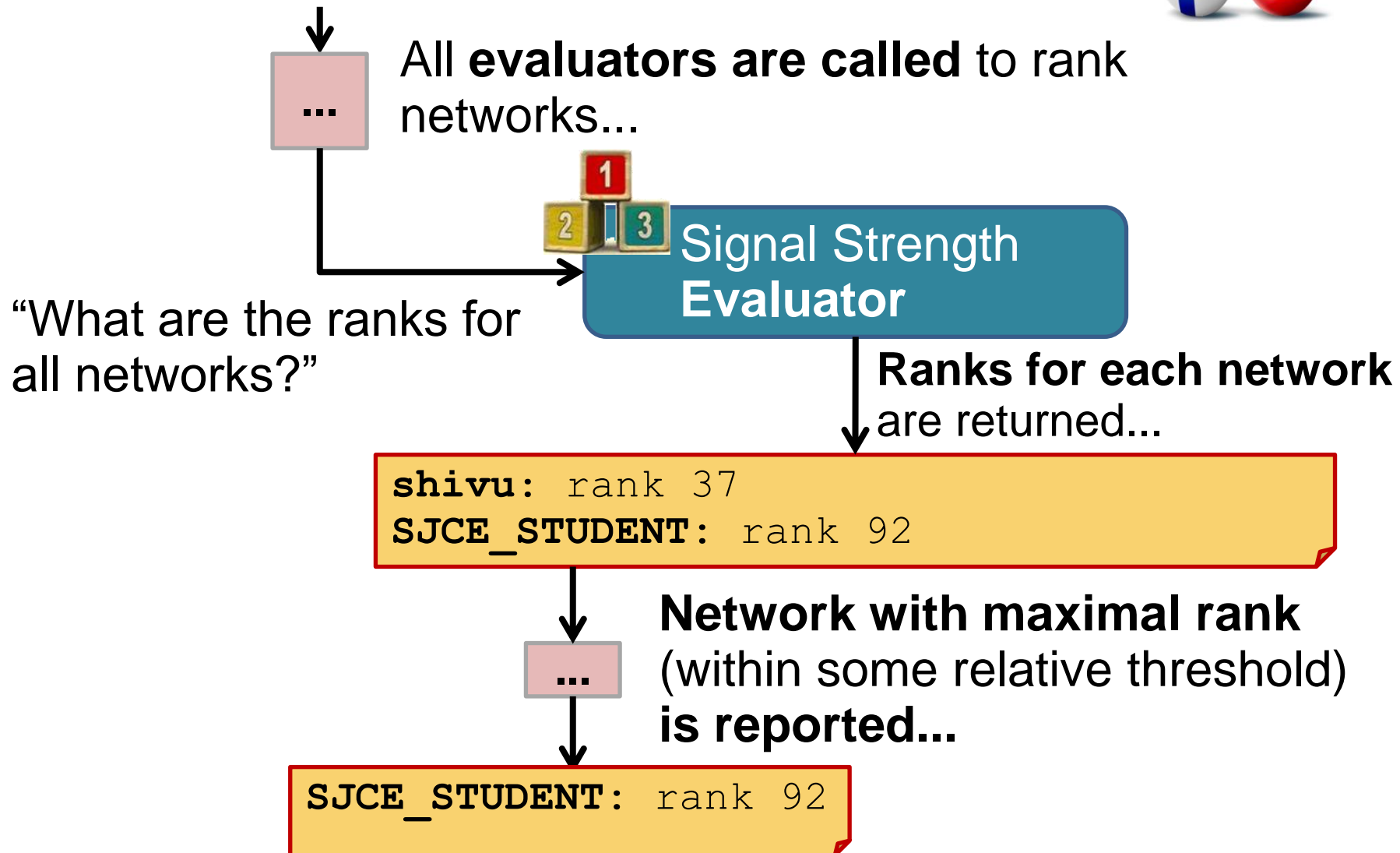
Network Information Object

Information about
non-existent networks
is **removed...**

Example: Signal Strength



Example: Signal Strength



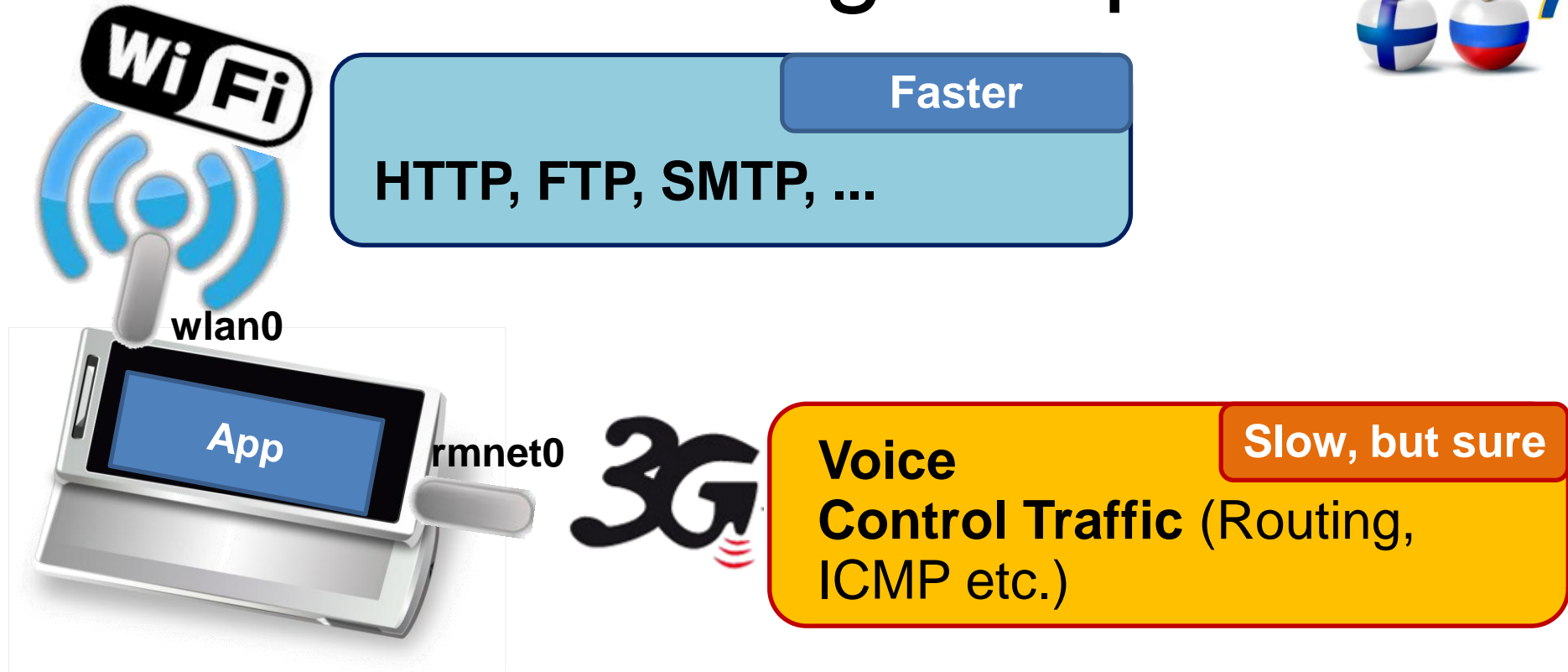
This was the only one evaluator, so **no voting**.
SJCE_STUDENT wins.

Subtle Details



- **Last network state** is always kept
 - And automatically discarded if too old
- **Automatic** conversion of measurement units
- **Careful calculation** of mean and st.dev.
- **Stability:**
 - **Network can safely disappear from scanning results** for a brief period of time. It would not participate in ranking, but **is not deleted**
 - Network ranks are compared within a configurable **threshold**
 - **Network existence time** is tracked; too early appearing networks are not ranked

Better Switching Scripts



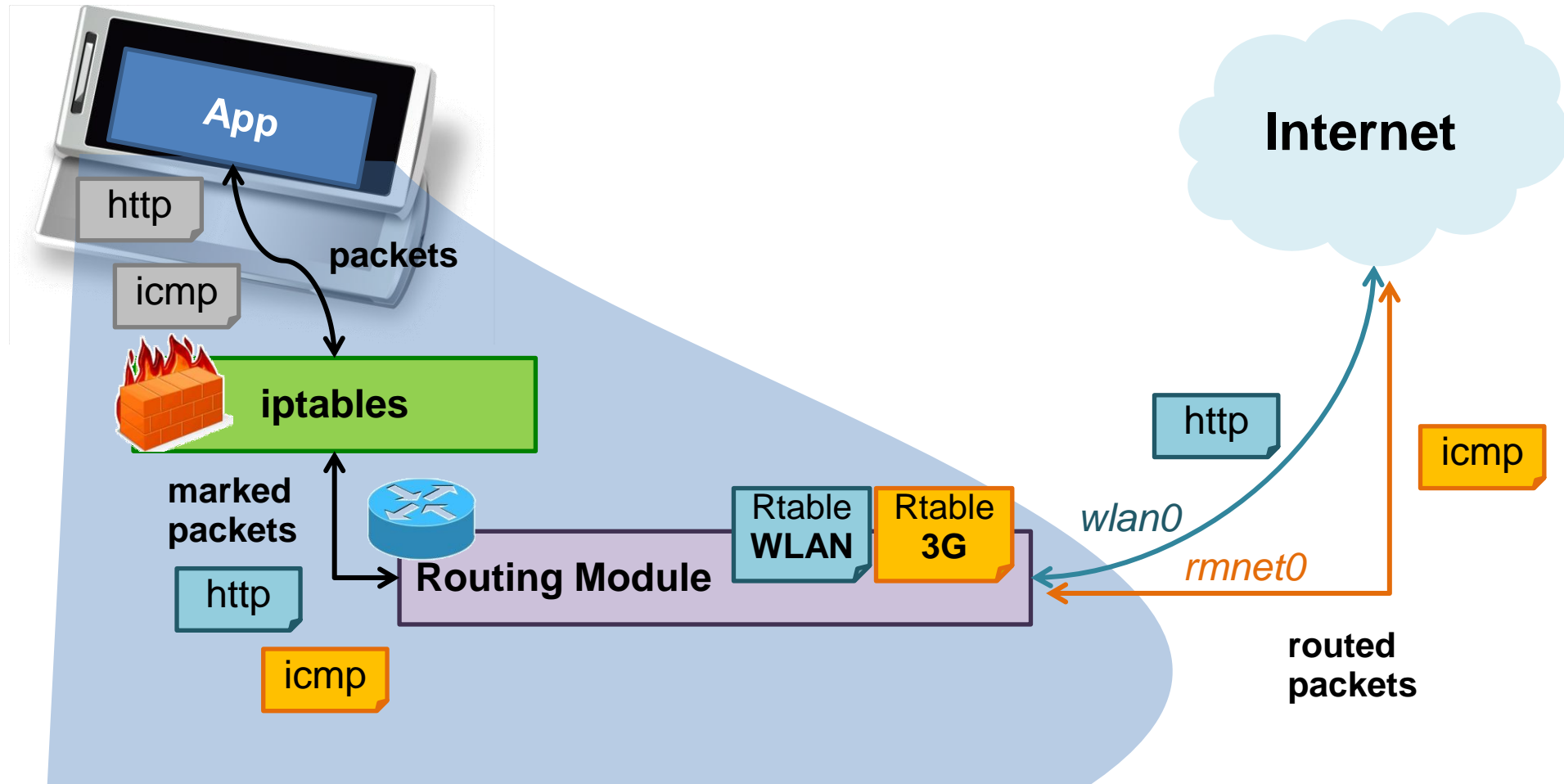
Routing part of the traffic through 3G, and other part through WLAN

- **When both WLAN and 3G are available, traffic is divided**
 - Division by protocol type, port #, etc.
 - Switching scripts **switch between WLANs** to get best signal, throughput etc.
- Else, everything goes through 3G

Better Switching Scripts



Modern Linux has a powerful firewall (**iptables**) and supports multiple routing tables (**iproute2**). We use both to mark traffic and route marked traffic through desired interfaces when 3G and WLAN is available:



Target Platforms



Required

Linux Kernel 2.6.28+
Qt 4.7+, QtMobility 1.2+
libprotobuf-lite

Recommended

iproute2
iptables
openvpn & tun.ko
wireless-tools

Results & Future Work



Current Results

- **Created a flexible framework** for creation of custom handover solutions *on the client side*
- **Successfully implemented and tested** a signal-strength based handover solution
- **Improved Network Switchers** offload some traffic through WLAN (e.g., heavy downloads, web surfing)

Future Work

- **Transparent switching between WLANs** while offloading traffic from 3G
- Offloading based on **environmental parameters** (e.g., more battery-consuming network gets less traffic)
- Take **multiple network parameters** into account when deciding which WLAN is best



Questions?



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