COGNITIVE RADIO BASED OPTIMAL CHANNEL SENSING FOR RESOURCE ALLOCATION IN COMMUNICATIONS

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Presentation Outline

- Introduction
- Problem Statement
- Aim of the Research
- Methodology
- Research Tools
- System Model
- Performance Analysis
- Conclusions & Future Work

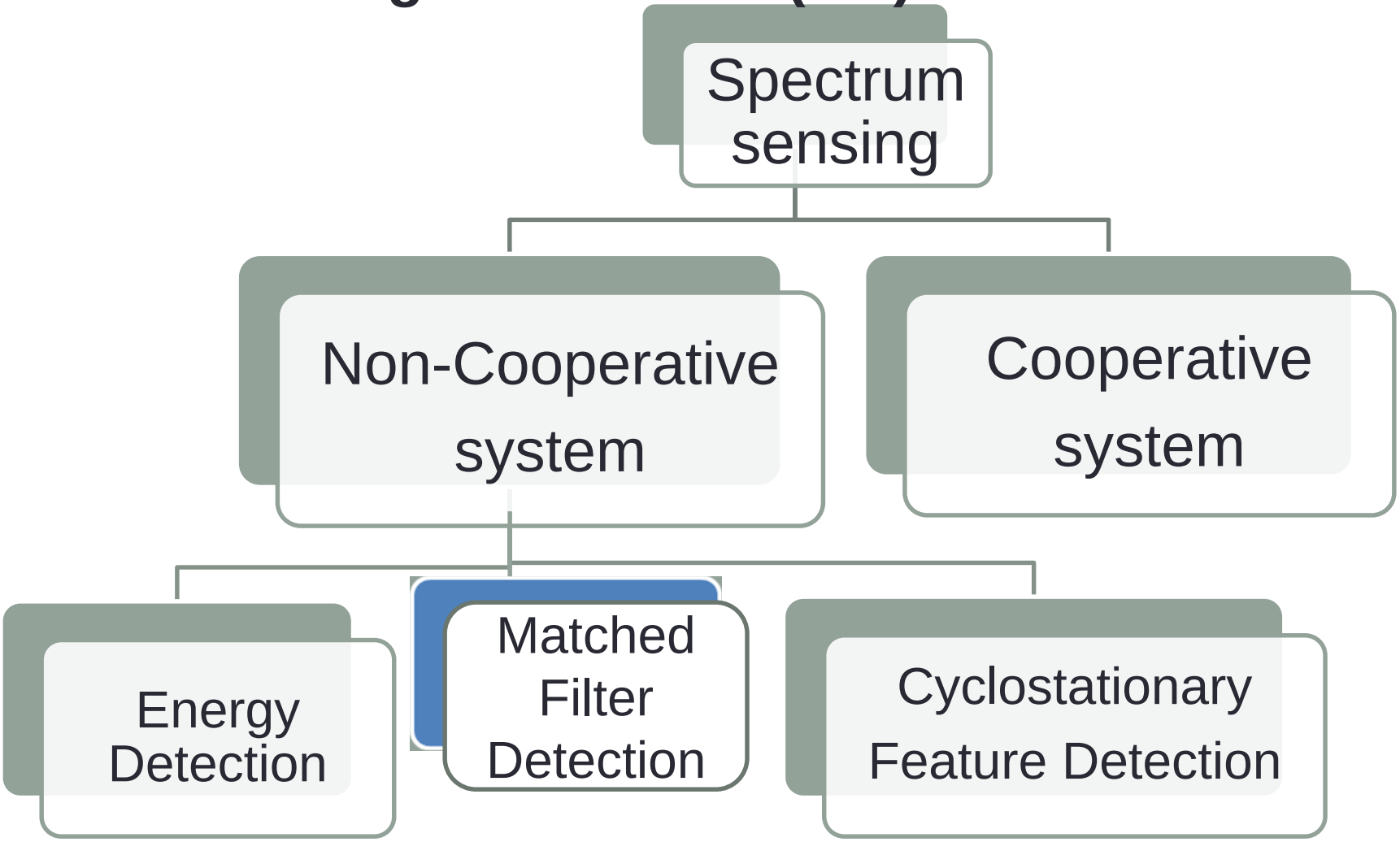
Introduction (1/2)

What is Cognitive Radio?

- An Intelligent Radio that can be reconfigured dynamically
- It can automatically detects available channels in a specific time and geographical locations
- User can reconfigure the “software defined radio” as per requirement
- Anytime anywhere communication without interrupting the Licensed user

Introduction (2/2)

Various Cognitive Radio (CR) Detections



Problem Statement

- Now a days the spectrum saturation problem is a critical issue
- So far all the cognitive radio detection technique has been proposed are Based on computer simulations, or using very complex Laboratory equipment.
- A trade off between complexity and accuracy is need to be resolved

Aim of the Research

To develop a Simple Cognitive Radio Detection Method for Android SmartPhone with Simple Architecture.

Measure the Performance of the model for validation.

Methodology

Develop the model for optimal channel detection

Develop an application for CR detection using Java Eclipse

Measure the performance of the developed application and generate Log files

Test the model in real test bed environment

Data collection and performance analysis

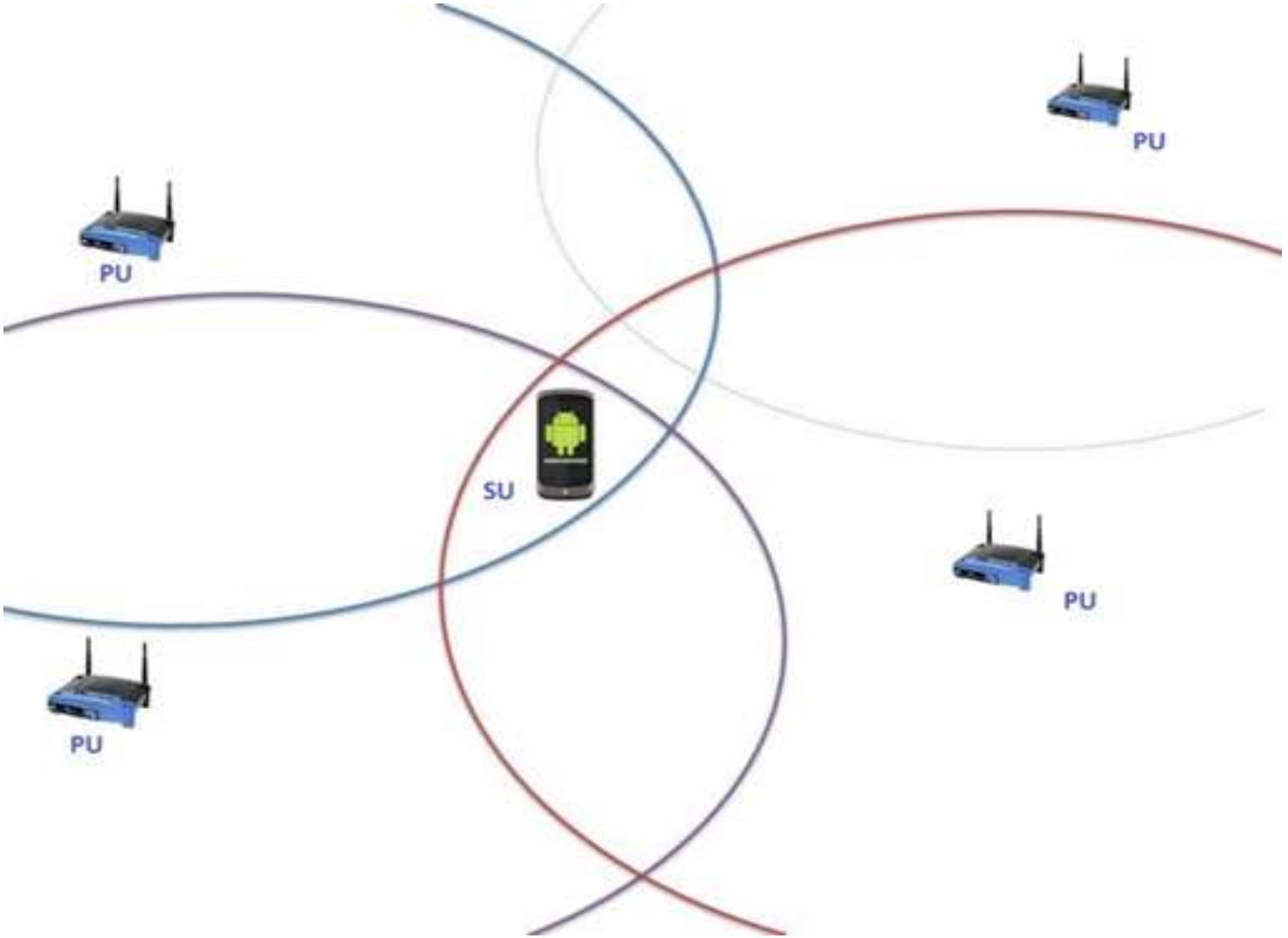
Research Tools

Android based Smartphone (Android version 4.0 or above)

Eclipse SDK for Application Development

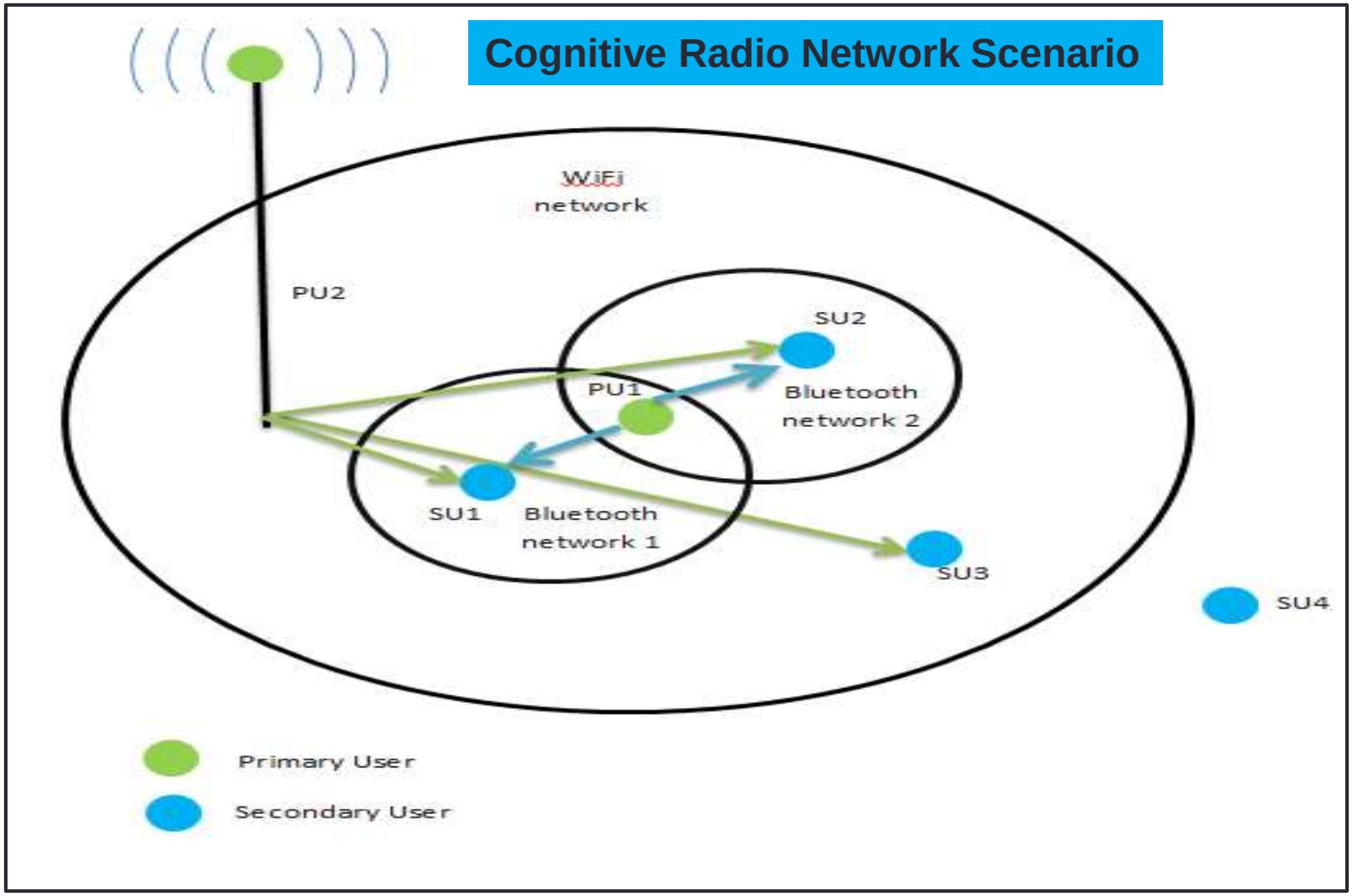
MATLAB R2012a for Performance Measurement

System Model (1/4)



Assumed System Model for Cognitive Radio detection

System Model (2/4)



System Model (3/4)

Java eclipse emulation Scenario

System Model: Analytical Model and Algorithm (4/4)

The presence or absence of PU detection criteria: H_0 ➔ Absence; H_1 ➔ Presence

$$x(t) = \begin{cases} w(t), & H_0 \\ h(t).s(t) + w(t), & H_1 \end{cases} \quad (1)$$

Where, x(t) = Received signal power by SU, w(t) = Noise power, h(t) = Channel gain, s(t) = Received PU signal.

Pseudo-code for Successful Free Channel Detection ➔

```
{
 int Threshold = -98 dBm // Noise floore level
  if (Signal.level <= Threshold)
            percentage = 0;        // Under H0
  else if (Signal.level >= -50 dBm)
              percentage = 100; // Under H1
  else
             percentage = 2 * (Signal.level + 100);
            }
freeChannelDetection% = 100 - percentage;
```

Performance Analysis (1/2)

Distance (meter)	Received Signal Strength (RSS) in dBm			
	Day 1 (cloudy noon)	Day 2 (sunny afternoon)	Day 3 (clean evening)	Average Value
20	-35	-36	-34	-35.00
40	-47	-46	-48	-47.00
60	-57	-56	-58	-57.00
80	-64	-63	-67	-64.67
100	-68	-70	-71	-69.67
130	-74	-77	-76	-75.67
160	-80	-82	-79	-80.33
200	-85	-82	-84	-83.67
250	-89	-89	-87	-88.33
300	-94	-97	-95	-95.33
350	-100	-97	-98	-98.33
370	fail	-100	-100	-100.50
400	fail	fail	fail	fail

Real-time experimental RSS values for various distances and conditions

Performance Analysis (2/2)

Interface between hardware and program

Android based Smart Phone

Performance Analysis (3/2)

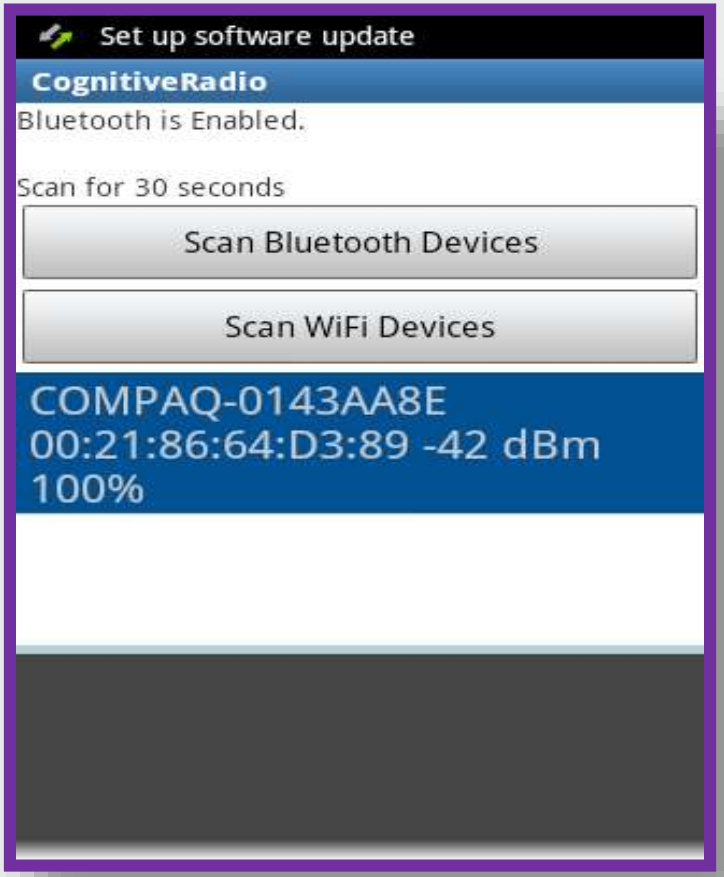
Cognitive Radio Main GUI Layout

Android based Smart Phone

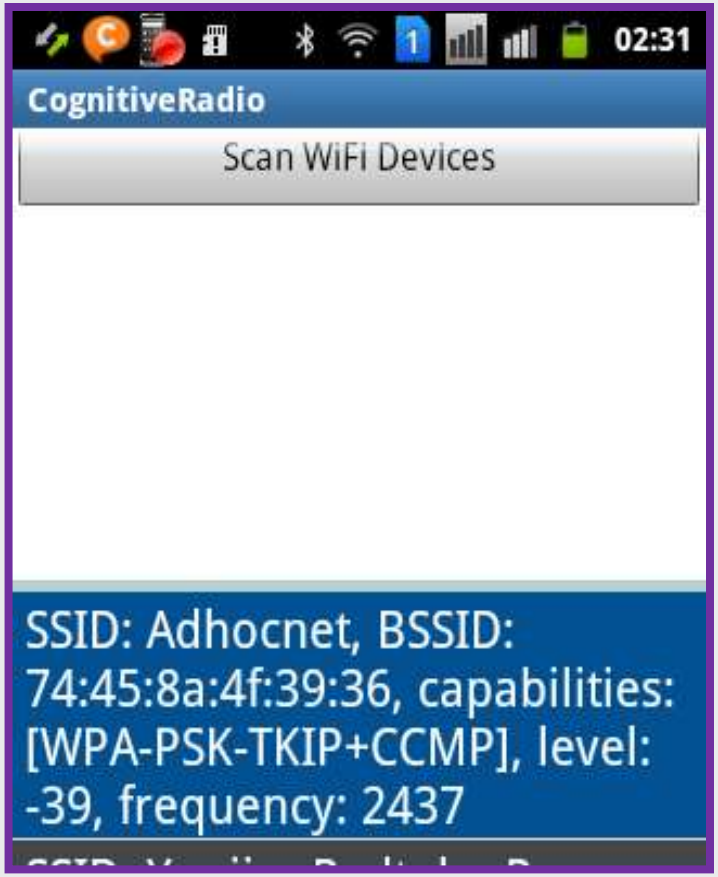
Performance Analysis (4/2)

Bluetooth and WiFi Detection Comparison

Android based Smart Phone



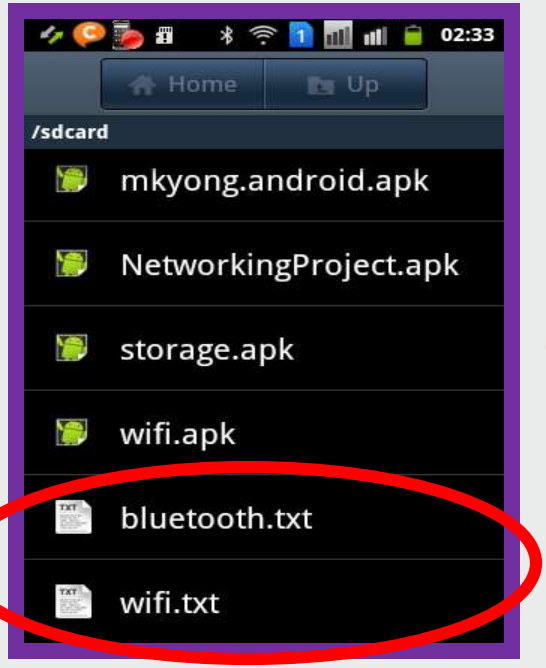
Bluetooth

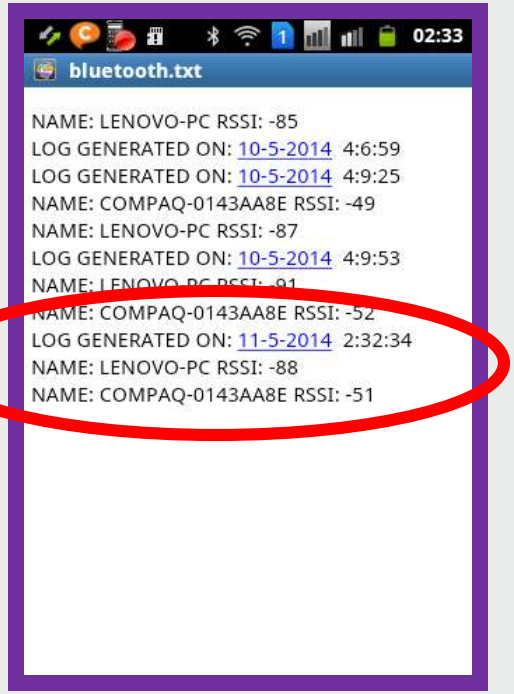


WiFi

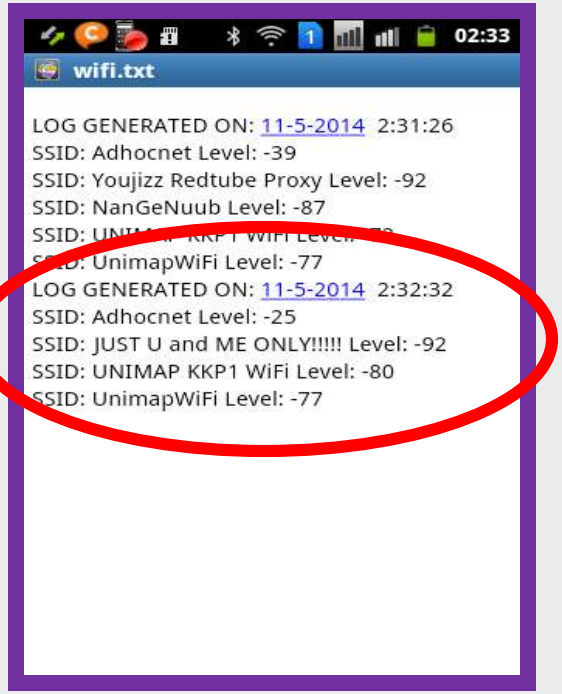
Performance Analysis (5/2)

Generated Log Files





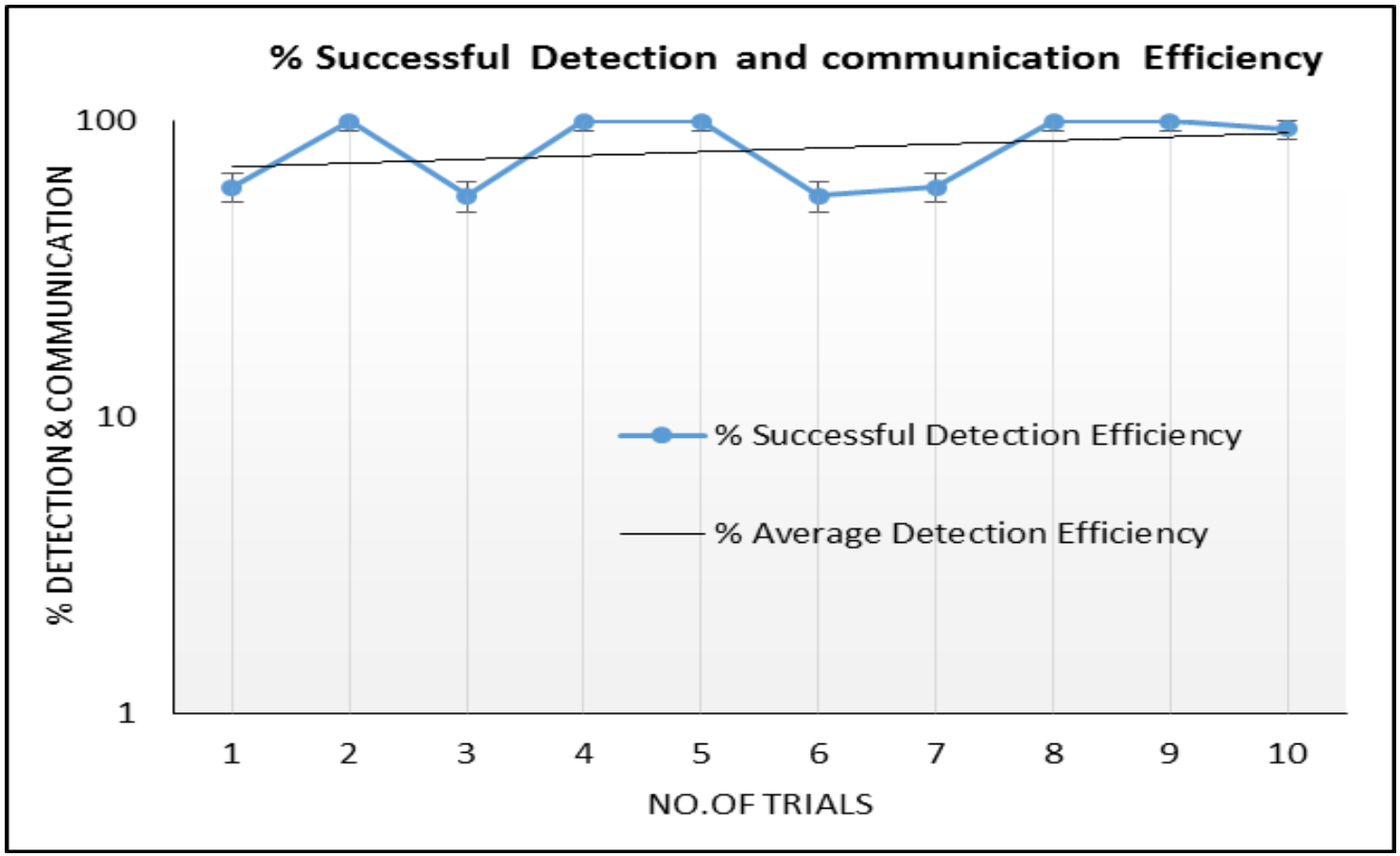
Bluetooth



WiFi

Performance Analysis (5/2)

Successful Detection and Communication Efficiency



- Most cases detection **100%** successful
- Avg detection efficiency approximately: **83%**

Conclusions & Future Work

❖ Cognitive radio network implementation has been done with successful cognitive radio channel detection and secondary user's communication without affecting primary user.

❖Efficiency of cognitive radio network environment has been verified and validated experimentally through test-bed using Android based smart phone. Most of the cases the successful detection efficiency is 100%.The average System efficiency is about 83%

❖Cognitive radio network perform as wanted.

❖ Future Work : Multi hop cognitive radio with automatic detection of Bluetooth and WiFI devices.

THANK YOU