

2016 WNFA LAB2

USRP

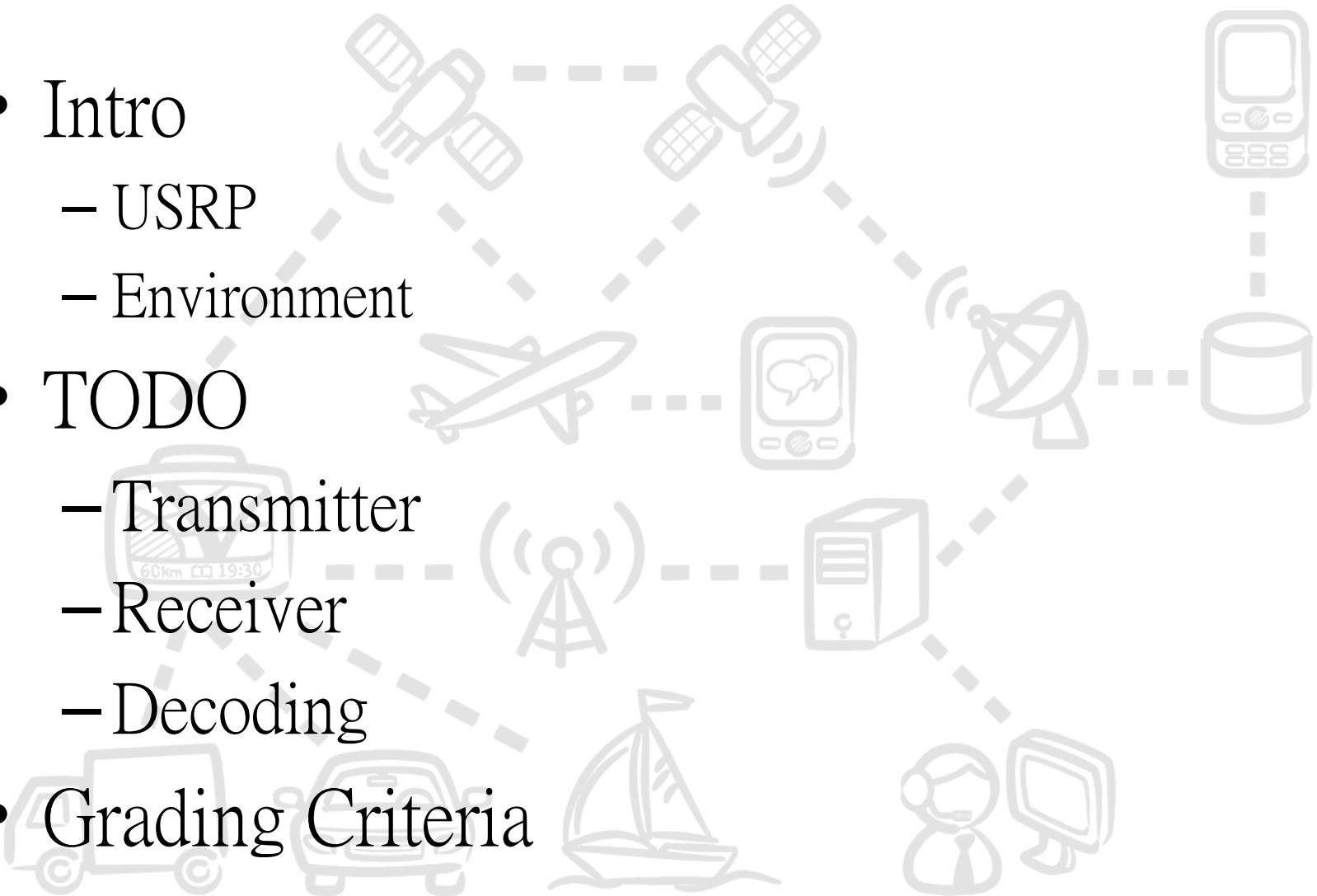
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2016.3.25



Outline

- Intro
 - USRP
 - Environment
- TODO
 - Transmitter
 - Receiver
 - Decoding
- Grading Criteria



Intro

What is USRP



- Universal Software Defined Radio

- Expensive !
- Use C++/ python/ GUI to define the radio !!

- Official document

- https://www.ettus.com/content/files/07495_Ettus_N200-210_DS_Flyer_HR.pdf





- UHD
 - USRP Hardware Driver
 - C++ API
 - <http://files.ettus.com/manual/>
 - <https://github.com/EttusResearch/uhd>
- UHD tool
 - **uhd_find_devices**
 - This program scans the network for supported devices and **prints out a list of discovered devices and their IP addresses.**

```
mvnl@mvnl-ThinkPad-Edge:~$ uhd_find_devices
linux; GNU C++ version 4.8.4; Boost_105400; UHD_003.010.git-156-g2d68f
-----
-- UHD Device 0
-----
Device Address:
  type: usrp2
  addr: 192.168.91.6
  name:
  serial: E6R17S6UN
-----
-- UHD Device 1
-----
Device Address:
  type: usrp2
  addr: 192.168.91.8
  name:
  serial: F2F7F3
```



– uhd_usrp_probe

- This program constructs an instance of the device and prints out its properties, such as detected daughterboards, frequency range, gain ranges,

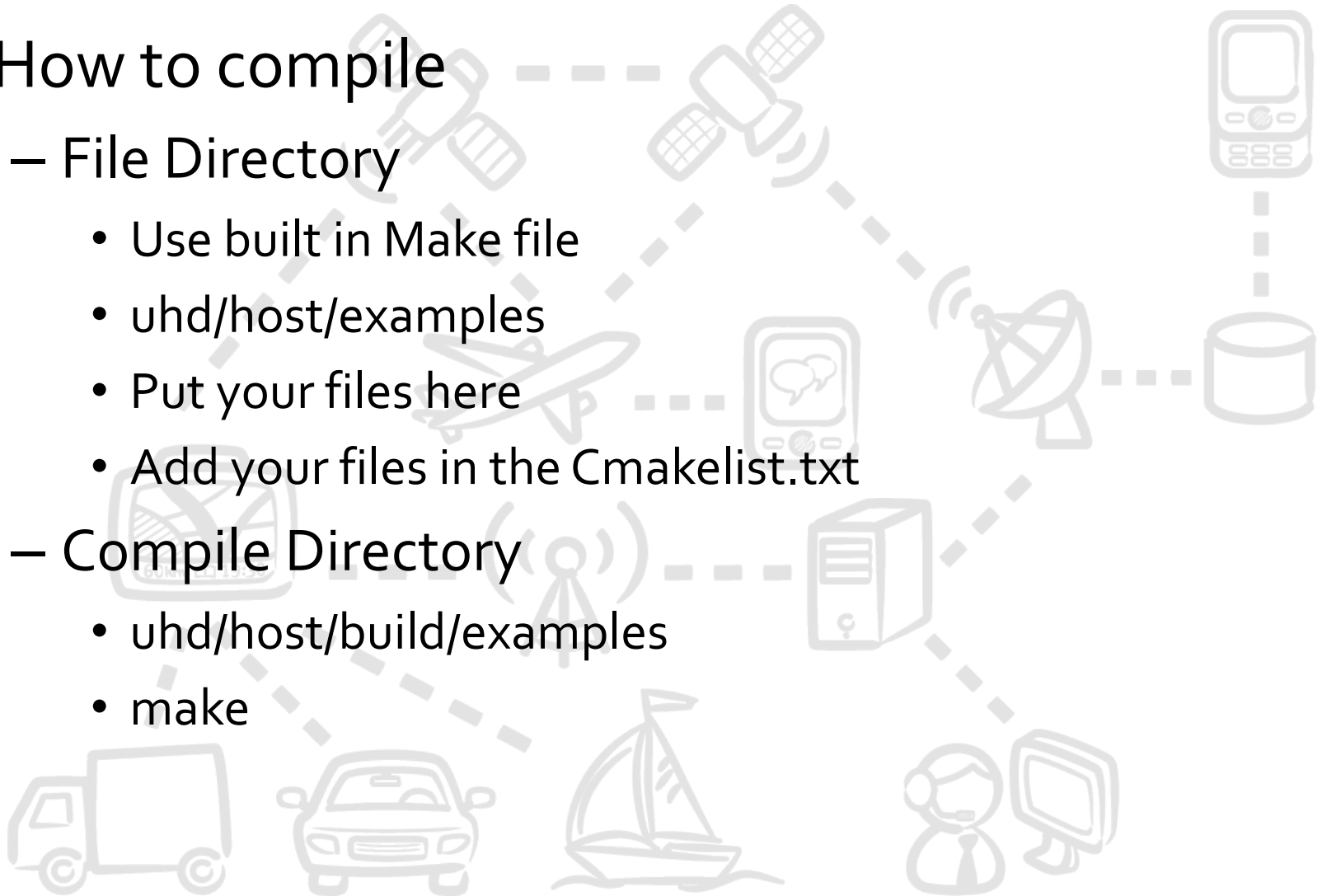
```

TX Dboard: A
ID: XCVR2450 (0x0060)

TX Frontend: 0
Name: XCVR2450 TX
Antennas: J1, J2
Sensors: lo_locked
Freq range: 2400.000 to 6000.000 MHz
Gain range VGA: 0.0 to 30.0 step 0.5 dB
Gain range BB: 0.0 to 5.0 step 1.5 dB
Bandwidth range: 24000000.0 to 48000000.0
Connection Type: QI
Uses LO offset: No

TX Codec: A
Name: ad9777
Gain Elements: None
  
```


- How to compile
 - File Directory
 - Use built in Make file
 - uhd/host/examples
 - Put your files here
 - Add your files in the Cmakelist.txt
 - Compile Directory
 - uhd/host/build/examples
 - make



Intro Environment

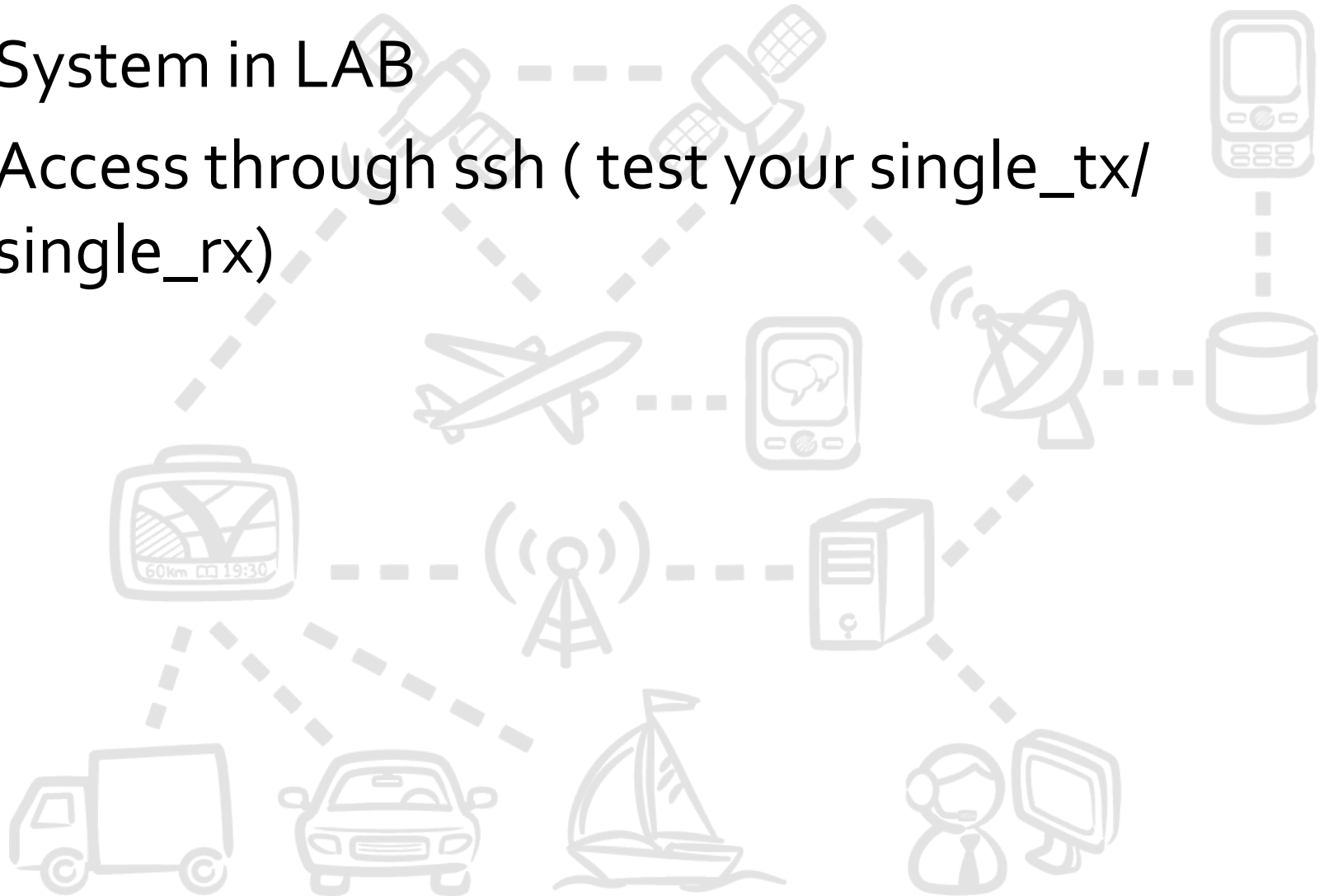


Last year.....

	USRPs	5/8(五)	5/9(六)	5/10(日)	5/11(一)	5/12(二)	5/13(三)	5/14(四)	借用說明	
09:30 ~ 11:30	USRP 1,2	WNFA Lecture	No reservation slot		x	x	x	Demo Day	1	在該時段及哪組USRP，著名組別
	USRP 3,4			第四組	x	x	2		每周時段借用限制	
	USRP 5,6				x	x	第十一組		第一週	42/11=3.81 至多四個時段
11:30 ~ 14:30	USRP 1,2	x			第一組	x	x		第二週	57/11=5.18 至多六個時段
	USRP 3,4	x			第四組	x	x		第三週	57/11=5.18 至多六個時段
	USRP 5,6	x			第十組	x	x		註:若這些時段都不方便，請與TA聯絡	
14:30 ~ 17:30	USRP 1,2	x			第一組	x	第二組		3	請在借用時段開始(結束)時至R424找TA借(還)器材，找不到助教可以打0970-913-225(請不要半夜叫助教起來上廁所XD)
	USRP 3,4	x			第四組	x	第七組			
	USRP 5,6	x			第十組	x	第十一組			
17:30 ~ 20:30	USRP 1,2	第七組			第七組	x	第二組		4	務必準時歸還勿影響下一時段借用組別使用之權利
	USRP 3,4	第二組		第五組	第五組					
	USRP 5,6	x		第十組	x					
20:30 ~ 22:30	USRP 1,2	第七組		第七組	第七組	第二組				
	USRP 3,4	第五組		第五組	第五組					
	USRP 5,6	第三組		第十組	第十一組	第十一組				



- System in LAB
- Access through ssh (test your single_tx/
single_rx)



- ssh wnfa_16_[#]@10.5.6.202
 - E.g. wnfa_16_01@10.5.6.202
 - HW code put in ~/uhd/host/example
 - single_tx.cpp
 - single_rx.cpp
 - cd ~/uhd/host/build
 - cmake .. (only the first time)
 - make
 - cd example (now in ~/uhd/host/build/example)
- 

- mkdir wn_trace
- put your **src_data_1.bin** here! (transmitted by Tx
- Transmitter :
 - ./single_tx --f=2.49 --i=128
- Receiver:
 - ./single_rx --f=2.49 --i=128
- Received data in **./wn_trace/recv_signal.bin**

Working Flow : (wn_lab2

- Run `program/matlab/singal_generator.m`
- Get `src_data_1.bin / src_data_1.mat` in `program/trace`
- Upload `src_data_1.bin` to `wnfa_16_[#]account`
- `~/uhd/host/build/example/wn_trace`
- run `./single_tx ./single_rx` under `~/uhd/host/build/example`
- Download ... `example/wn_trace/recv_signal.bin`

- Put `recv_signal.bin` in program/trace
- Run program/decode.m to get the plot



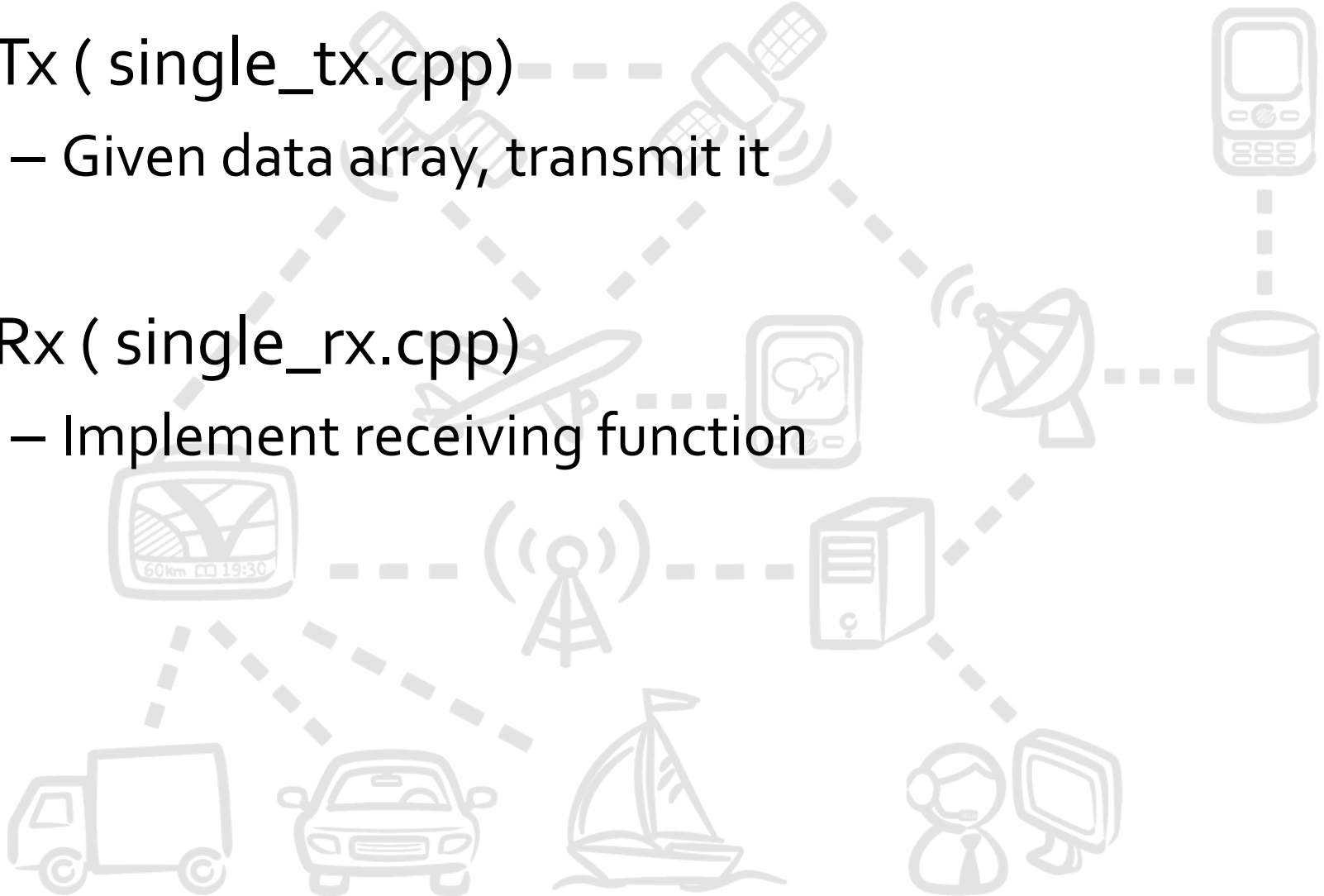
TODO

Tx / Rx



臺灣大學

- Tx (single_tx.cpp)
 - Given data array, transmit it
- Rx (single_rx.cpp)
 - Implement receiving function



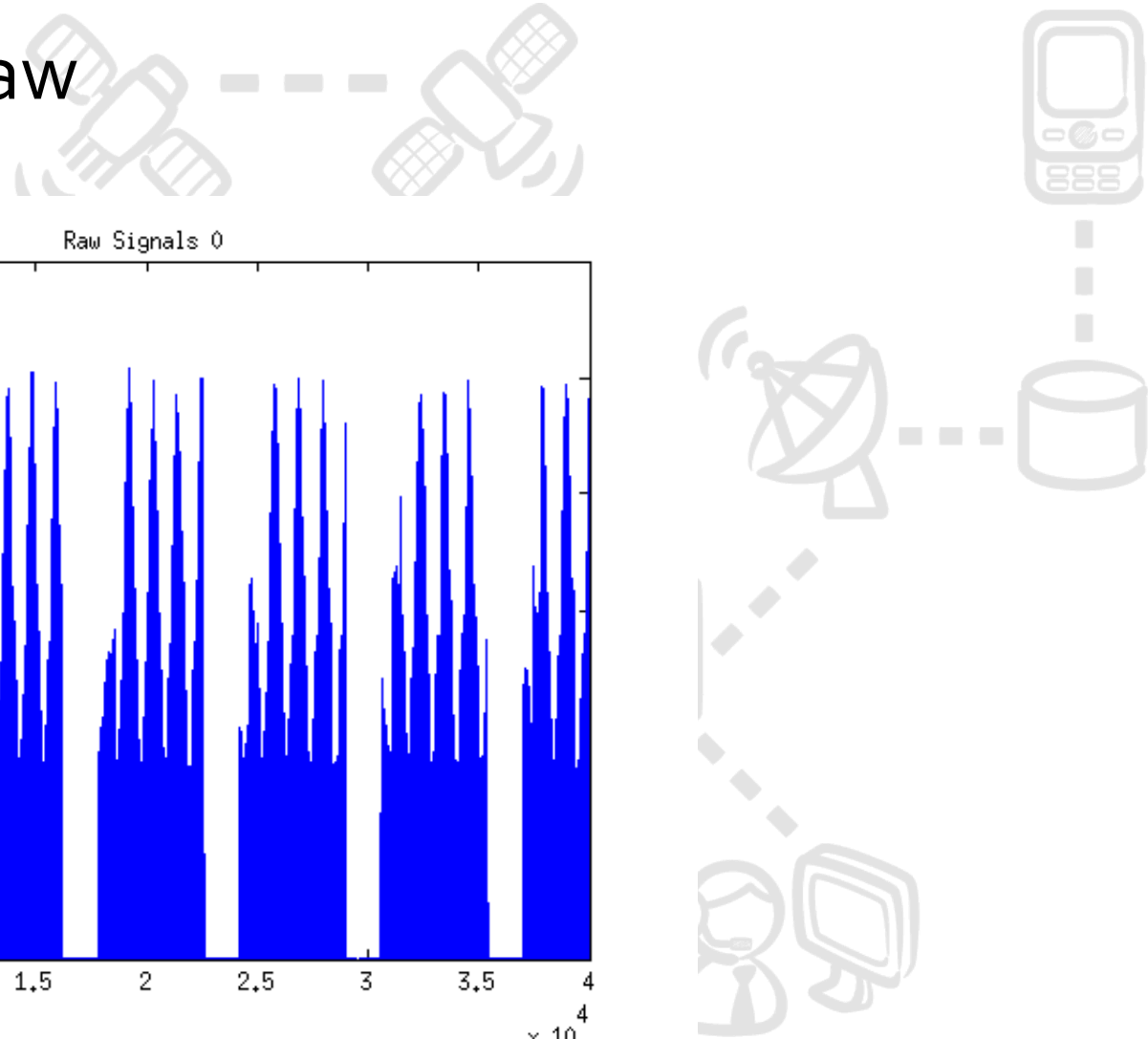
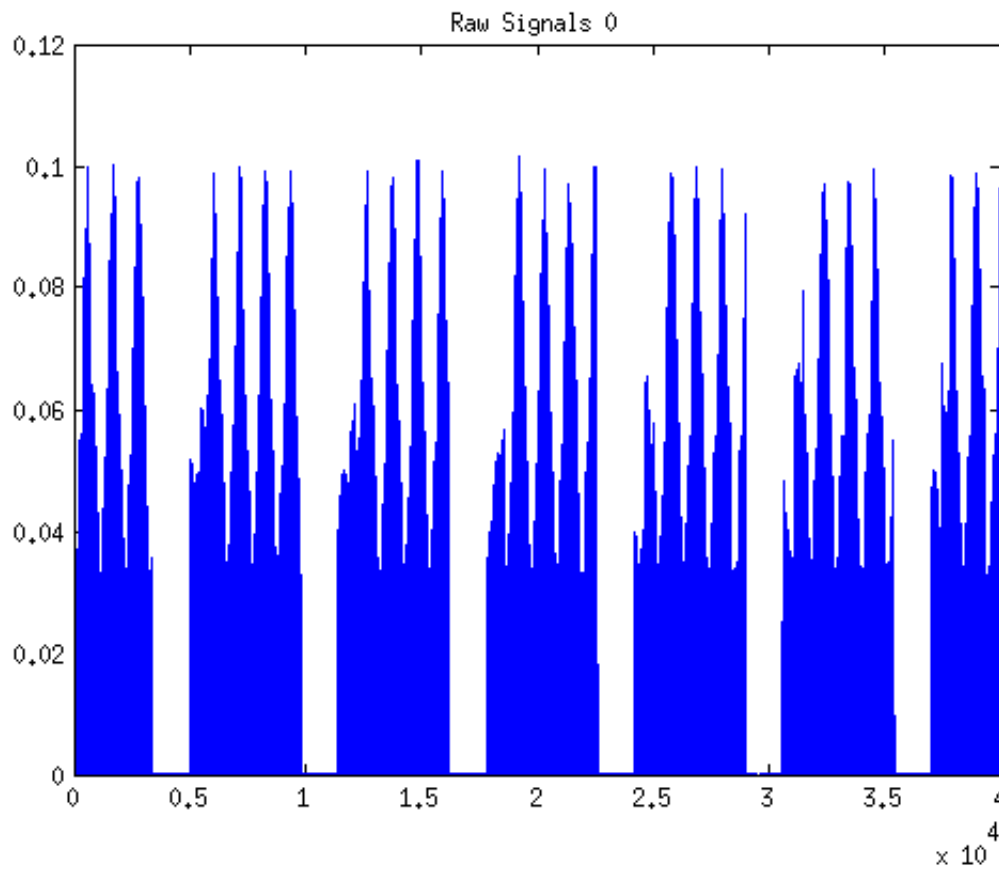
TODO Decoding - MATLAB



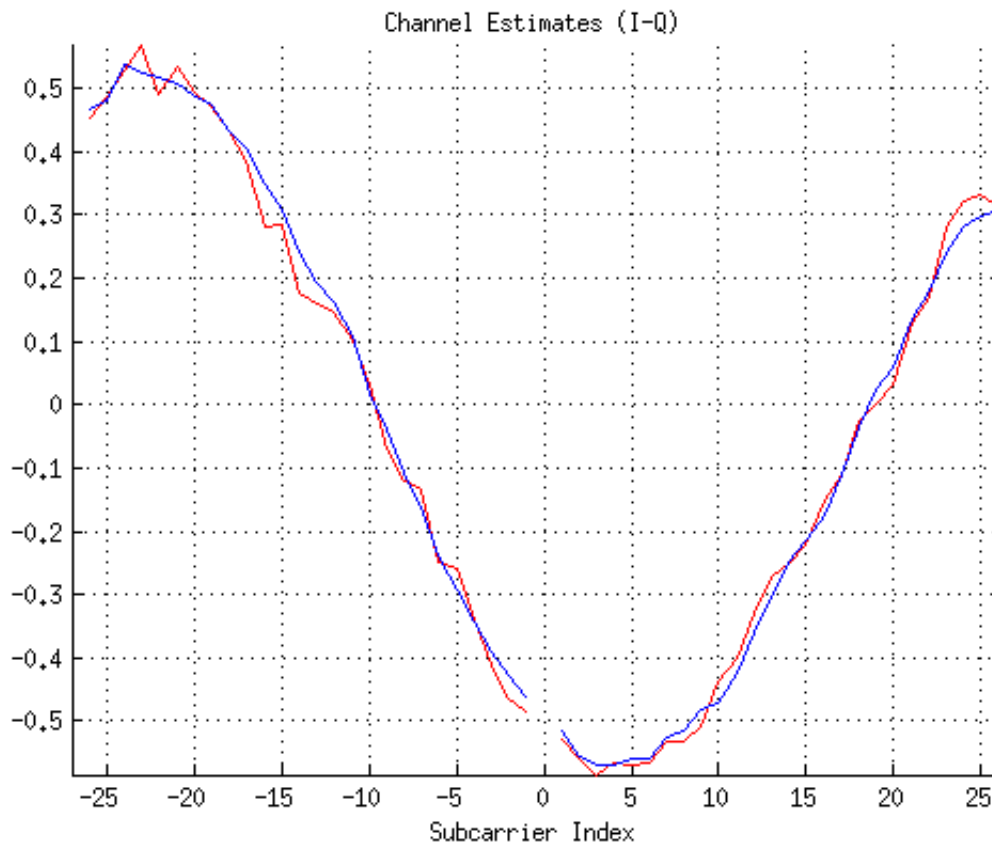
- Decode.m
 - CFO correction
 - Packet detection
 - Phase Track
 - Calculate SNR



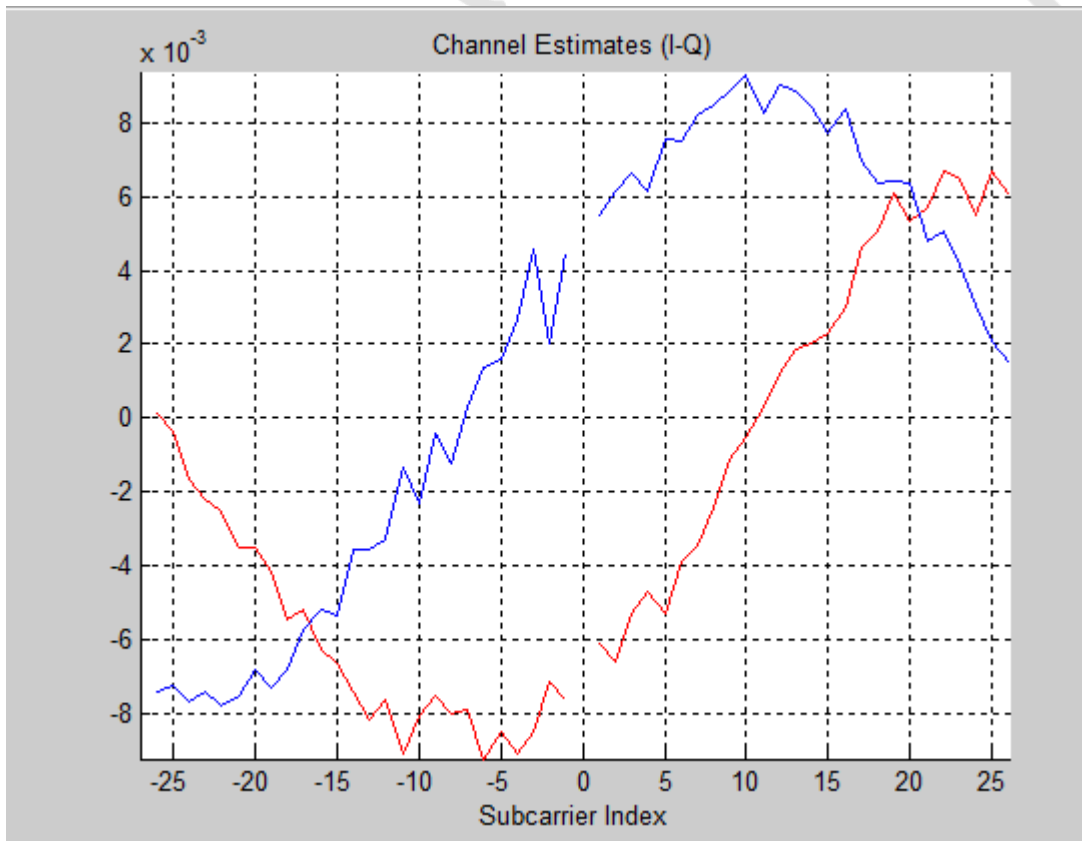
- Figure 1 : Raw



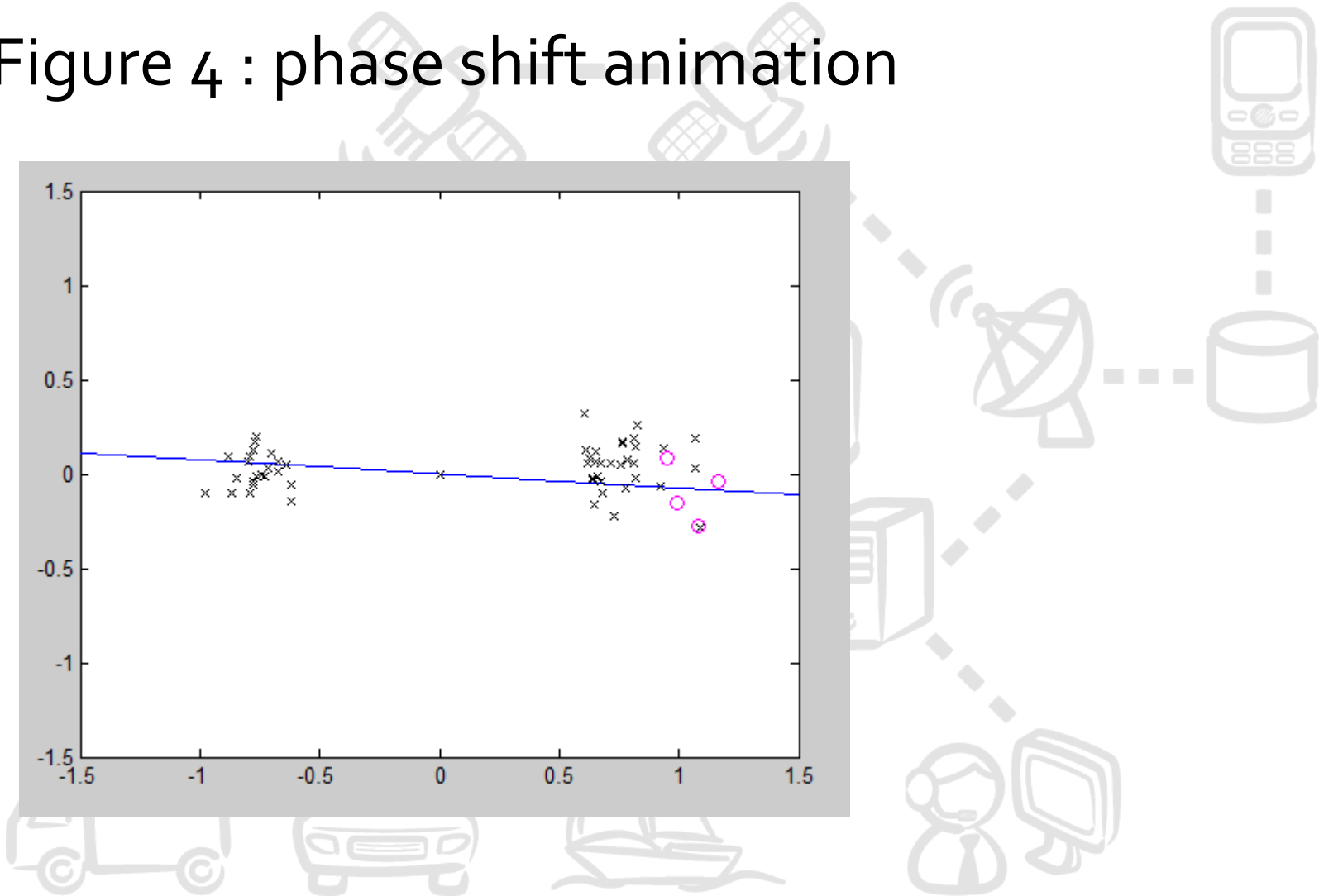
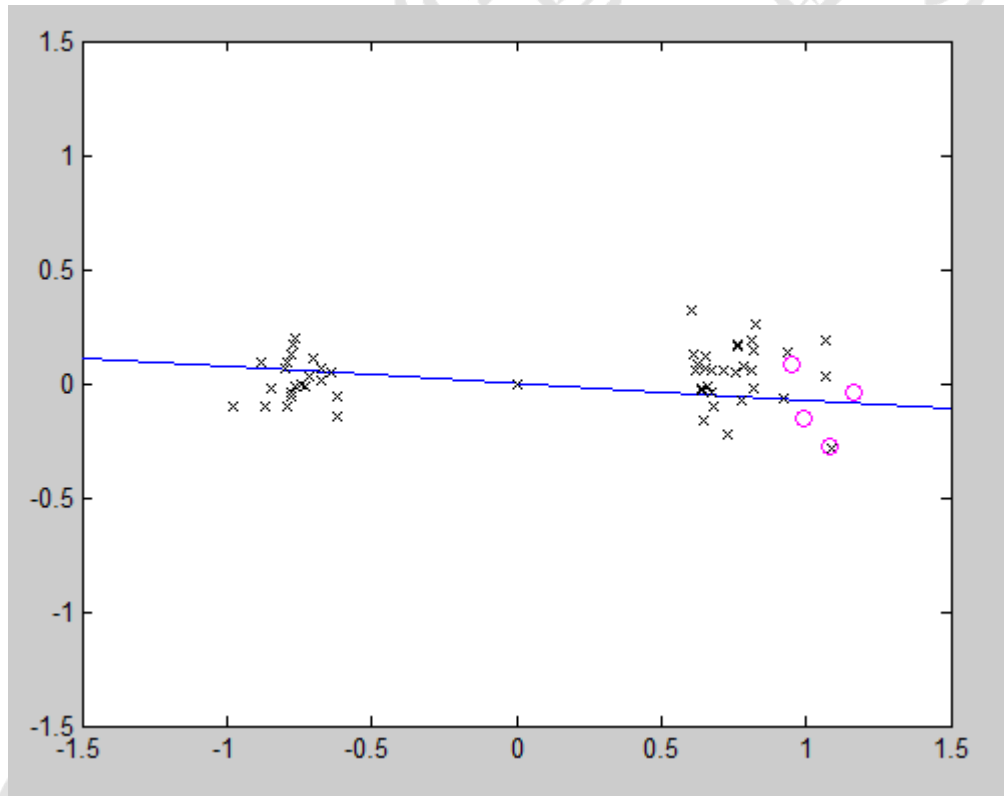
- Figure 2: Preamble Channel



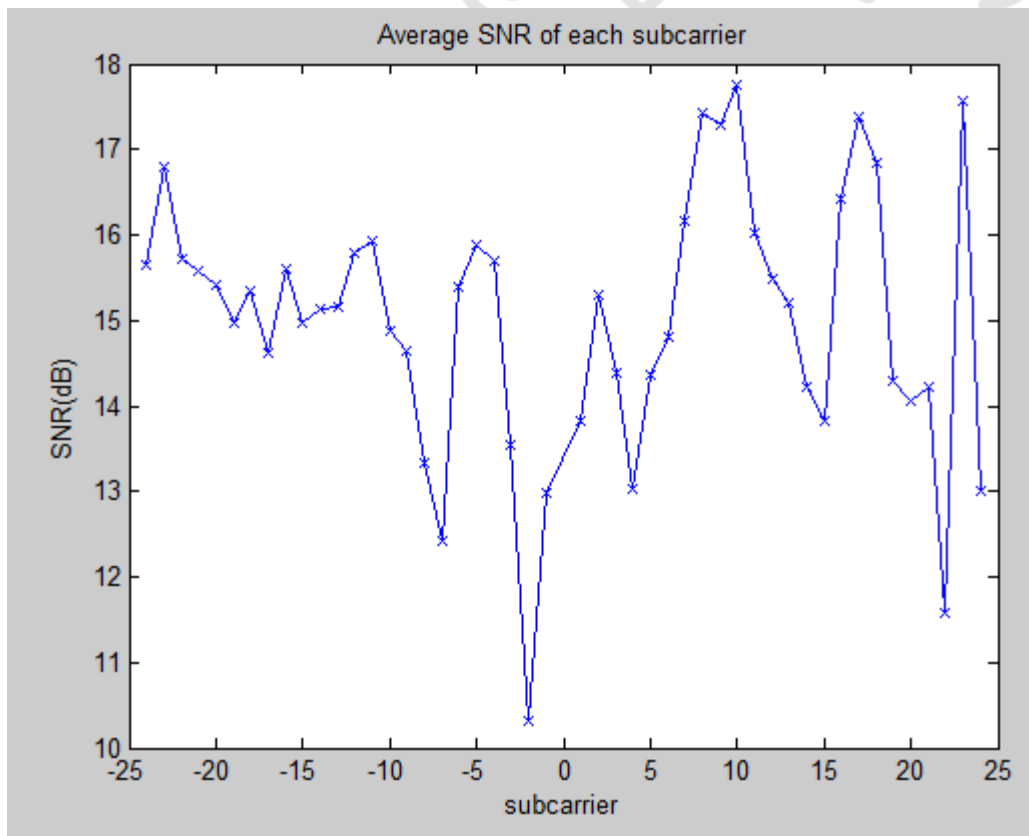
- Figure 3 : subcarrier estimation



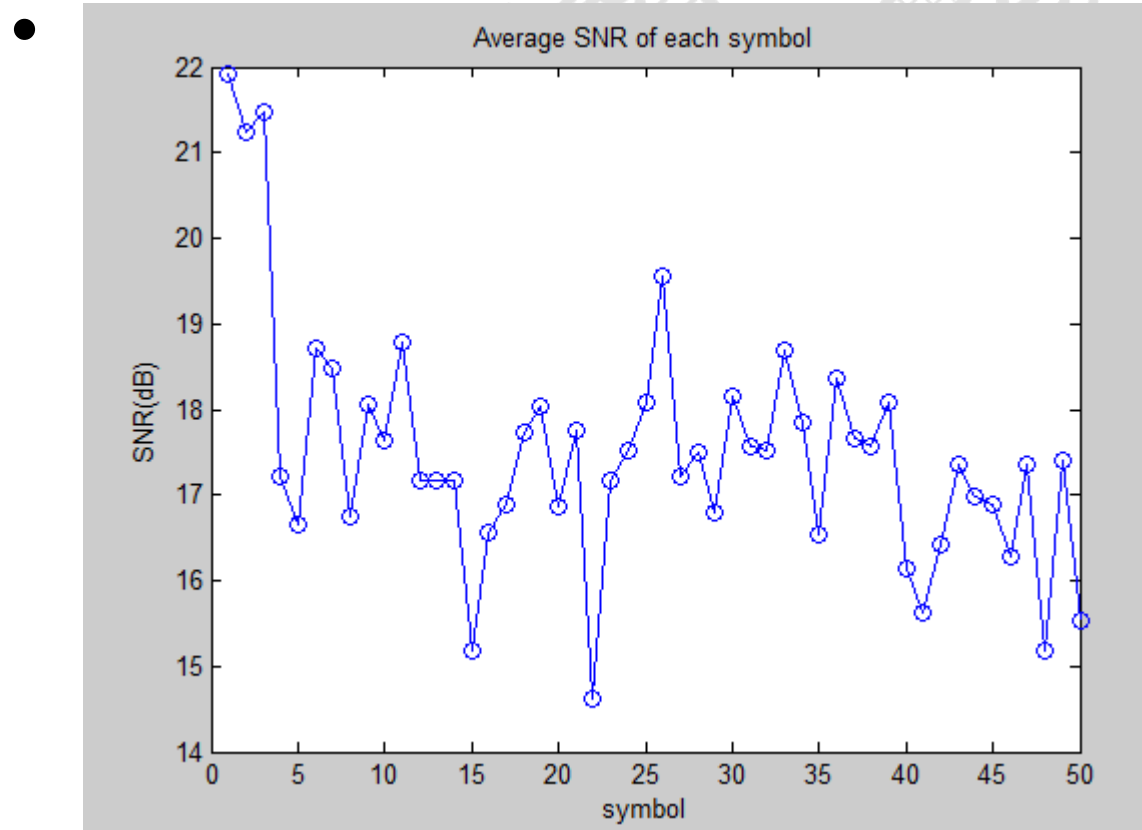
- Figure 4 : phase shift animation



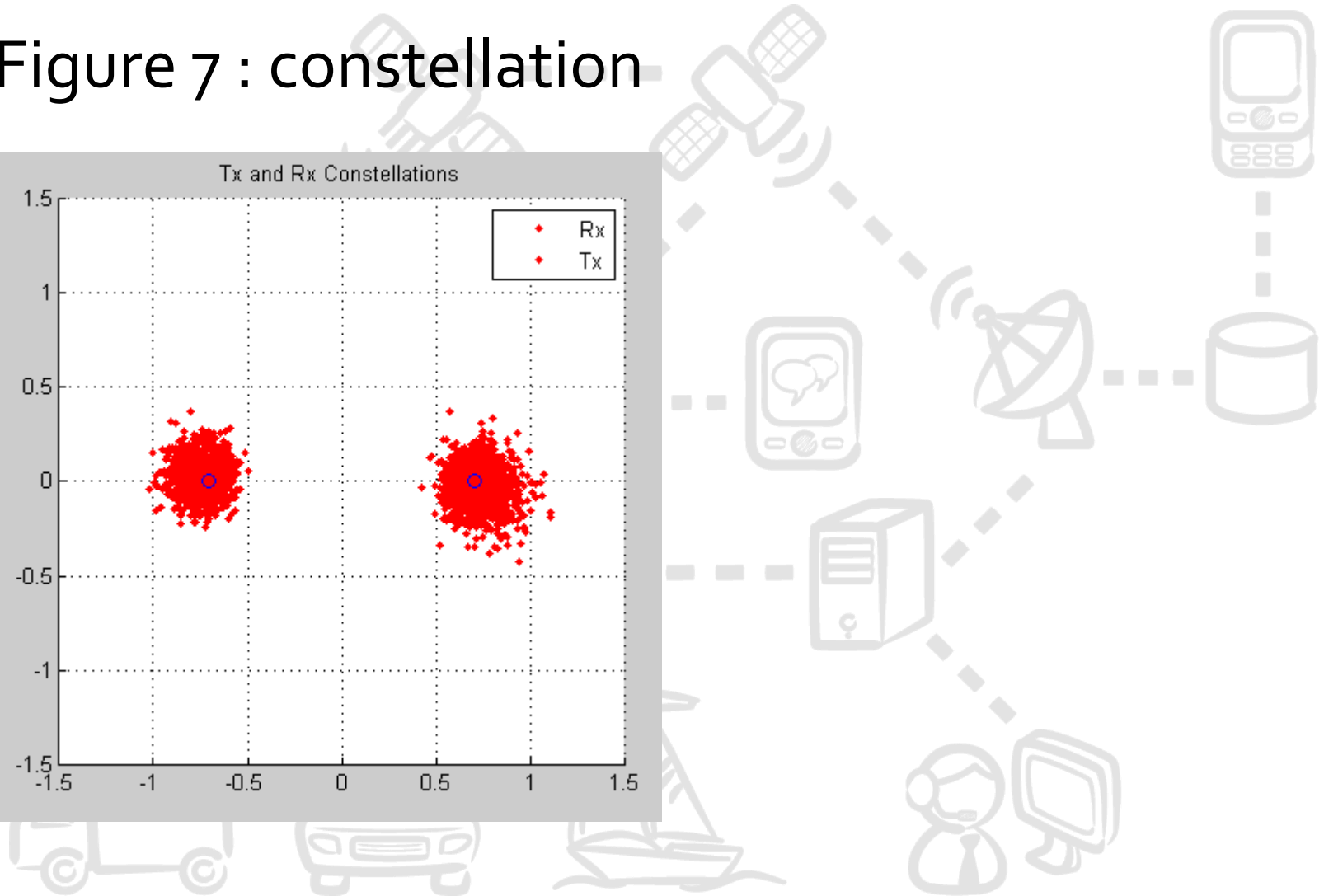
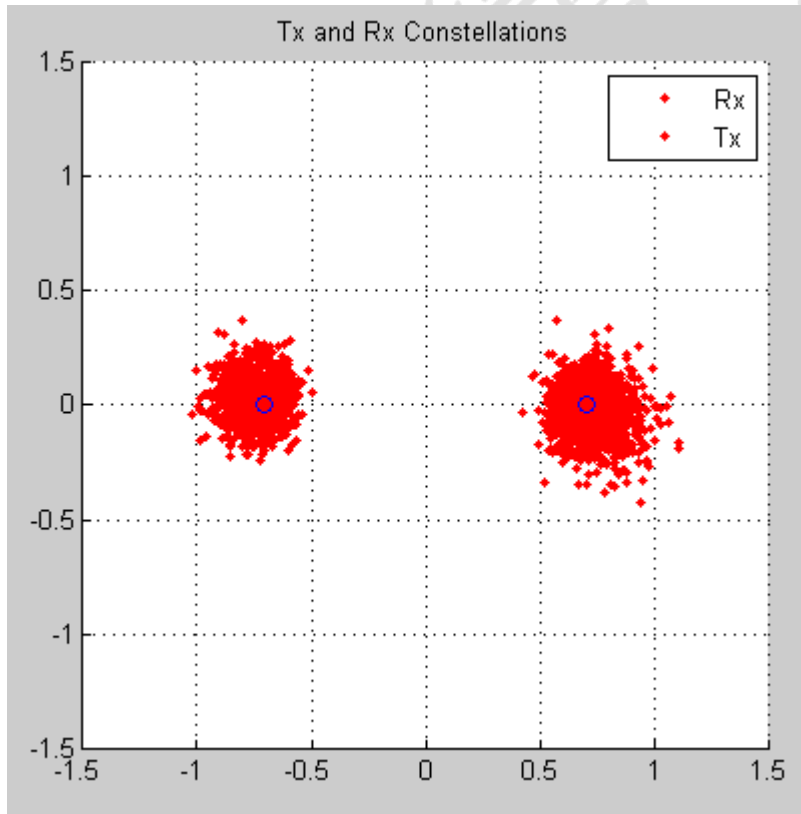
- Figure 5 : subcarrier SNR (may be different)



- Figure 6 : symbol SNR (may be different)



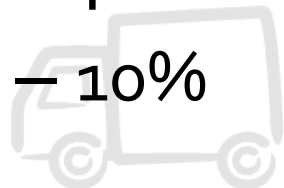
- Figure 7 : constellation



Grading Criteria



- Tx : 15%
- Rx : 15%
 - If only either of them work, judge by if can work w/ TA version Tx/ Rx
- MATLAB
 - Figure 2-3 : 5%
 - Figure 4-7: 10%
- Report
 - 10%



Grading Criteria

- Deadline: 4/26 (Tue.) 23:59 **email** to wn@csie.ntu.edu.tw
 - Email subject: **[WN]lab2_teamXX**
 - **[WN]lab2_teamXX.zip**
 - source code (single_tx.cpp/ single_rx.cpp/ decode.m phaseTrack.m pkt_detection.m)
 - Report(.pdf)
- **Demo-4/26 (Tue.)**
 - Please register the demo slot. And come to CSIE R424 at that time. (TBA)
 - All you should do are :
 - Run the working flow in p15

特別評分機制

- 90% Lab 團體成績 (由各個作業負責的助教決定)
- 10% 小組互評成績
 - 匿名
 - 給分範圍為 $-2.5 \sim 2.5$
 - 給分總和需等於 0 (ex $0.25/0.25/-0.25/-0.25$)
- 目的
 - Report 上的工作分配有時無法準確的表達各個組員各自的想法，因此添加此機制作參考

- Contact to TAs :
 - facebook
<https://www.facebook.com/groups/wn15spring/>
 - Email : wn@csie.ntu.edu.tw
 - Office hour : Tue. 13:20~14:10/TBA
- @ CSIE R424



Q&A

