Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [Frame Synchronization to Combat In/Out Interference in WBAN]
Date Submitted: [5 March 2008]
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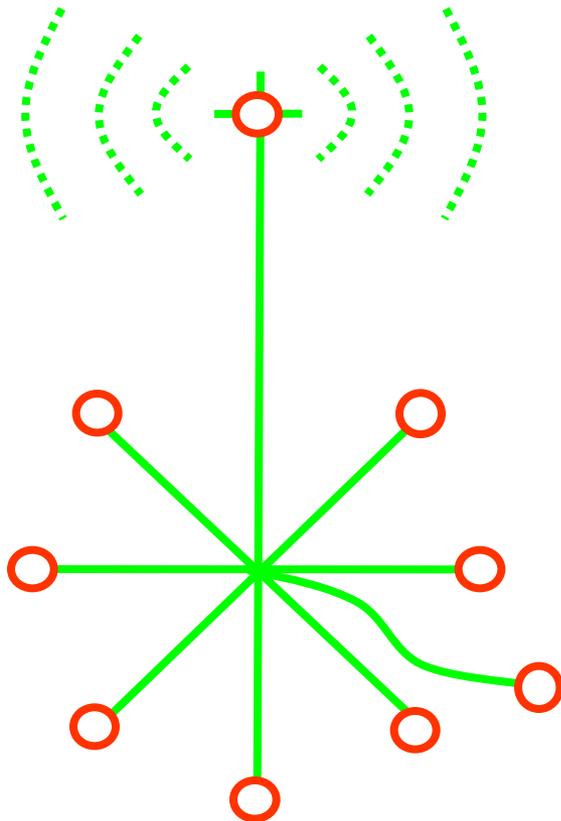**Re:** [Contribution to IEEE 802.15.6 Meeting, March 2008]

Abstract: [Propose frame synchronization method to avoid interference problems]

Purpose: [Proposal]

Frame Synchronization to Combat In/Out Interference in WBAN

March 2008

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Issues in WBAN Work Scope

APP	Non-medical High Speed / Medical Very high QoS	Arrange Requirements

APP

Non-medical
High Speed

Medical

Very high QoS

Arrange Requirements
- ❖ List up user requirements
- ❖ Check realizability
- ❖ If no, reduce requirements

MAC

Full Single MAC

Hybrid   Dual MAC

Independent Multiple MAC

Check Stumbling Blocks
- ❖ In-body / Out-body Interference
- ❖ Multiple MAC or Single MAC ?
- ❖ Compromize power & speed
- ❖ Medical / Non-medical support

PHY

400MHz	2.4GHz	UWB
~ Kbps	~Mbps	~10Mbps

Choose existing technique
- ❖ Select good chip
- ❖ Enhance antenna matching
- ❖ Reduce system size & Good design
- ❖ Add process gain for medical use ?

Process Gain for Medical Use

Major Challenges of WBAN MAC (1)

1. In-body / Out-body Mutual Interference

- ❖ In-body transmission fatally obstructs reception from out-body
- ❖ Conventional techniques(CSMA, LBT) helpless
- ❖ Any solution to overcome the In/Out problem?

2. Multiple PHY & Single MAC

- ❖ Inevitable to use multiple PHYs, yet a single MAC is desired.
- ❖ Any solution to support multiple speeds with a single MAC?

# Major Challenges of WBAN MAC (2)

3. Power Consumption vs Speed & Duty Cycle

- ❖ Higher Speed needs Higher power consumption
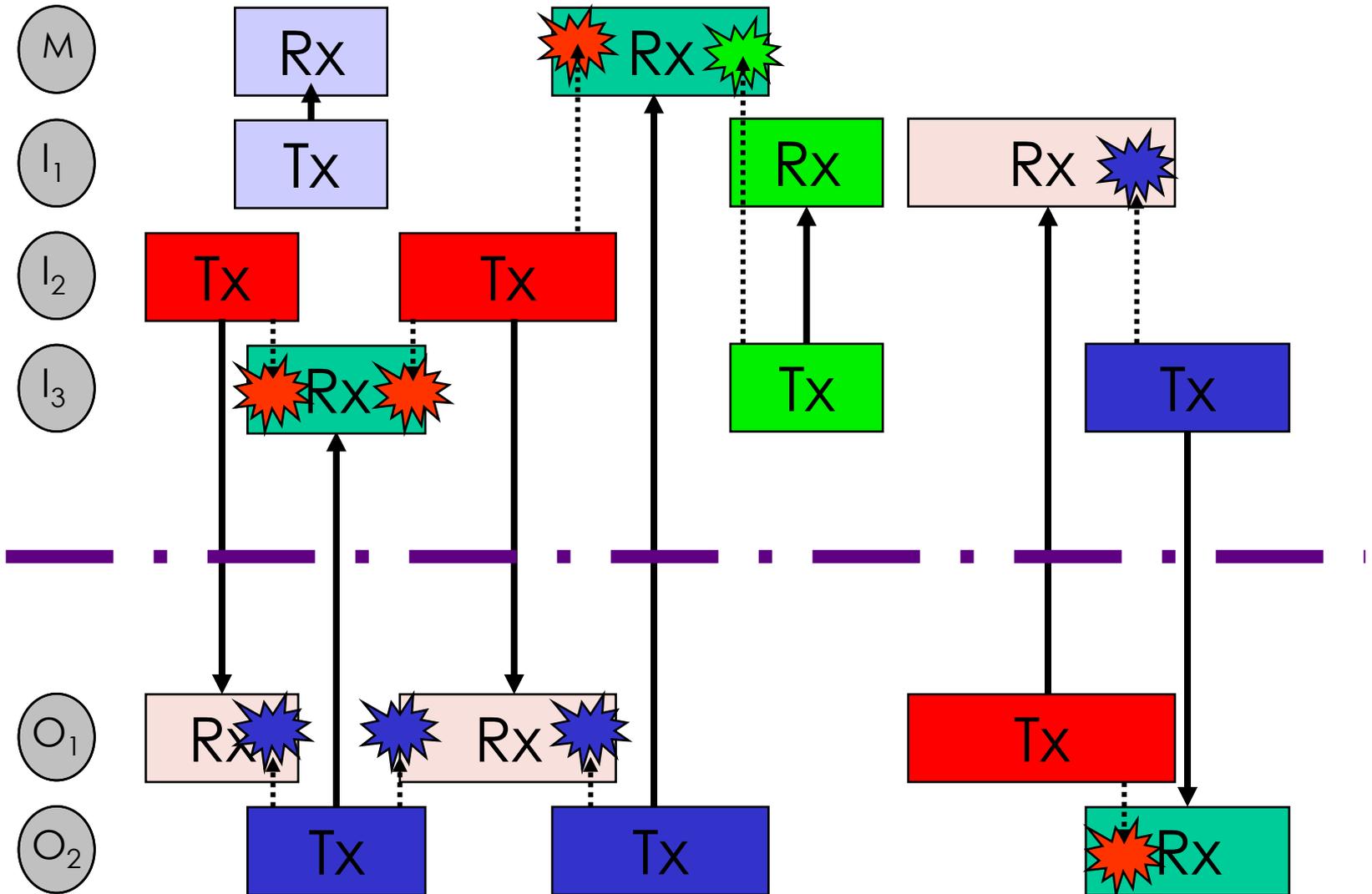- ❖ What will be the speed limit to compromise power consumption ?

4. Medical / Non-Medical Dual support

- ❖ Medical : Low speed (~Kbps) ;
  - high QoS (BER < 10^{-10})
- ❖ Non Medical : Higher Speed is Better ;
  - Reasonable QoS (BER < 10^{-3})
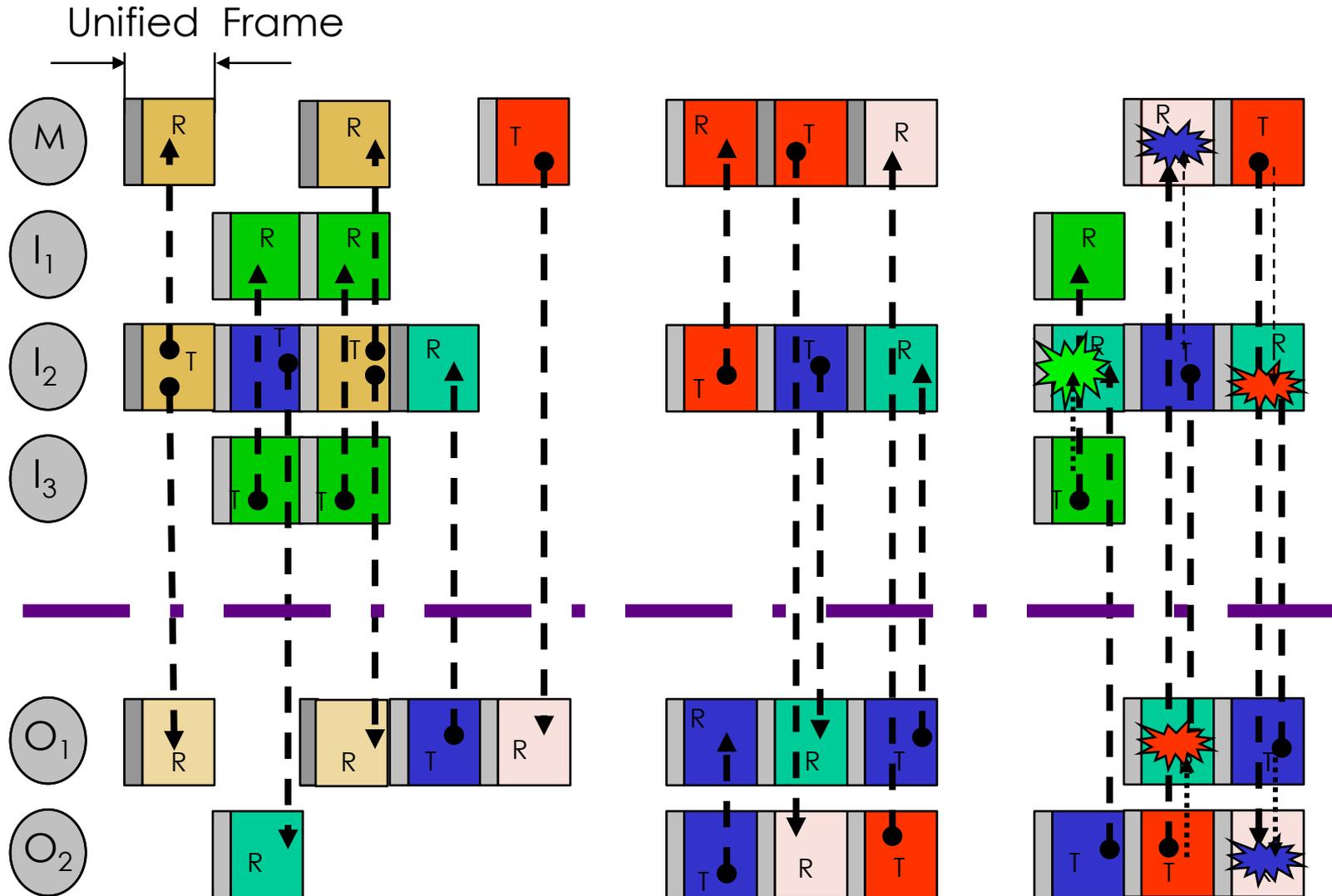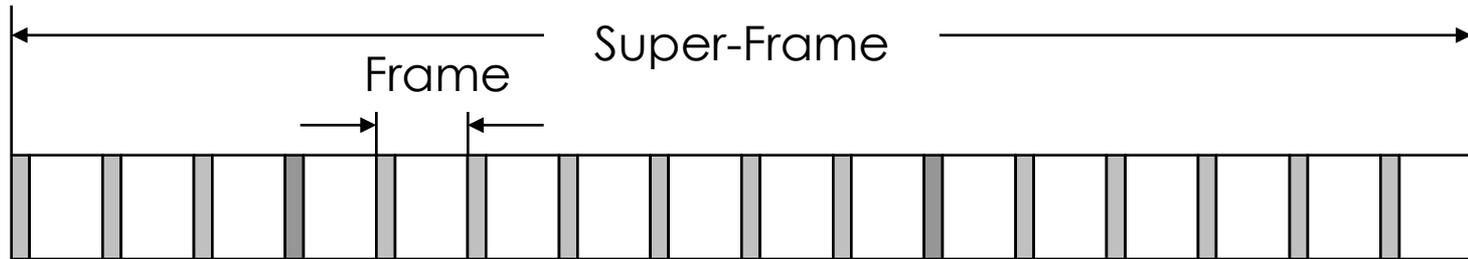- ❖ Any solution to support dual purpose ?

In-body / Out-body Interference
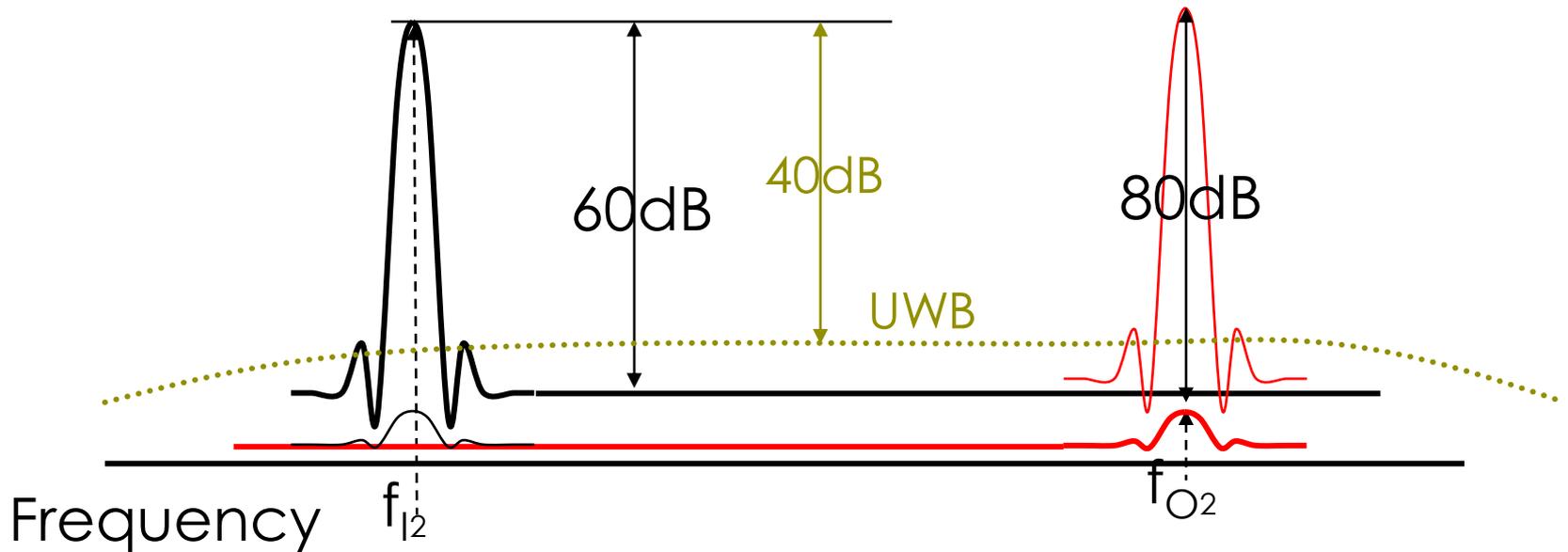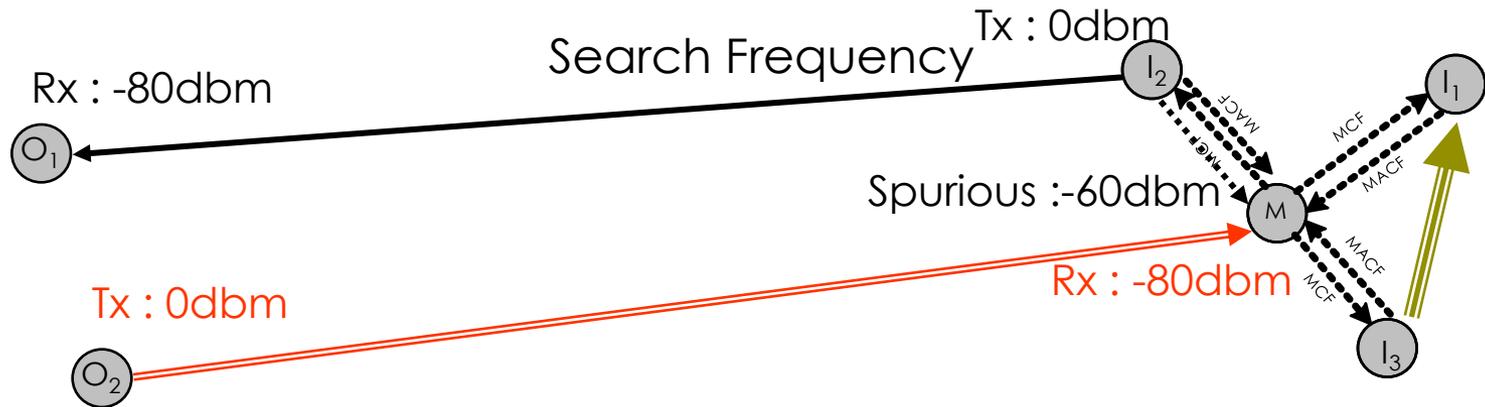
In / Out Interference

Synchronized Frames

Synchronized (Super-)Frame

Super-Frame

Frame

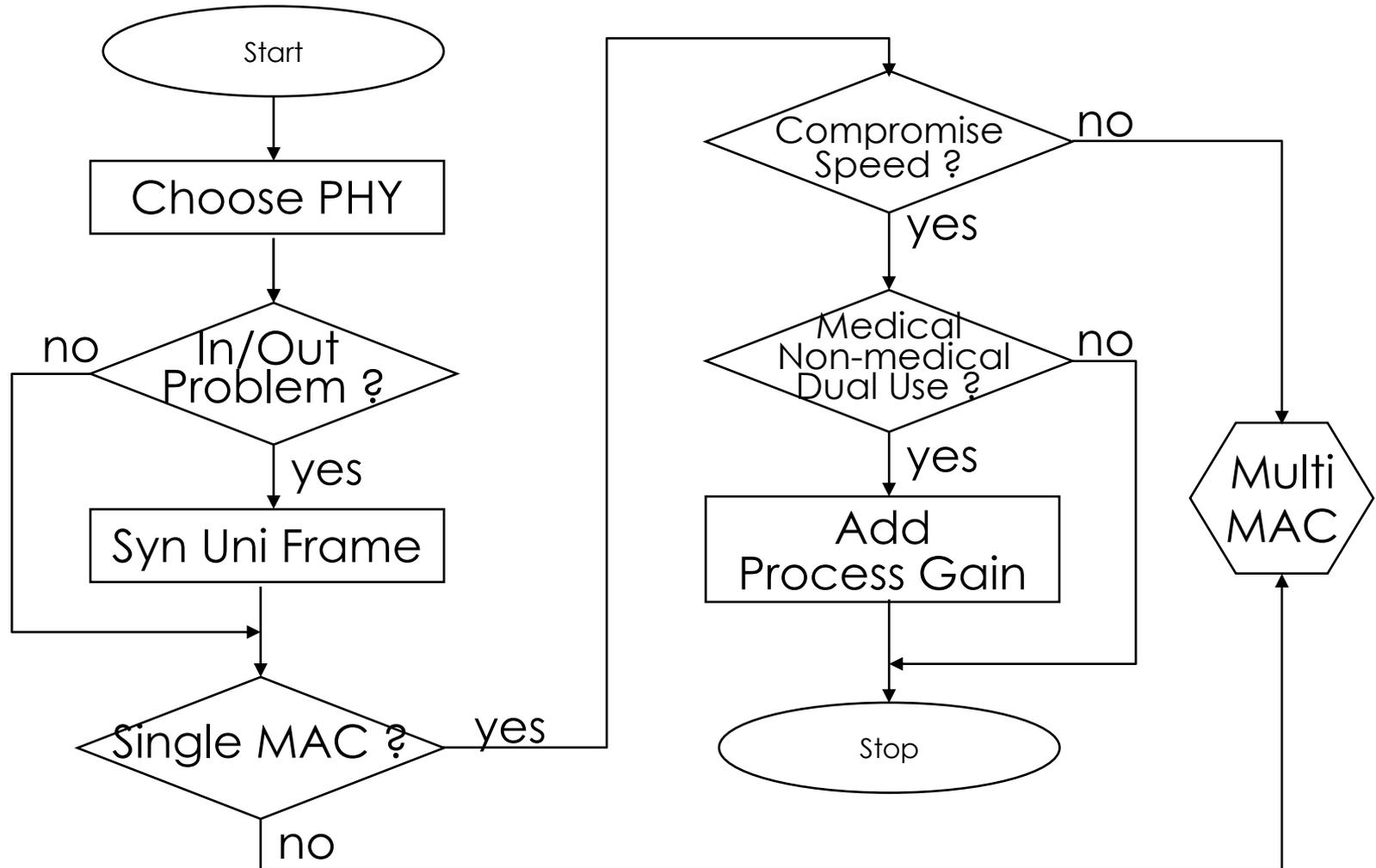| Control Packet | User Packet #1 | User Packet #2 | ... | User Packet #n |

Control Packet:
- ❖ Sync Pattern
- ❖ Frequency Set
- ❖ Direction (Tx or Rx)
- ❖ Control Data
- ❖ Frame Type

User Packet:
- ❖ Sync Pattern (?)
- ❖ Frequency (?)
- ❖ Packet Type
- ❖ User Data (Payload)
- ❖ Process Gain

WBAN Selection Process

Conclusion

- ❖ In-body / Out-body Interference is fatal in WBAN.

- ❖ MAC with Synchronized Frames can solve the In/Out Problem.

- ❖ Synchronized frames may also facilitate multiple payload speeds with a novel control packet design
  - ◆ Thus realizing a single MAC with multiple PHY

- ❖ Synchronized frames for both In/Out Interference Avoidance and Multiple Speeds