

# Unique Mesh Wireless Design on Motion Ship

Muhti Subiyantoro



# About Me

- 1974 - Born in Trenggalek
- 1999 – Graduated Electronic Eng. Universitas Muhammadiyah Malang
- 1999 – Start Working in Internet Service Provider
- 2004 – Using MikroTik
- 2006 - PT. Spectrum Indowibawa, Surabaya
  - Technical & Training Manager
  - MikroTik Certified Trainer
  - Academy Coordinator

# About Spectrum

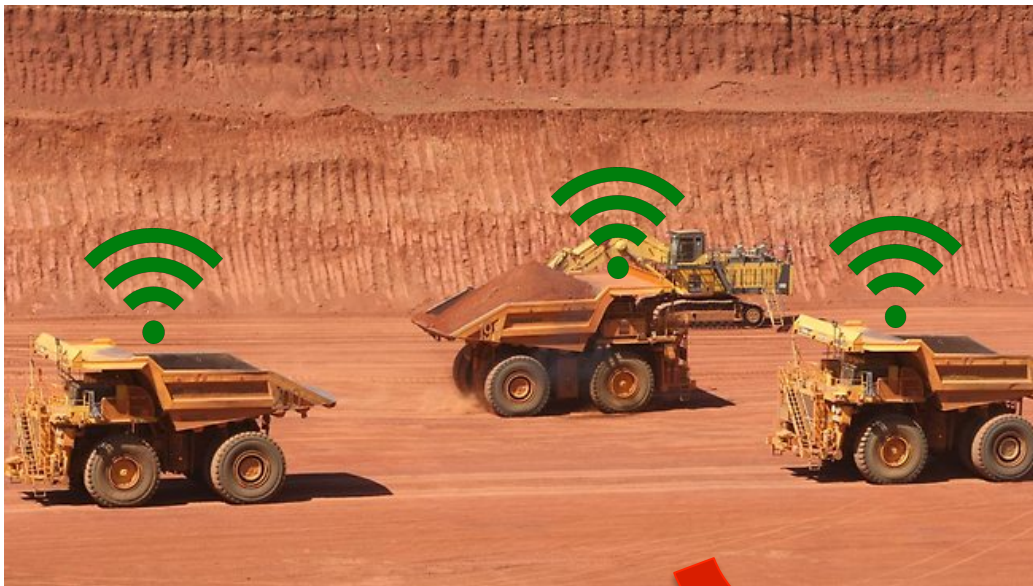


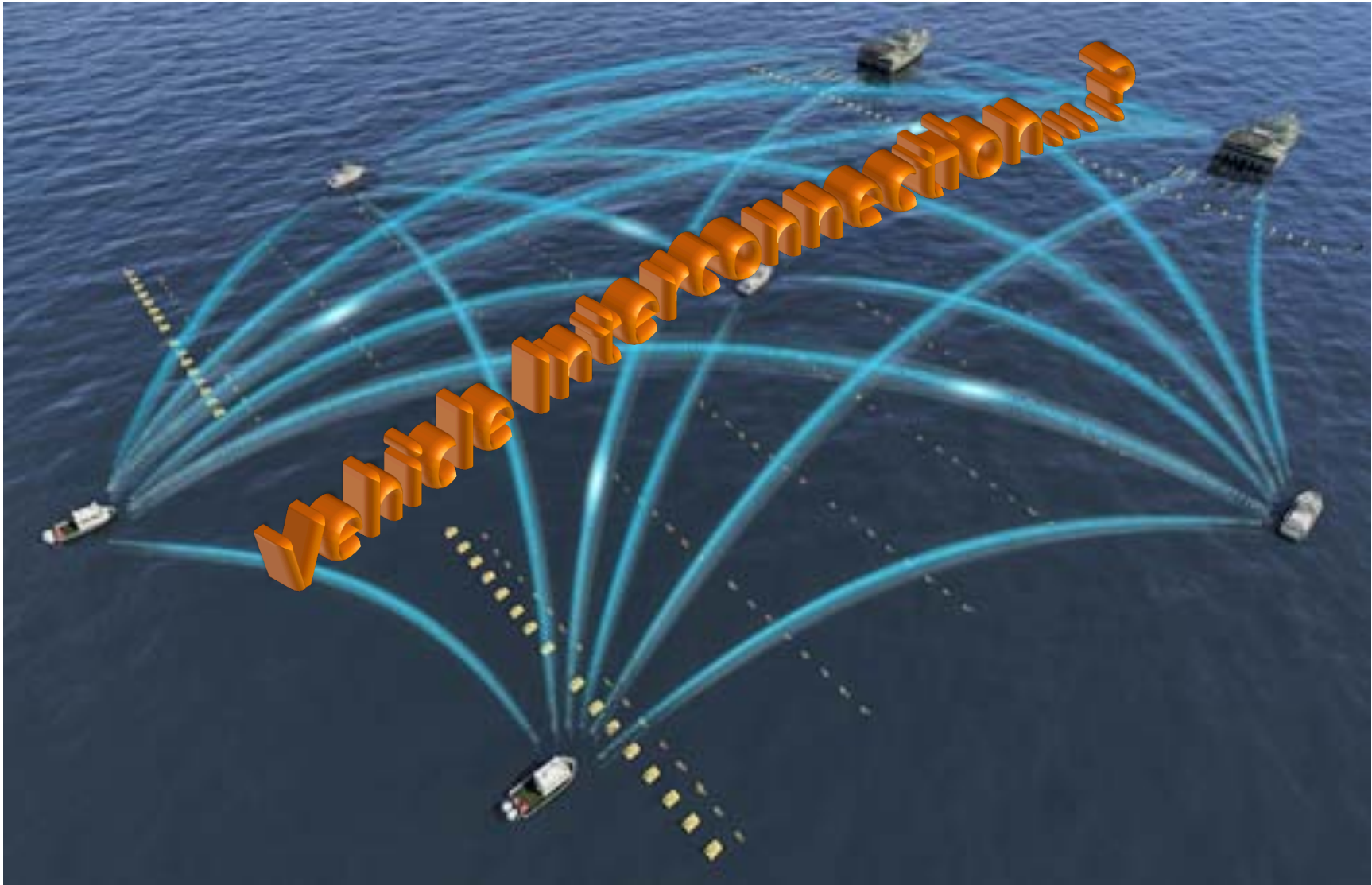
Network Infrastructure Unit

- Reseller Wireless & Router Equipment
- MikroTik
  - Consultant
  - Certified Training Partner
  - Network System Integrator

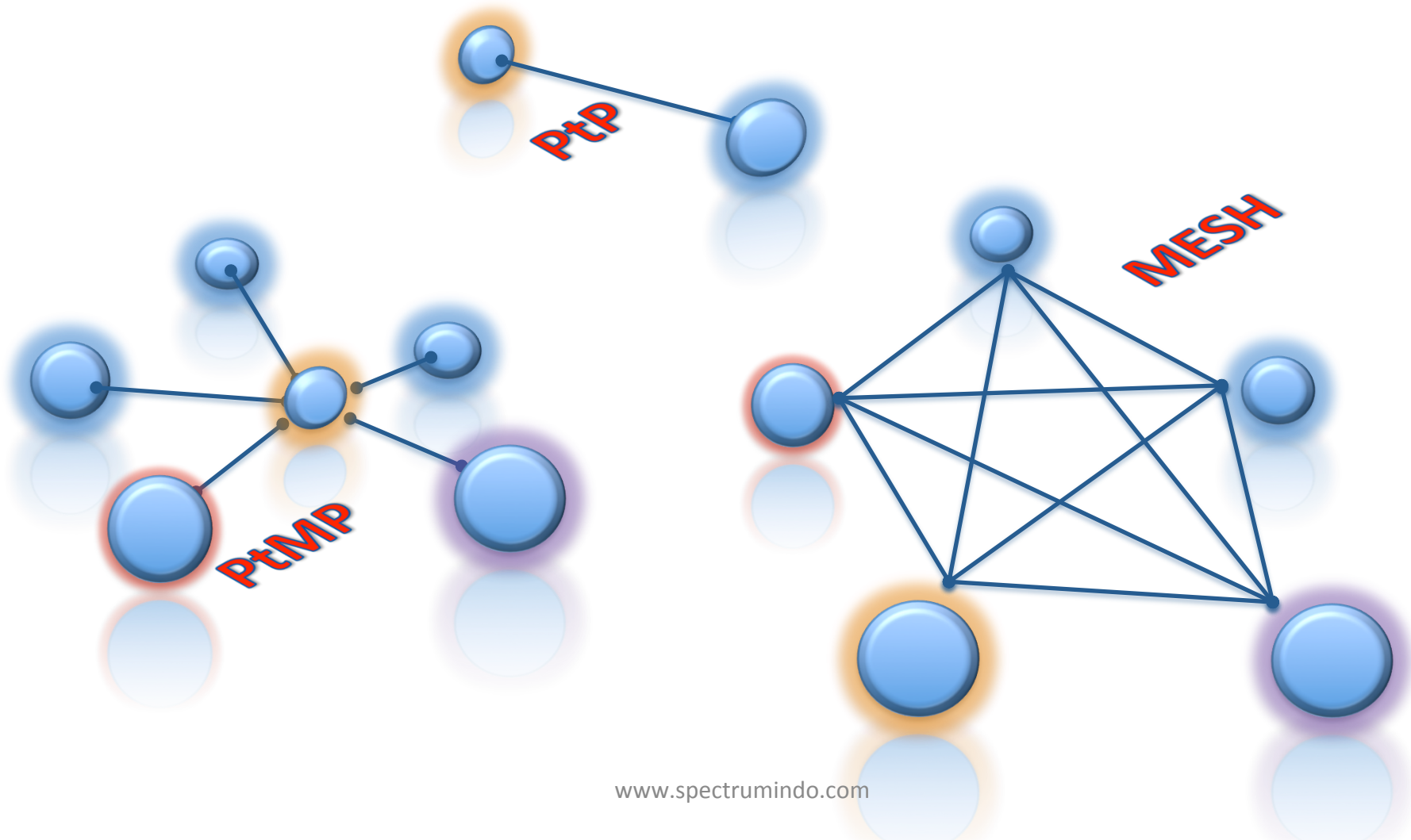
IDEA...?







# Wireless Connection Topology



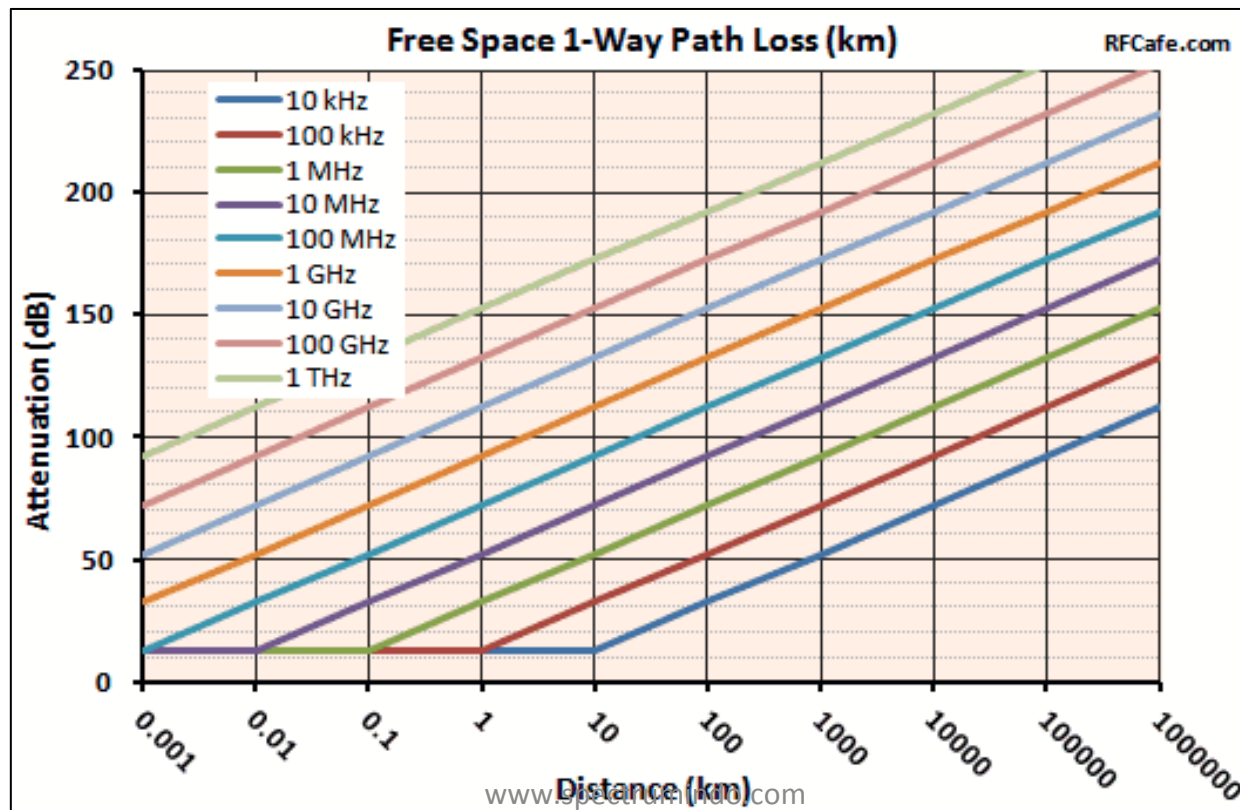


# Wireless Variable

- Frequency
- Distance
- Coverage
- Tx Power
- Throughput
- Height of Antenna
- Interference
- Topology

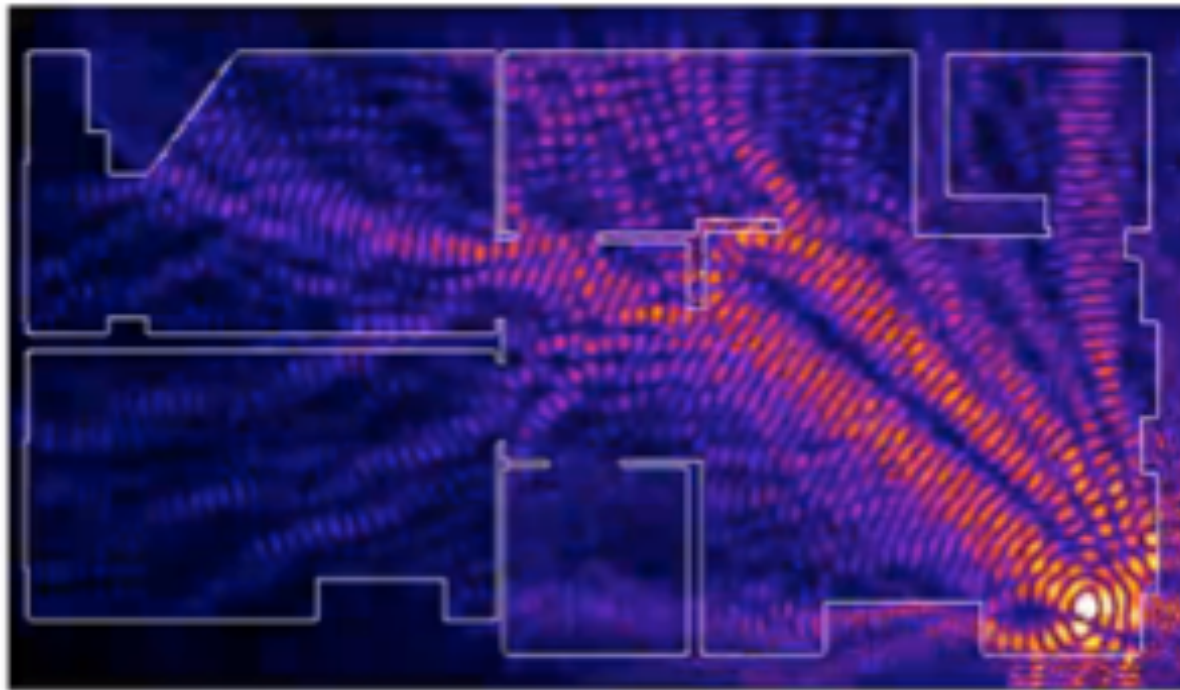
# Frequency

- Lower Frequency, less Path Loss
- Less Path Loss, more distance



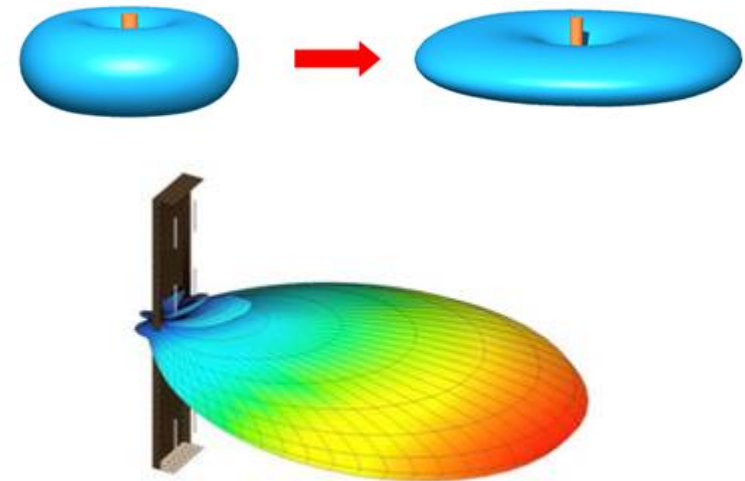
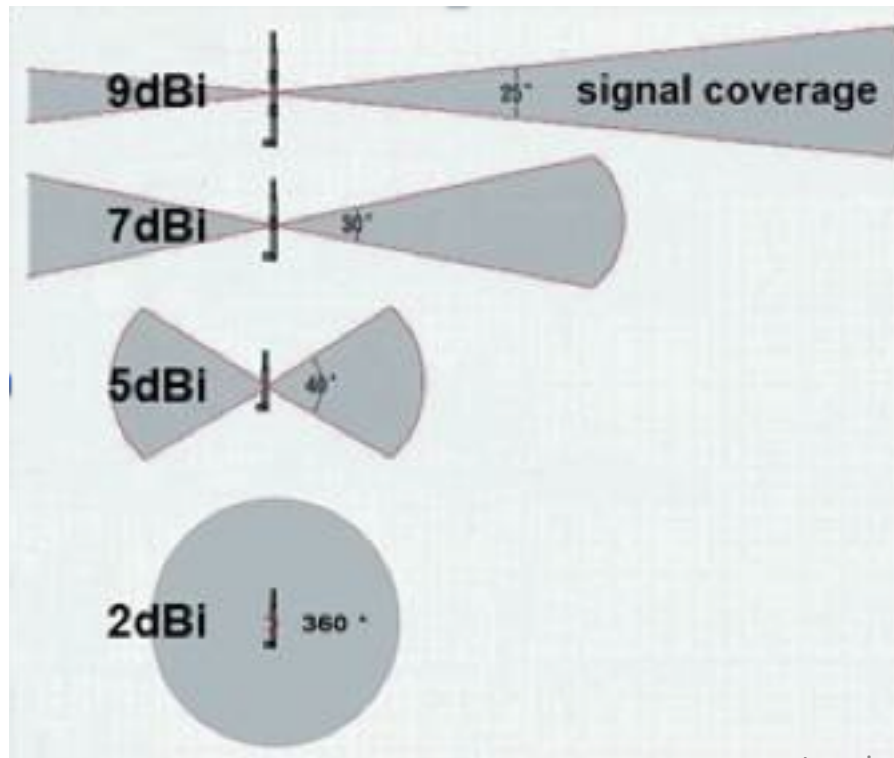
# Distance

- More Distance, Less Signal
- Less Signal, Less Throughput



# Coverage

- Higher Antenna Gain, Less Coverage Beam
- Less Coverage Beam, More Distance



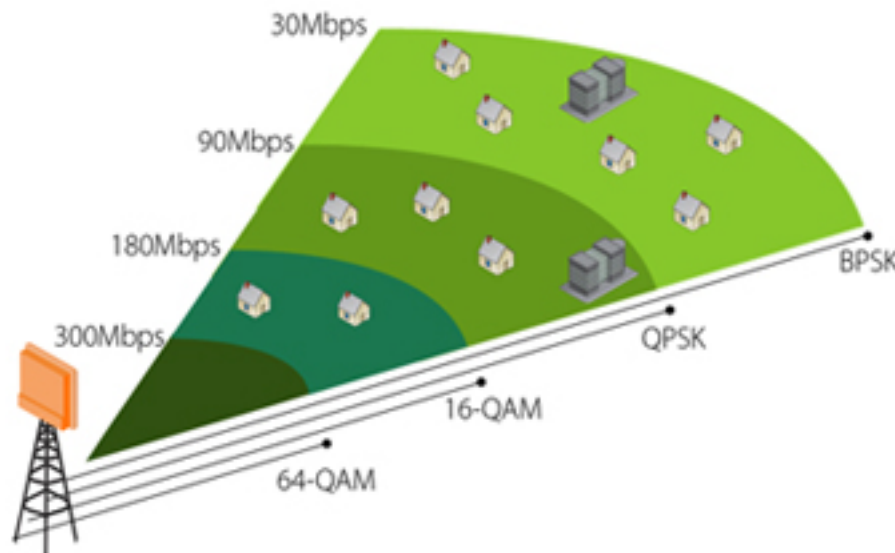
# Tx Power

- Higher Tx, More Distance
- Higher Tx, More Throughput in Distance



# Throughput

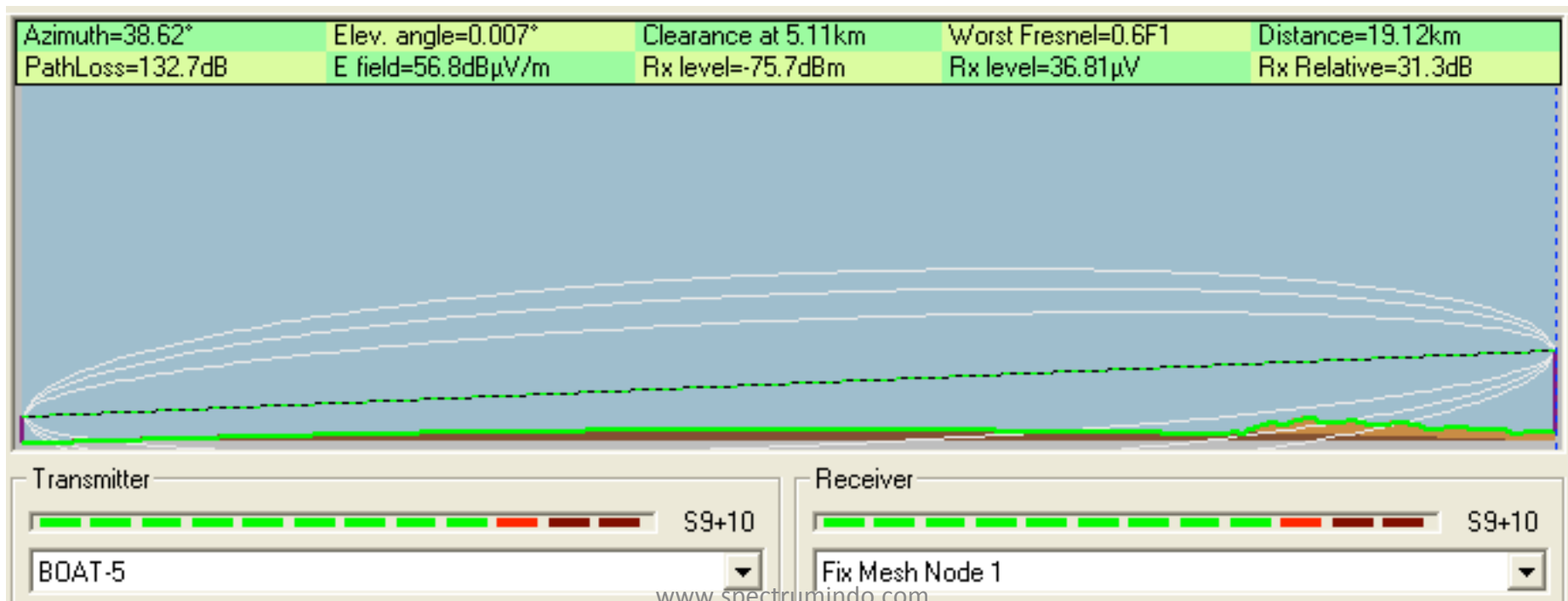
- More Tx Power, More Throughput in Distance
- Higher Antenna Gain, More Throughput in Distance



MCS Index	Modulation	Spatial Streams	802.11n Data Rate			
			20 MHz		40 MHz	
			L-GI	S-GI	L-GI	S-GI
0	BPSK	1	6.5	7.2	13.5	15
1	QPSK	1	13	14.4	27	30
2	QPSK	1	19.5	21.7	40.5	45
3	16-QAM	1	26	28.9	54	60
4	16-QAM	1	39	43.3	81	90
5	64-QAM	1	52	57.8	108	120
6	64-QAM	1	58.5	65	121.5	135
7	64-QAM	1	65	72.2	135	150
8	BPSK	2	13	14.4	27	30
9	QPSK	2	26	28.9	54	60
10	QPSK	2	39	43.3	81	90
11	16-QAM	2	52	57.8	108	120
12	16-QAM	2	78	86.7	162	180
13	64-QAM	2	104	115.6	216	240
14	64-QAM	2	117	130	243	270
15	64-QAM	2	130	144.4	270	300

# Heigh of Antenna

- Enough Heigh of Antenna, good Fresnel Zone
- Good Fresnel Zone, no signal reflected by obstacle



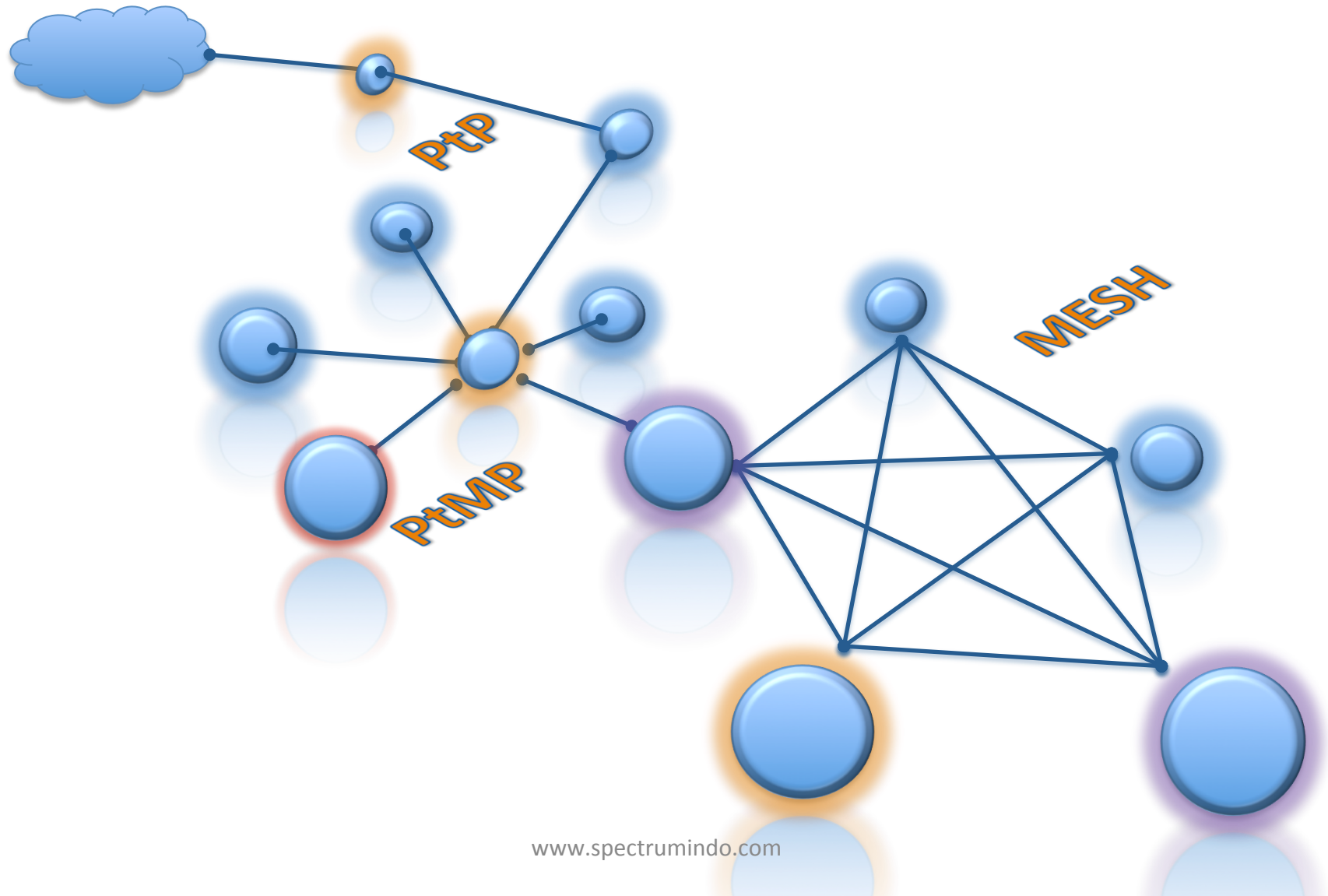
# Interference

- High interference, low link quality

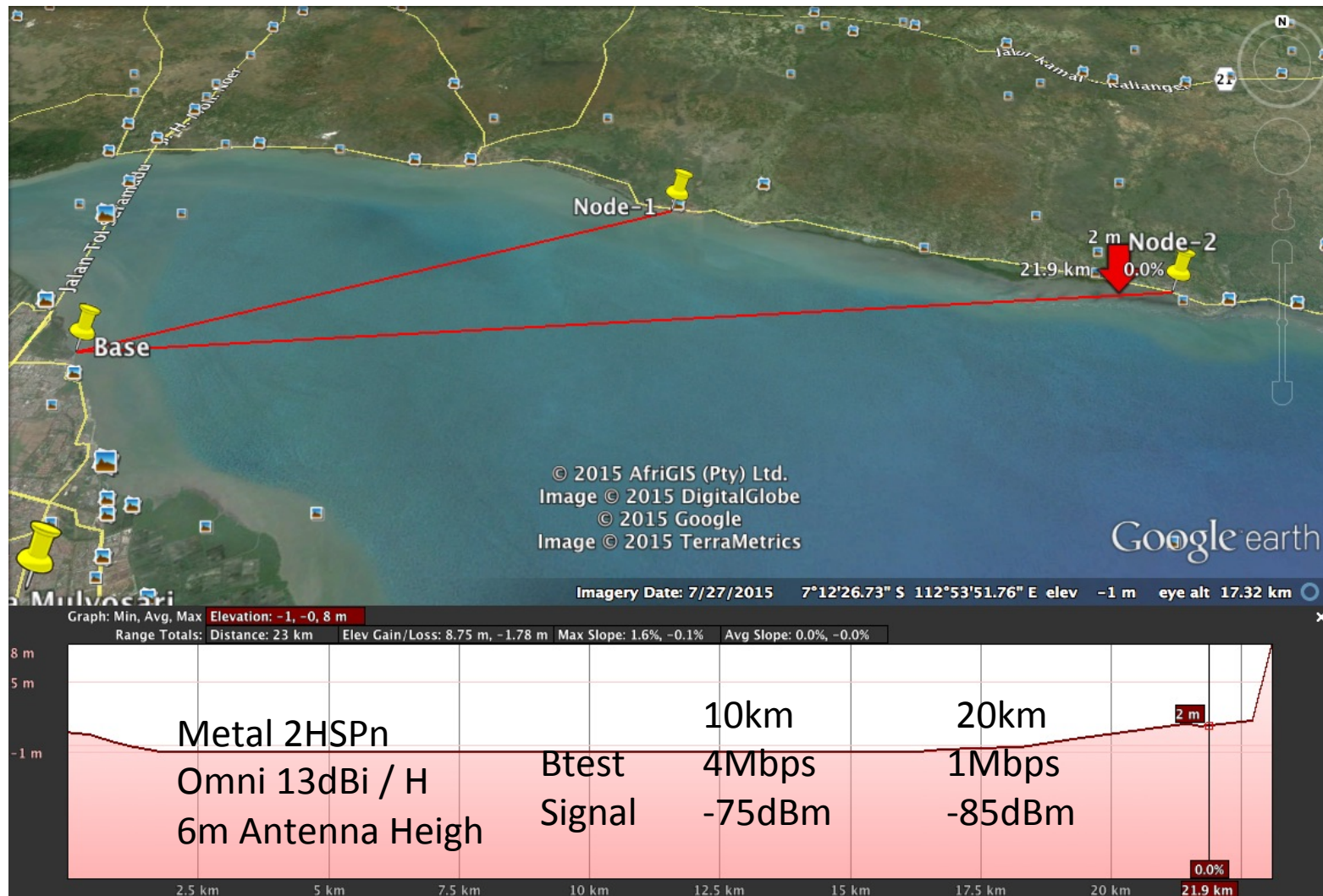




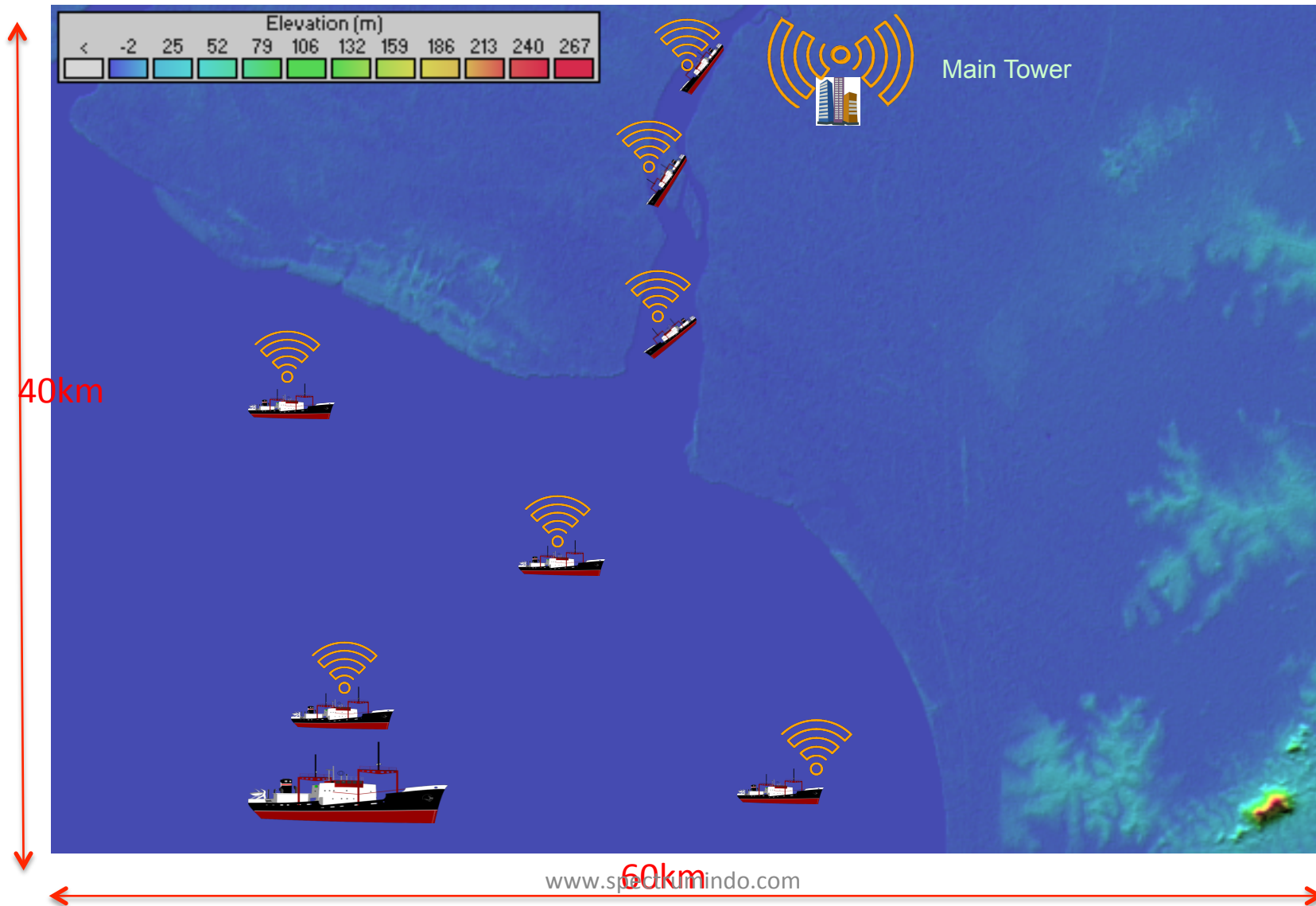
# Combining Topology



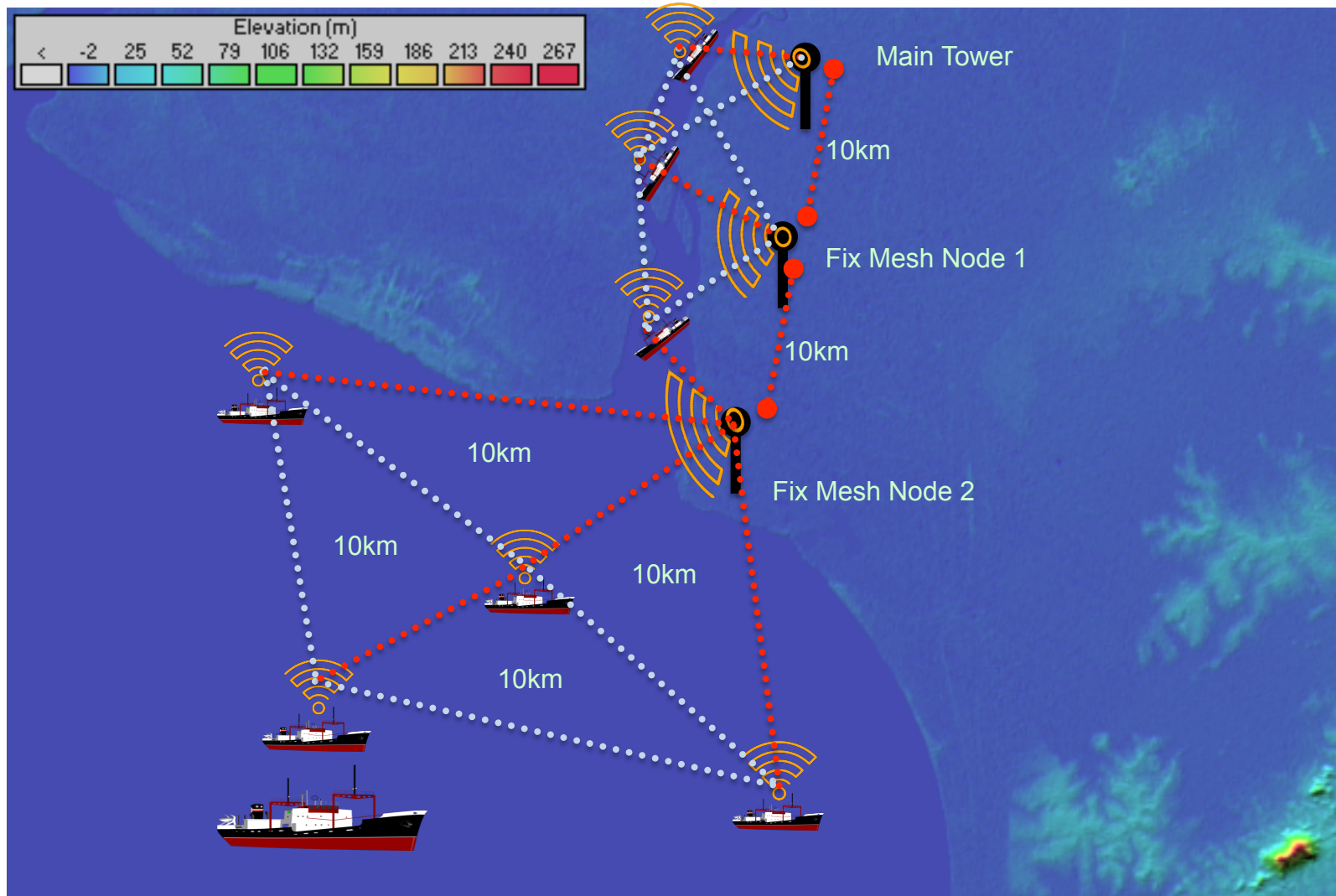
# Test on Field



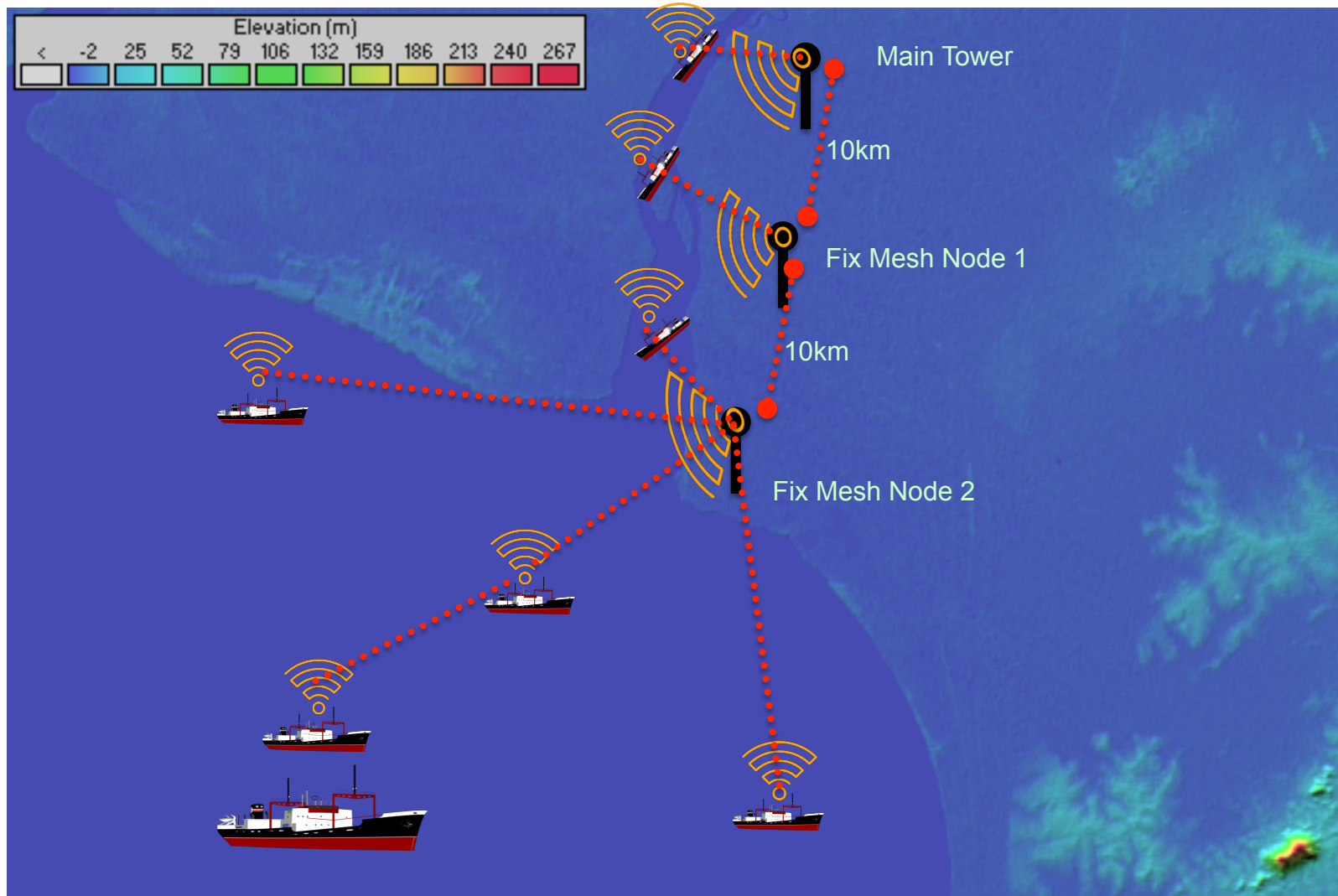
# Moving Vehicle Network Plan



# Infrastructure Link Design



# Connection Tree



# Mesh with MikroTik

- Wireless WDS Mesh with Mesh Interface
  - Mode : Ap-Bridge
  - Band : 2 Ghz – Only-N
  - Channel Width : 20 Mhz
  - SSID : Deep\_Sea
  - Frequency : 2427
  - Security Profile : Default
  - WDS Mode : Static
  - WDS Default Bridge : none
  - Mesh : Mesh\_1
  - Mesh Port : Ether1, All WDS Interface

# Main Tower Node

Interface <wlan1>

General Wireless WDS Nstreme NV2 Status Traffic

Mode: ap bridge

Band: 5GHz-A

Channel Width: 20MHz

Frequency: 5180 MHz

SSID: Link\_1

Scan List: default

Wireless Protocol: any

Security Profile: default

Interface <wlan2>

General Wireless Data Rates Advanced HT ...

Mode: ap bridge

Band: 2GHz-only-N

Channel Width: 20MHz

Frequency: 2427 MHz

SSID: Deep\_Sea

Radio Name: Main\_Tower

Scan List: default

Interface <wlan1>

General Wireless WDS Nstreme NV2 Status Traffic

WDS Mode: static

WDS Default Bridge: none

WDS Ignore SSID

Interface <wlan2>

HT MCS WDS Nstreme NV2 Tx Power ...

WDS Mode: static

WDS Default Bridge: none

WDS Default Cost: 100

WDS Cost Range: 50-150

WDS Ignore SSID

Wireless Tables

Interfaces Nstreme Dual Access List Registration Connect List Security Profiles Channels

[-] [Filter] [Reset]

Radio Name	MAC Address	Interface	Uptime	AP	...	Last Activi...	Tx/Rx Signal
↔ BOAT_1	00:0C:42:61:6A:77	wlan2	00:12:25	yes	yes	0.000	-38/-30
↔ Link_Node_1	00:0C:42:31:38:A8	wlan1	00:02:04	yes	yes	4.110	-20/-19

Wireless Tables

Interfaces Nstreme Dual Access List Registration Connect List Security Profiles Channels

[+] [-] [Check] [X] [Info] [Filter] [CAP] [Scanner] [Freq. Usage] [Alignment] [Wire]

Name	Type	L2 MTU	Tx	R
;;; Link_to_Node_1				
R	↔ wlan1	Wireless (Atheros AR5413)	1600	0 bps
RSA	↔ wds_Node_1	WDS	1600	0 bps
;;; MESH_to_BOAT				
R	↔ wlan2	Wireless (Ath		
RSA	↔ wds_BOAT_1	WDS		
	↔ wds_BOAT_2	WDS		
	↔ wds_BOAT_3	WDS		
	↔ wds_BOAT_4	WDS		
	↔ wds_BOAT_5	WDS		
	↔ wds_BOAT_6	WDS		
	↔ wds_BOAT_7	WDS		

Mesh

Mesh Ports FDB

[+] [-] [Check] [X] [Info] [Filter]

Interface	Mesh
I ether1	Mesh_1
wds_BOAT_1	Mesh_1
I wds_BOAT_2	Mesh_1
I wds_BOAT_3	Mesh_1
I wds_BOAT_4	Mesh_1
I wds_BOAT_5	Mesh_1
I wds_BOAT_6	Mesh_1
I wds_BOAT_7	Mesh_1
wds_Node_1	Mesh_1

Interface <Mesh\_1>

General HWMP Status Traffic

Mesh Portal

Default Hoplimit: 32

PREQ Waiting Time: 4

PREQ Retries: 2



# NODE - 1

Interface <wlan1>

General Wireless WDS Nstreme NV2 Status Traffic

Mode: ap bridge

Band: 5GHz-A

Channel Width: 20MHz

Frequency: 5180 MHz

SSID: Link\_1

Scan List: default

Interface <wlan2>

General Wireless HT HT MCS WDS Nstreme ...

Mode: ap bridge

Band: 2GHz-only-N

Channel Width: 20MHz

Frequency: 2427 MHz

SSID: Deep\_Sea

Scan List: default

Wireless Protocol: any

Security Profile: default

Interface <wlan1>

General Wireless WDS Nstreme NV2 Status Traffic

WDS Mode: static

WDS Default Bridge: none

WDS Ignore SSID

Interface <wlan2>

HT HT MCS WDS Nstreme NV2 Status Traffic ...

WDS Mode: static


WDS Default Bridge: none

WDS Ignore SSID

Wireless Tables								
Interfaces		Nstreme Dual	Access List	Registration	Connect List	Security Profiles	Channels	
-		Filter		Reset				
Radio Name	MAC Address	Interface	Uptime	AP	...	Last Activi...	Tx/Rx Signal	
↔BOAT_1	00:0C:42:61:6A:77	wlan2	00:00:35	yes	yes	0.260	-29/-25	
↔Link_Node_2	00:0C:42:31:38:39	wlan1	00:03:03	yes	yes	0.260	-17/-17	
↔Main_Tower	00:0C:42:31:38:AF	wlan1	00:03:03	yes	yes	0.000	-14/-15	

Wireless Tables							
Interfaces		Nstreme Dual	Access List	Registration	Connect		
+		-		CAP		Scanner	
Name	Type						
;;; Link_Main_Tower+Node_2							
R	↔wlan1	Wireless (Atheros AR...					
RSA	↔wds_Main_Tower	WDS					
RSA	↔wds_Node_2	WDS					
;;; AP_to_BOAT							
R	↔wlan2	Wireless (Atheros AR...					
RSA	↔wds_BOAT_1	WDS					
	↔wds_BOAT_2	WDS					
	↔wds_BOAT_3	WDS					
	↔wds_BOAT_4	WDS					
	↔wds_BOAT_5	WDS					
	↔wds_BOAT_6	WDS					
	↔wds_BOAT_7	WDS					

Mesh							
Mesh		Ports	FDB				
+		-		CAP		Scanner	
Interface	Mesh						
I ether1	Mesh-1						
wds_BOAT_1	Mesh-1						
I wds_BOAT_2	Mesh-1						
I wds_BOAT_3	Mesh-1						
I wds_BOAT_4	Mesh-1						
I wds_BOAT_5	Mesh-1						
I wds_BOAT_6	Mesh-1						
I wds_BOAT_7	Mesh-1						
wds_Main_Tower	Mesh-1						
wds_Node_2	Mesh-1						

Mesh				
Mesh		Ports	FDB	
				
	Mesh	Type	MAC Address	On Interface
A	Mesh-1	local	00:0C:42:45:A3:FB	
A	Mesh-1	mesh	7C:C3:A1:88:0B:F1	wds_Main_Tower
	Mesh-1	larval	00:1C:42:96:FC:93	
A	Mesh-1	local	00:0C:42:61:6A:5E	
RA	Mesh-1	mesh	00:0C:42:46:86:2F	wds_Main_Tower
A	Mesh-1	mesh	00:0C:42:46:86:35	wds_Node_2
A	Mesh-1	mesh	00:0C:42:46:86:41	wds_BOAT_1
A	Mesh-1	local	00:0C:42:31:38:A8	

# NODE - 2

Interface <wlan1>

General Wireless WDS Nstreme NV2 Status Traffic

Mode: **ap bridge**

Band: 5GHz-A

Channel Width: 20MHz

Frequency: 5180 MHz

SSID: Link\_1

Scan List: default

Interface <wlan2>

General Wireless HT HT MCS WDS Nstreme ...

Mode: **ap bridge**

Band: 2GHz-only-N

Channel Width: 20MHz

Frequency: 2427 MHz

SSID: Deep\_Sea

Scan List: default

Wireless Protocol: any

Security Profile: default

Interface <wlan1>

General Wireless WDS Nstreme NV2 Status Traffic

WDS Mode: **static**

WDS Default Bridge: none

WDS Ignore SSID

Interface <wlan2>

HT HT MCS WDS Nstreme NV2 Status Traffic ...

WDS Mode: **static**

WDS Default Bridge: none

WDS Ignore SSID

Wireless Tables

Interfaces Nstreme Dual Access List Registration Connect List Security Profiles Channels

[-] [Filter] [Reset]

Radio Name	MAC Address	Interface	Uptime	AP	...	Last Activi...	Tx/Rx Signal ...
↔ BOAT_1	00:0C:42:61:6A:77	wlan2	00:00:28	yes	yes	0.630	-47/-44
↔ Link_Node_1	00:0C:42:31:38:A8	wlan1	00:06:51	yes	yes	0.000	-17/-18

Wireless Tables

Interfaces Nstreme Dual Access List Registration

[+] [-] [Check] [X] [Print] [Filter] [CAP] [Scan]


Name	Type
;;; Link_Between_BTS	
RS ↔ wlan1	Wireless (Atheros AR...
RSA ↔ wds_Node_1	WDS
;;; Mesh_to_BOAT	
R ↔ wlan2	Wireless (Atheros AR...
RSA ↔ wds_BOAT_1	WDS
↔ wds_BOAT_2	WDS
↔ wds_BOAT_3	WDS
↔ wds_BOAT_4	WDS
↔ wds_BOAT_5	WDS
↔ wds_BOAT_6	WDS
↔ wds_BOAT_7	WDS

Mesh

Mesh Ports FDB

[+] [-] [Check] [X] [Print] [Filter]

Interface	Mesh
I ether1	Mesh_1
wds_BOAT_1	Mesh_1
I wds_BOAT_2	Mesh_1
I wds_BOAT_3	Mesh_1
I wds_BOAT_4	Mesh_1
I wds_BOAT_5	Mesh_1
I wds_BOAT_6	Mesh_1
I wds_BOAT_7	Mesh_1
wds_Node_1	Mesh_1

Mesh				
Mesh Ports FDB				
				
	Mesh	Type	MAC Address	On Interface
A	Mesh_1	local	00:0C:42:46:86:35	
A	Mesh_1	local	00:0C:42:31:38:39	
	Mesh_1	larval	7C:C3:A1:88:0B:F1	
	Mesh_1	larval	00:1C:42:96:FC:93	
A	Mesh_1	mesh	00:0C:42:45:A3:FB	wds_Node_1
RA	Mesh_1	mesh	00:0C:42:46:86:2F	wds_Node_1
A	Mesh_1	local	00:0C:42:61:6D:41	
A	Mesh_1	mesh	00:0C:42:46:86:41	wds_BOAT_1

# BOAT - 1

Interface <wlan2>

General Wireless HT HT MCS WDS Nstreme ...

Mode: ap bridge

Band: 2GHz-only-N

Channel Width: 20MHz

Frequency: 2427 MHz

SSID: Deep\_Sea

Scan List: default

Wireless Protocol: any

Security Profile: default

Interface <wlan2>

HT HT MCS WDS Nstreme NV2 Status Traffic ...

WDS Mode: static

WDS Default Bridge: none

WDS Ignore SSID

Wireless Tables

Interfaces Nstreme Dual Access List Registration Connect List

+ - ✓ ✗ CAP Scanner Freq

	Name	Type	L2 MTU	Tx
X	wlan1	Wireless (Atheros AR...	1600	
R	wlan2	Wireless (Atheros AR...	1600	
	wds_BOAT_2	WDS		
	wds_BOAT_3	WDS		
	wds_BOAT_4	WDS		
	wds_BOAT_5	WDS		
	wds_BOAT_6	WDS		
	wds_BOAT_7	WDS		
RSA	wds_Main_Tower	WDS	1600	
RSA	wds_Node_1	WDS	1600	
RSA	wds_Node_2	WDS	1600	

Wireless Tables													
Interfaces		Nstreme Dual		Access List		Registration		Connect List		Security Profiles		Channels	
[-]		[Filter]		[Reset]									
Radio Name	MAC Address	Interface	Uptime	AP	...	Last Activi...	Tx/Rx Signal ...						
MESH_NODE_1	00:0C:42:61:6A:5E	wlan2	00:13:17	yes	yes	0.740	-26/-28						
MESH_NODE_2	00:0C:42:61:6D:41	wlan2	00:13:20	yes	yes	0.450	-44/-47						
Main_Tower	00:0C:42:61:6A:46	wlan2	00:07:33	yes	yes	0.000	-30/-36						

Mesh			
Mesh		Ports	FDB
[+] [-] [Check] [X] [Info] [Filter]			
Interface	Mesh		
I ether1	Mesh_1		
I wds_BOAT_2	Mesh_1		
I wds_BOAT_3	Mesh_1		
I wds_BOAT_4	Mesh_1		
I wds_BOAT_5	Mesh_1		
I wds_BOAT_6	Mesh_1		
I wds_BOAT_7	Mesh_1		
wds_Main_Tower	Mesh_1		
wds_Node_1	Mesh_1		
wds_Node_2	Mesh_1		

Mesh					
Mesh		Ports	FDB		
[Filter]					
	Mesh	Type	MAC Address	On Interface	L
A	Mesh_1	local	00:0C:42:46:86:41		
A	Mesh_1	local	00:0C:42:61:6A:77		
	Mesh_1	larval	00:1C:42:96:FC:93		
RA	Mesh_1	mesh	00:0C:42:46:86:2F	wds_Main_Tower	
	Mesh_1	larval	7C:C3:A1:88:0B:F1		
	Mesh_1	larval	00:0C:42:45:A3:FB		
A	Mesh_1	mesh	00:0C:42:46:86:35	wds_Node_2	



MikroTik WinBox Loader v2.2.18

Connect To: 00:0C:42:46:86:41 ... Connect

Login:	MAC Address	IP Address	Identity	Version	Board ...
	00:0C:42:45:A3:FB	192.168.10.2	NODE_1	6.32.2	RB433AH
Password:	00:0C:42:46:86:2F	192.168.10.1	Main_Tower	6.32.2	RB433AH
	00:0C:42:46:86:35	192.168.10.3	NODE_2	6.32.2	RB433AH
	00:0C:42:46:86:41	192.168.10.11	BOAT_1	6.32.2	RB433AH

Note:

```

OS-X:~ multi$ ping -c 3 192.168.10.1
PING 192.168.10.1 (192.168.10.1): 56 data bytes
64 bytes from 192.168.10.1: icmp_seq=0 ttl=64 time=0.378 ms
64 bytes from 192.168.10.1: icmp_seq=1 ttl=64 time=0.359 ms
64 bytes from 192.168.10.1: icmp_seq=2 ttl=64 time=0.437 ms

--- 192.168.10.1 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.359/0.391/0.437/0.033 ms
OS-X:~ multi$ ping -c 3 192.168.10.2
PING 192.168.10.2 (192.168.10.2): 56 data bytes
64 bytes from 192.168.10.2: icmp_seq=0 ttl=64 time=2.179 ms
64 bytes from 192.168.10.2: icmp_seq=1 ttl=64 time=0.629 ms
64 bytes from 192.168.10.2: icmp_seq=2 ttl=64 time=0.875 ms

--- 192.168.10.2 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.629/1.228/2.179/0.680 ms
OS-X:~ multi$ ping -c 3 192.168.10.3
PING 192.168.10.3 (192.168.10.3): 56 data bytes
64 bytes from 192.168.10.3: icmp_seq=0 ttl=64 time=0.914 ms
64 bytes from 192.168.10.3: icmp_seq=1 ttl=64 time=0.851 ms
64 bytes from 192.168.10.3: icmp_seq=2 ttl=64 time=1.006 ms

--- 192.168.10.3 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.851/0.924/1.006/0.064 ms
OS-X:~ multi$ ping -c 3 192.168.10.11
PING 192.168.10.11 (192.168.10.11): 56 data bytes
64 bytes from 192.168.10.11: icmp_seq=0 ttl=64 time=0.611 ms
64 bytes from 192.168.10.11: icmp_seq=1 ttl=64 time=0.871 ms
64 bytes from 192.168.10.11: icmp_seq=2 ttl=64 time=0.638 ms

--- 192.168.10.11 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.611/0.707/0.871/0.117 ms

```

# Advantage

- Loop free Topology
- Route selection base on path cost
- The cost is automatically calculated base on actual link BW
- On demand route selection / tree base Topology



Thank You...

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