# The EvoLogics Acoustic Modem
Integration into NURC's MOOS Environment
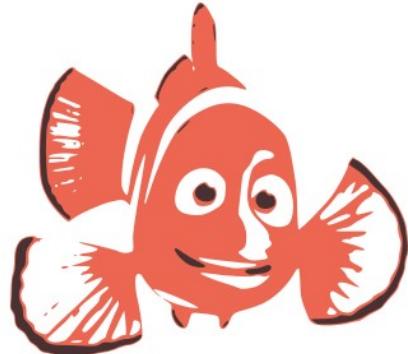
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Stephanie Kemna
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MOOS-DAWG, July 19-20, 2011

Our Vehicle – OEX AUV
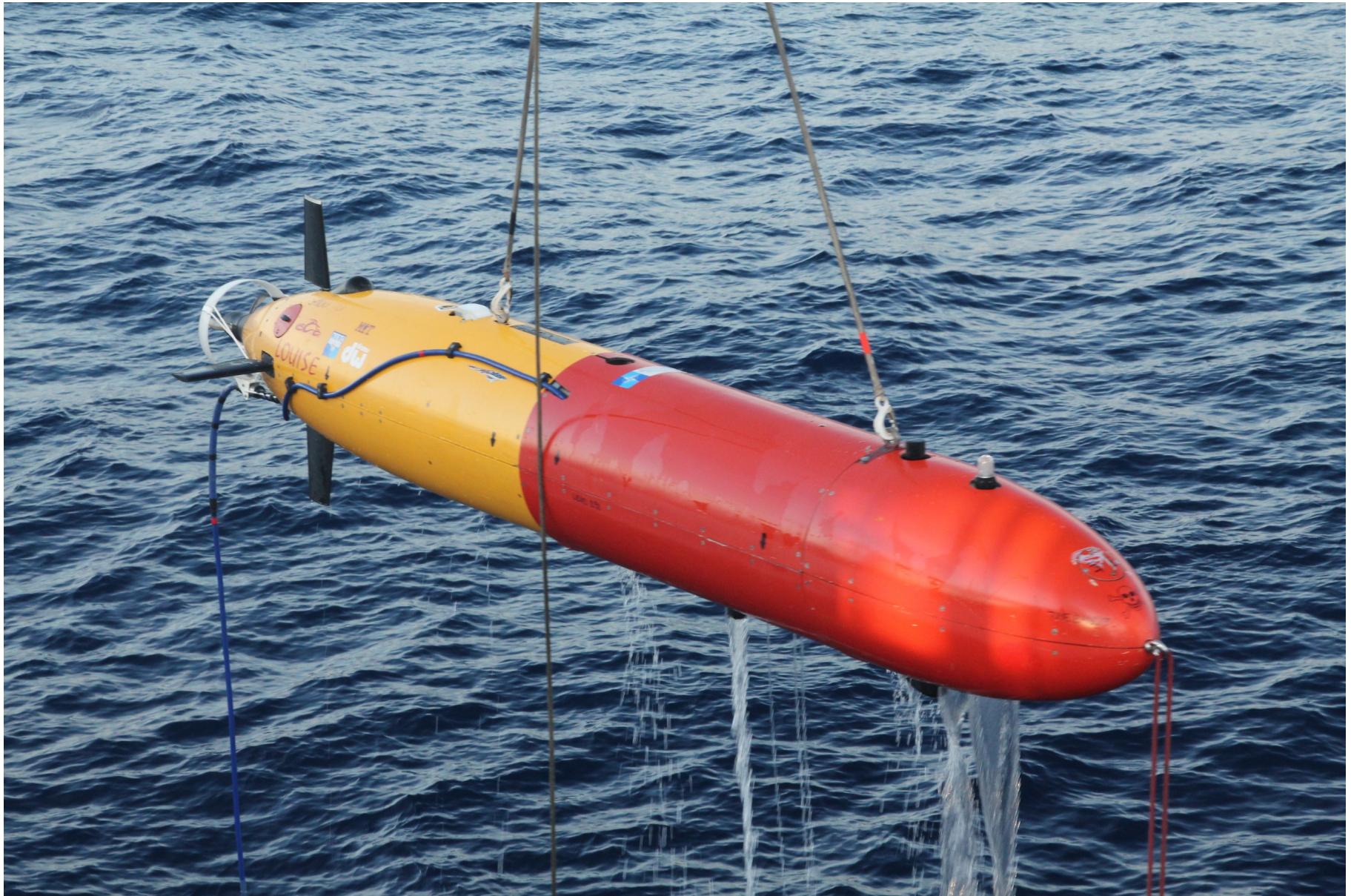
Past Modem Configuration

- WHOI (Woods Hole Oceanographic Institute) Micro-Modems

  - Alliance (top side)

  - OEX Groucho

  - OEX Harpo

- MIT's pAcommsHandler

- EdgeTech (frontseat modem)

pAcommsHandler
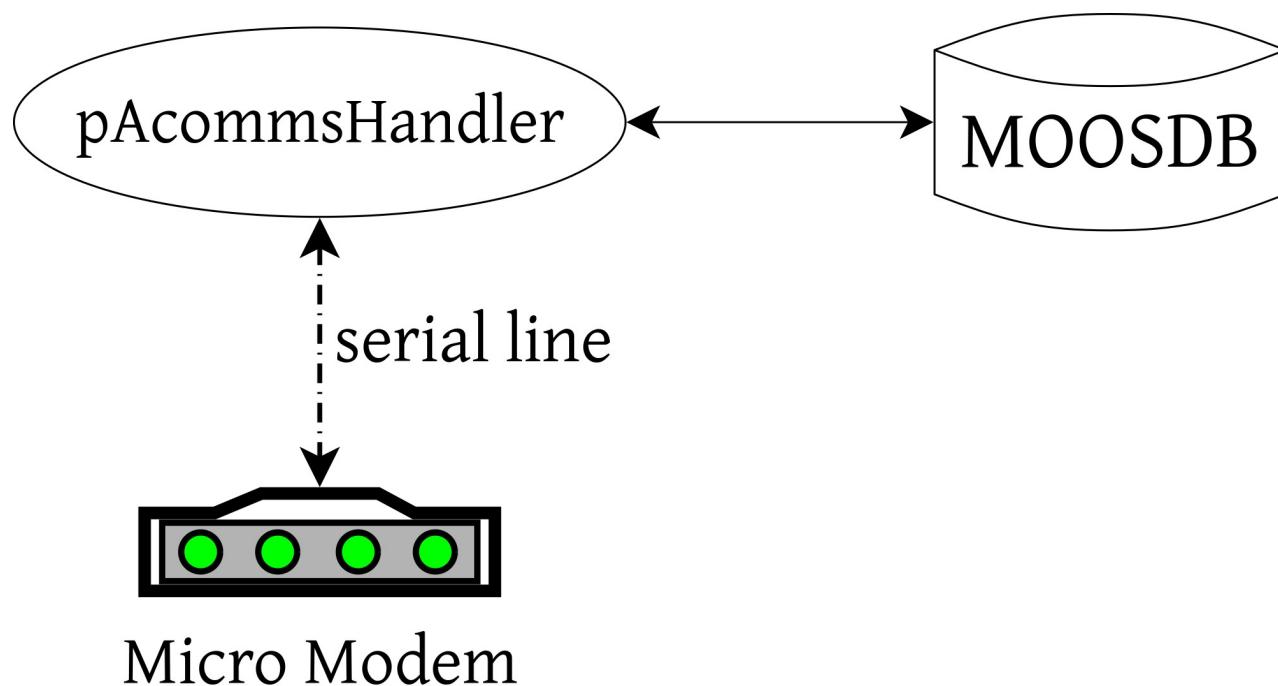
What's in pAcommsHandler

arnings and ungrouped messages ─────
```
7:38 | modem id [26], name [whitetip], type [auv], location name
etip]
7:38 | modem id [27], name [hammerhead], type [auv], location nam
ammerhead]
7:38 | modem id [29], name [folaga], type [glider], location name
laga]
7:38 | ********************************
7:38 |
7:38 | reading in geodesy information:
7:38 | success!
7:39 | got update for MAC: destination=1,update_type=add,poll_typ
ata,poll_from_id1=1,poll_to_id1=-1,poll_rate1=0,poll_wait1=15,pol
pe2=data,poll_from_id2=14,poll_to_id2=1,poll_rate2=0,poll_wait2=1
l_type3=data,poll_from_id3=13,poll_to_id3=1,poll_rate3=0,poll_wa
15
7:39 | type is add
```

C related messages (goby_amac) ─────
```
_time: 15
7:39 | cycles since day start: 1264
7:39 | the MAC TDMA next cycle begins at time: 2011-Mar-28 15:48:

8:00 | cycle order: [ d1/-1@0 d14/1@0 d13/1@0  ]
8:00 | starting slot: type: data | src: 1 | dest: -1 | rate: 0 |
_time: 15
8:15 | cycle order: [d1/-1@0  d14/1@0 d13/1@0  ]
8:15 | starting slot: type: data | src: 14 | dest: 1 | rate: 0 |
_time: 15
8:30 | cycle order: [d1/-1@0 d14/1@0  d13/1@0  ]
8:30 | starting slot: type: data | src: 13 | dest: 1 | rate: 0 |
_time: 15
8:45 | cycle order: [ d1/-1@0 d14/1@0 d13/1@0  ]
8:45 | starting slot: type: data | src: 1 | dest: -1 | rate: 0 |
_time: 15
```

ncoder messages (goby_dccl) ─────
```
7:39 | NURC_STATUS_ALLIANCE: trig: NODE_REPORT_NMEA_SHIP | out: O
URC_STATUS_ALLIANCE_HEX_32B | in: IN_NURC_STATUS_ALLIANCE_HEX_32B
ize: {17/32B} [136/256b] | message var N: 6
7:39 | NURC_STATUS_LEONARDO: trig: NODE_REPORT_AIS | out: OUT_NUR
ATUS_LEONARDO_HEX_32B | in: IN_NURC_STATUS_LEONARDO_HEX_32B | siz
17/32B} [130/256b] | message var N: 6
7:39 | NURC_STATUS: trig: 5s | out: OUT_NURC_STATUS_HEX_32B | in:
NURC_STATUS_HEX_32B | size: {17/32B} [129/256b] | message var N:

7:39 | NURC_TRIGGER_UPDATE: trig: OUTGOING_TRIGGER_UPDATE | out:
NURC_TRIGGER_UPDATE_HEX_32B | in: IN_NURC_TRIGGER_UPDATE_HEX_32B
ze: {8/32B} [59/256b] | message var N: 3
7:39 | NURC_DEPLOY: trig: OUTGOING_COMMAND | out: OUT_NURC_DEPLOY
32B | in: IN_NURC_DEPLOY_HEX_32B | size: {31/32B} [241/256b] | m
ge var N: 22
7:39 |
```

ecoder messages (goby_dccl) ─────
```
:34 | finished decode of VIEW_POINT
:34 | publish/subscribe variables are:
       VIEW_POINT: std::string: active=true:label_oex.grouch
```

5. stack push - outgoing messages (goby_queue) ─────

Information Display

DCCL

Queue

MAC

Modem Driver

6. ─────
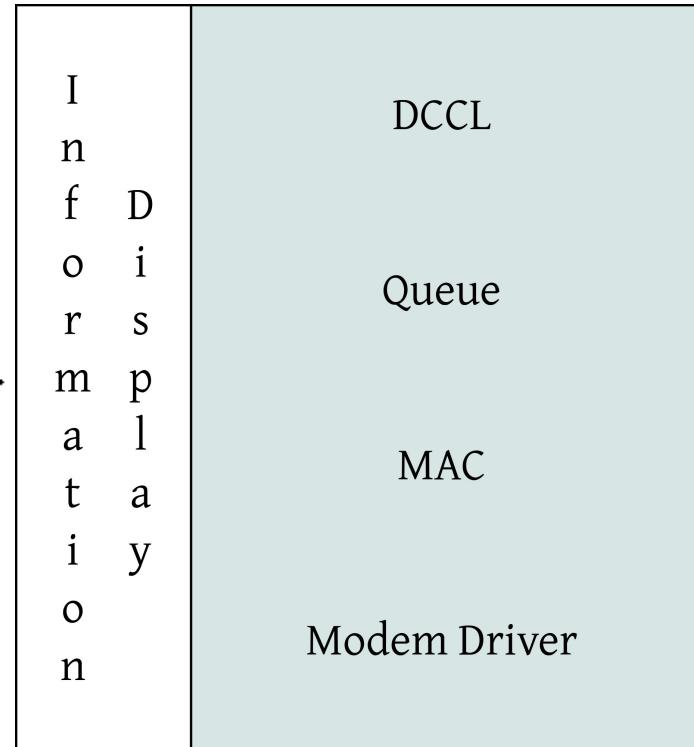
7. priority contest (goby_queue) ─────
```
15:48:00 | starting priority contest... request: rate 0 | max_size 32
B
15:48:00 |      all other queues have no messages
15:48:45 | starting priority contest... request: rate 0 | max_size 32
B
15:48:45 |      all other queues have no messages
```

8. outgoing queuing messages (goby_queue) ─────
```
15:47:38 |      blackout_time: 0
15:47:38 |      max_queue: 3
15:47:38 |      newest_first: true
```

9. incoming queuing messages (goby_queue) ─────
```
15:48:19 | received message: src 14 | dest 1 | size 32B |
rame 1 | *54
15:48:19 | published received data to IN_NURC_STATUS_HEX_3
 dest 0 | size 17B | ack true | frame 1 | *5a
15:48:19 | published received data to IN_VIEW_POINT_HEX_32
dest 0 | size 15B | ack true | frame 1 | *09
15:48:34 | received message: src 13 | dest 1 | size 32B |
rame 1 | *02
15:48:34 | published received data to IN_NURC_STATUS_HEX_3
 dest 0 | size 17B | ack true | frame 1 | *55
15:48:34 | published received data to IN_VIEW_POINT_HEX_32
dest 0 | size 15B | ack true | frame 1 | *50
```

10. outgoing micromodem messages (goby_modemdriver) ─────
```
15:47:42 | (Warning): resending $CCCFG because we had no m
e for 3 second(s).
15:47:42 | $CCCFG,ALL,0*33
15:47:42 | (Warning): modem reports error: $CAERR,154742,N
15:47:45 | (Warning): resending $CCCFG because we had no m
e for 3 second(s).
15:47:45 | $CCCFG,ALL,0*33
15:47:45 | (Warning): modem reports error: $CAERR,154745,N
15:47:48 | (Warning): resending $CCCFG because we had no m
e for 3 second(s).
15:47:48 | (Warning): modem did not respond to our command
3 retries, continuing onwards anyway...
15:48:15 | (Warning): resending $CCCYC because we had no m
e for 29 second(s).
15:48:15 | $CCCYC,0,14,1,0,0,1*6C
15:48:30 | $CCCYC,0,13,1,0,0,1*6B
```

11. incoming micromodem messages (goby_modemdriver) ─────
```
c0404a8686c7a13af3088*00
15:48:19 | $CATXP,4*46
15:48:19 | $CATXF,4*50
15:48:26 | $CAREV,154826,AUV,0,92,0.85*09
15:48:30 | $CACYC,0,13,1,0,0,1*69
15:48:30 | $CATXP,4*46
15:48:30 | $CATXF,4*50
15:48:31 | $CARXP,0*44
15:48:34 | $CADQF,250*4A
15:48:34 | $CARXD,13,1,1,1,2015b793da0c0b00253e406068a7ac3
a0404a0fadd420f1670a8*51
15:48:34 | $CATXP,4*46
15:48:34 | $CATXF,4*50
15:48:36 | $CAREV,154836,AUV,0,92,0.85*08
15:48:46 | $CAREV,154846,AUV,0,92,0.85*0F
15:48:56 | $CAREV,154856,AUV,0,92,0.85*0E
```

12. tcp share ─────
```
15:47:38 | tcp_share_enable is false
```

pAcommsHandler Message Flow
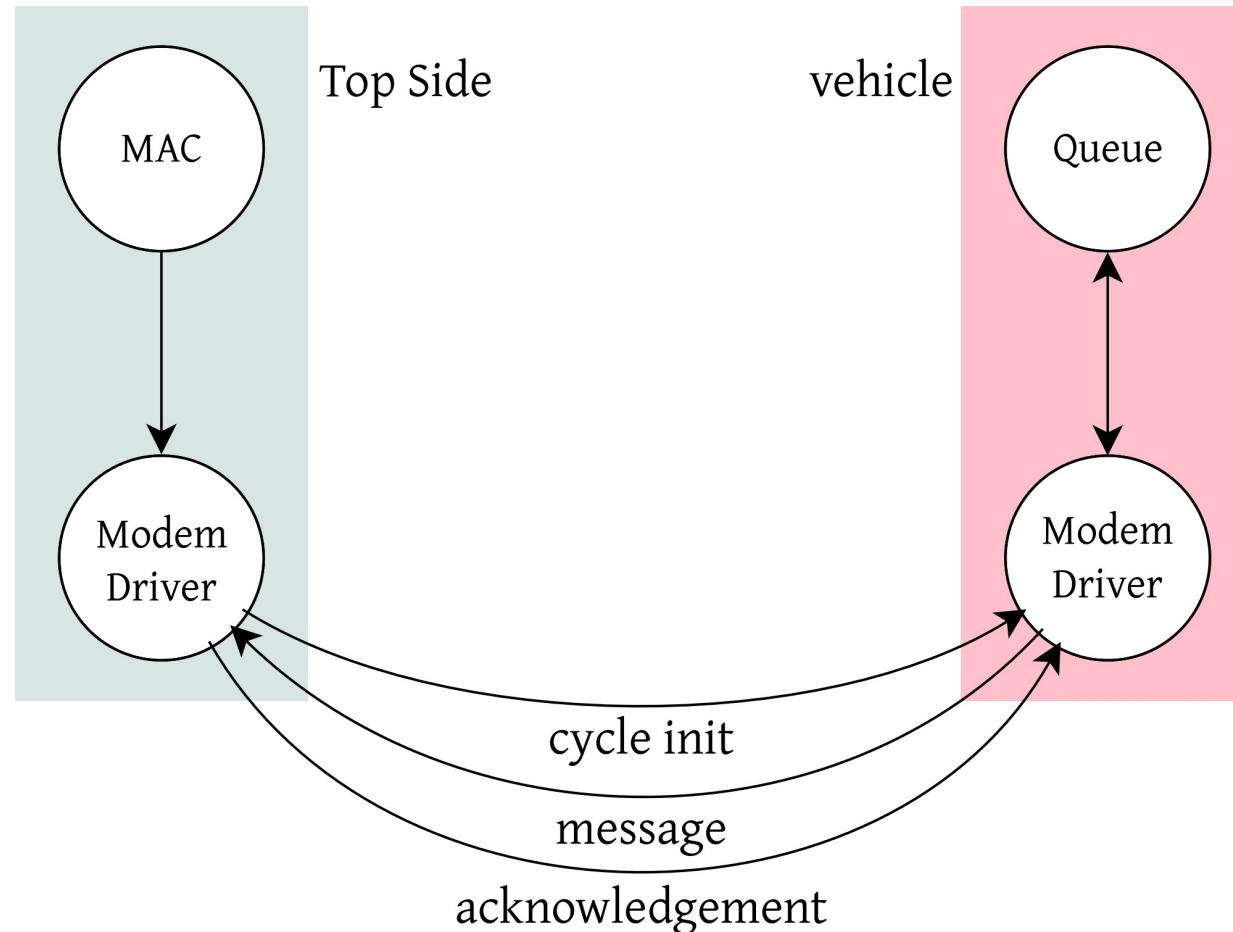
EvoLogics Modem

- S2C R 8/16
- Sweep-Spread Carrier (S2C)
    - EvoLogics patent

EvoLogics Modem Specs

- Operating frequency band: 7 ... 17 kHz

- Transducer beam pattern: hemispherical

- Working range: 8000 meters

- Interfaces: 2 x RS 232, Ethernet

- Internal data buffer: 1 MB

- Hydroacoustic link: up to 6.9 Kbps in Burst mode

- Sophisticated MAC

- Instant Messaging: 64 bytes @ 976 bps

First attempt: a hack
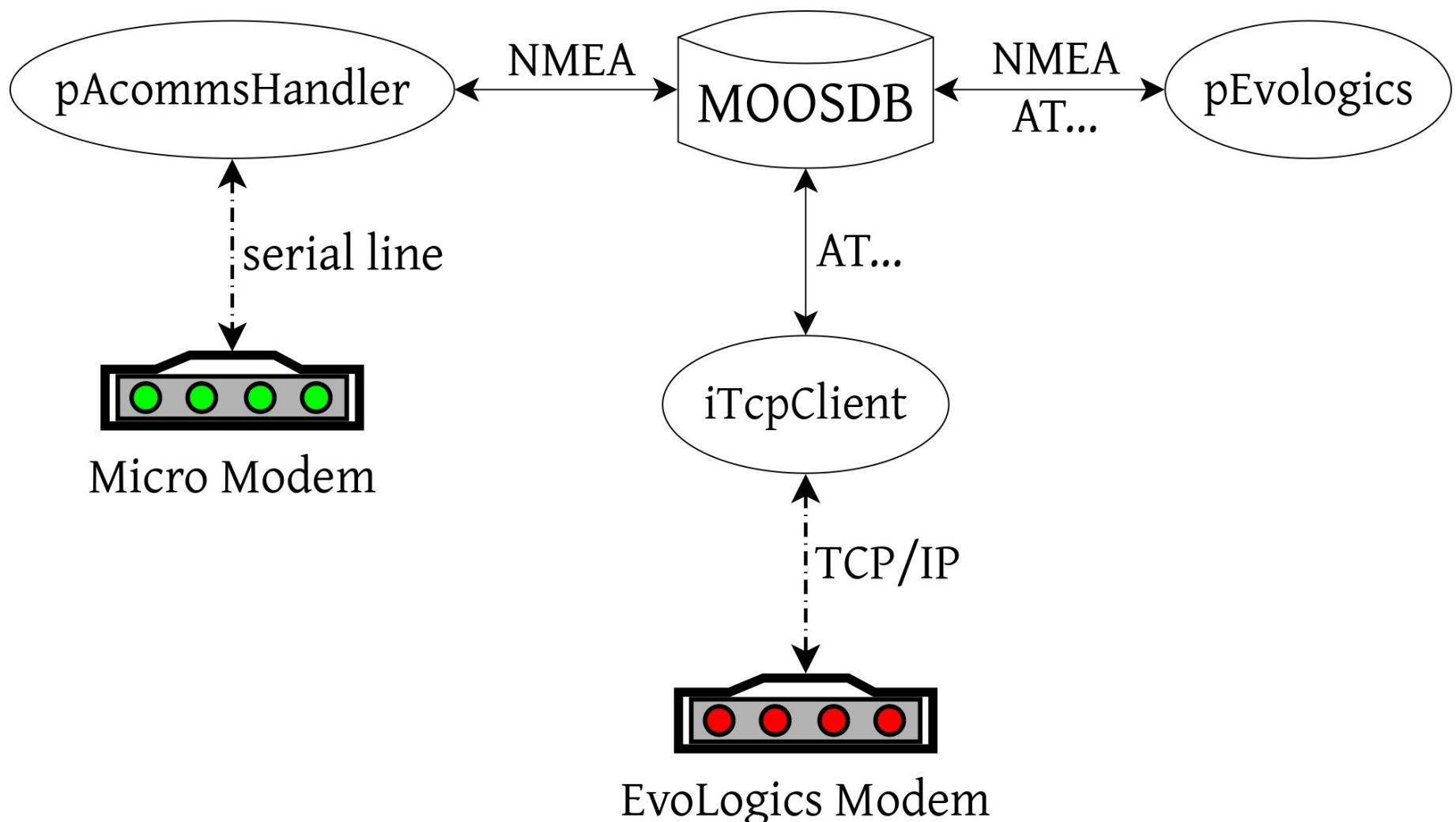
What next?

- Requirements analysis
    - Comms group
    - Autonomy group
- Proper design
- Implementation
- Testing
    - Simulation
    - At sea during June Engineering Trial

Requirements - Comms group

- Routing

- DTN (Delay Tolerant Networking)

- Store and forward

- Alternative MAC layers

- Cross-layer relationships

- Collaboration with other institutes

# Solution - Comms group
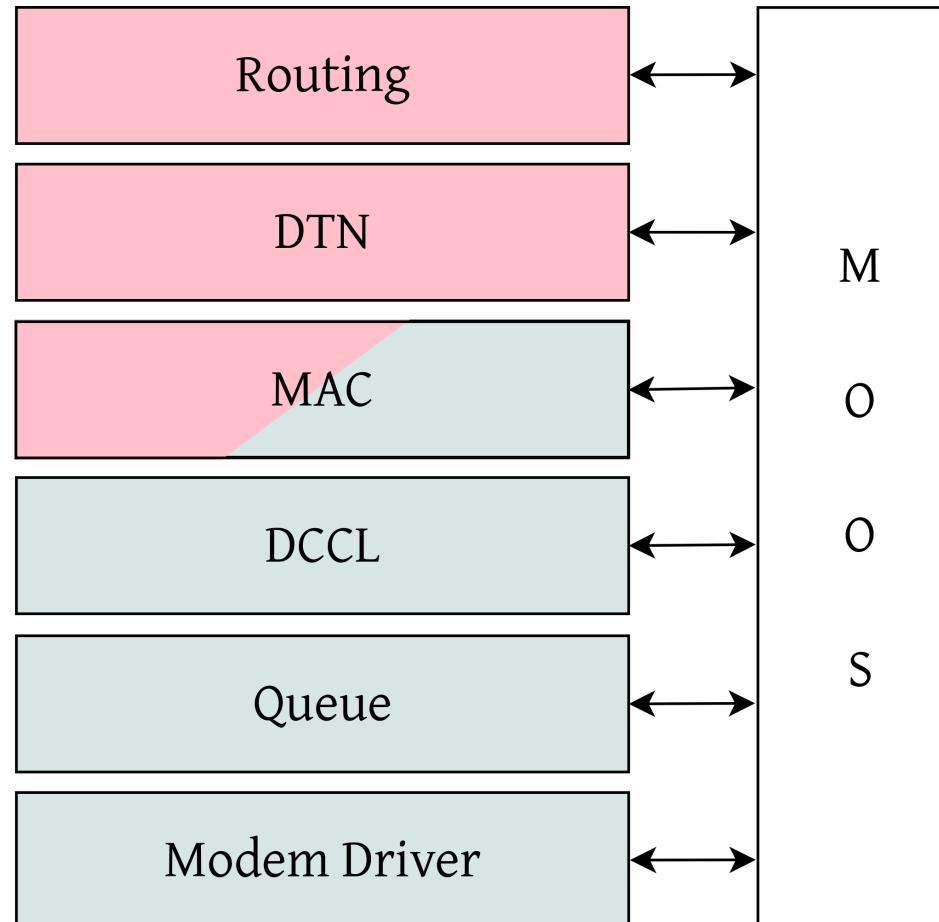
Advanced solution - Comms group
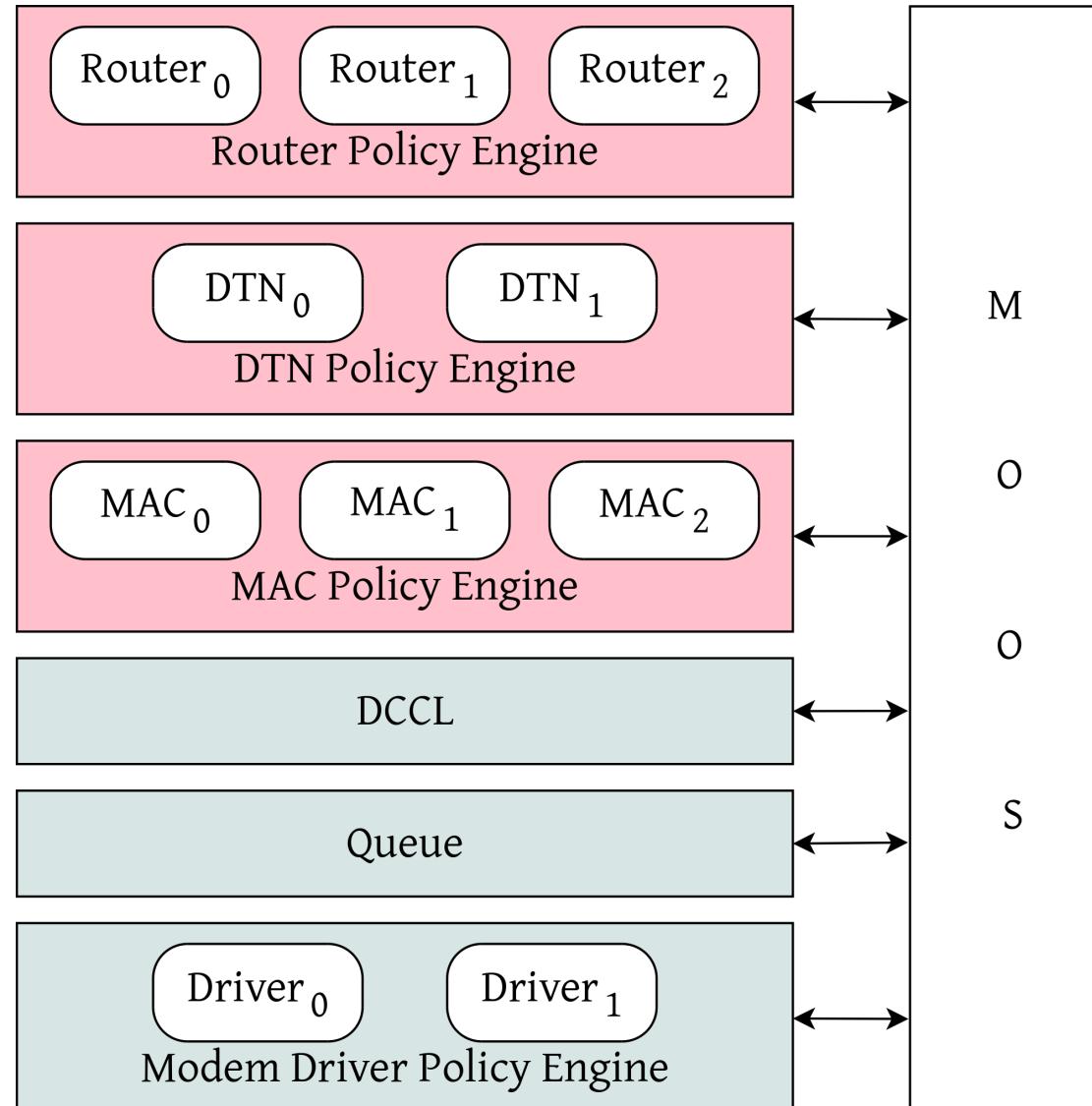
Requirements - Autonomy group

- Same as what we have now, but longer range

- Side-by-side use of Micro-Modem, EvoLogics

- iCommander

- Message configuration

- Replacement for iModemSim

- Available for June Engineering Trial

Solution - Autonomy group
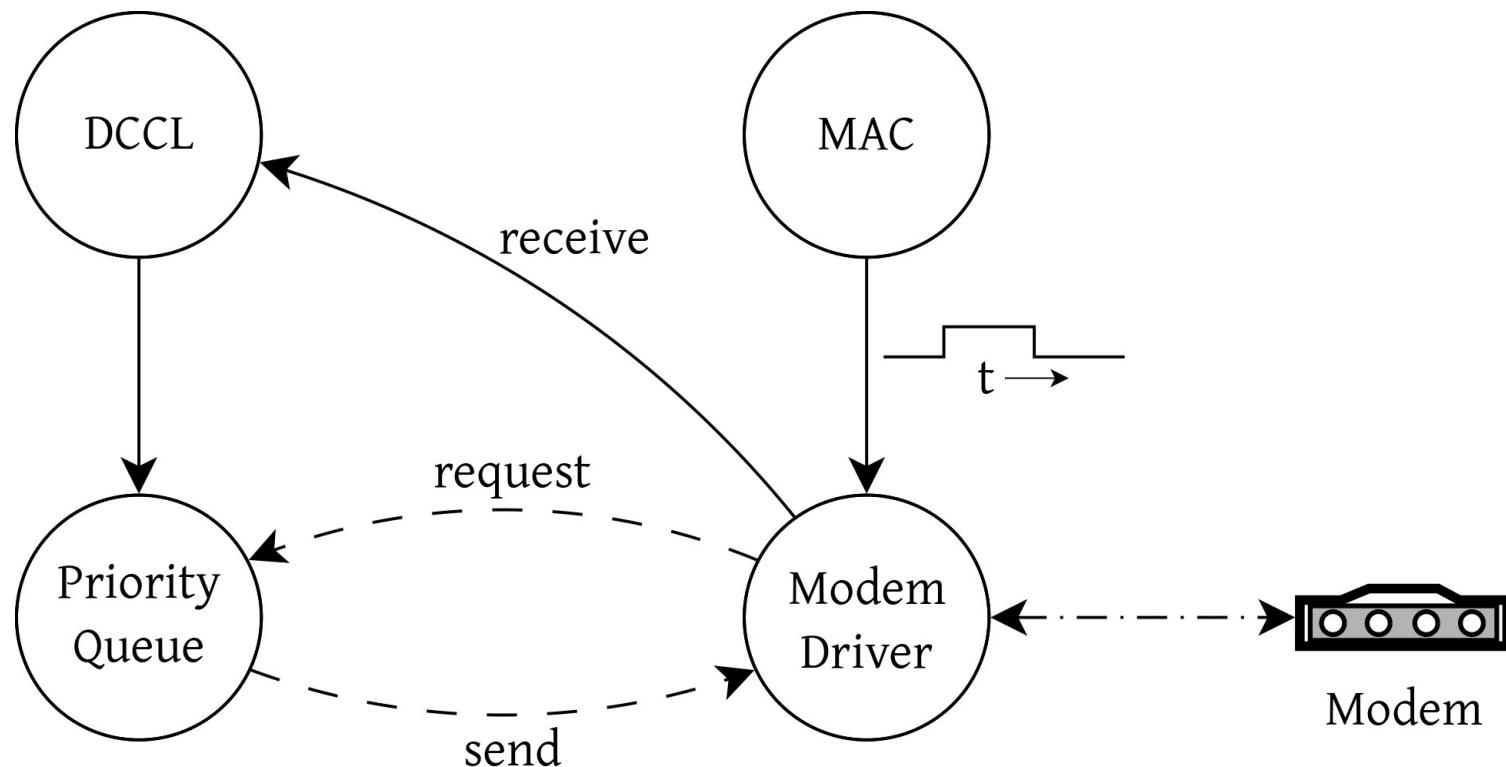
NEMO with Micro-Modem
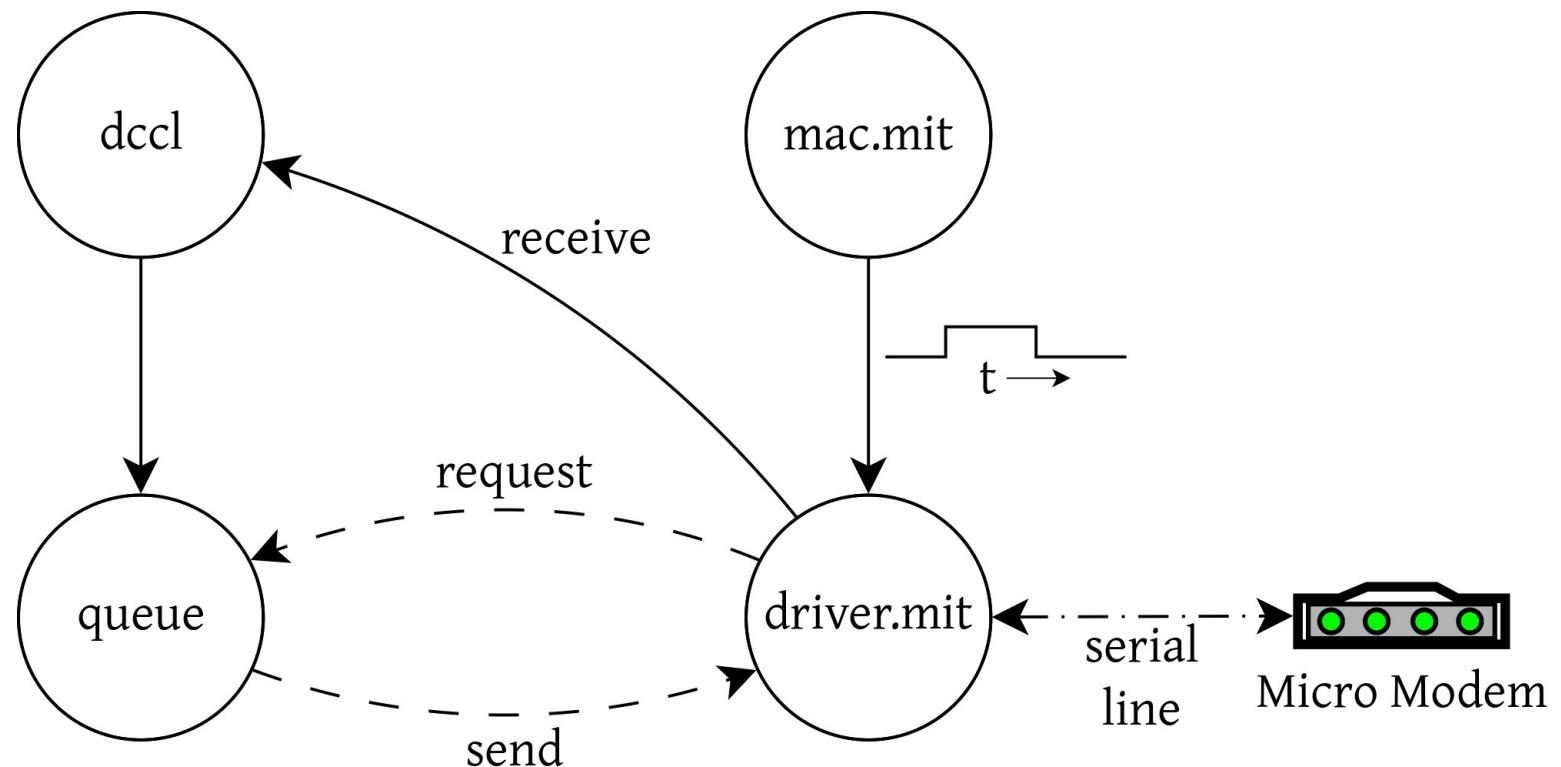
NEMO with EvoLogics
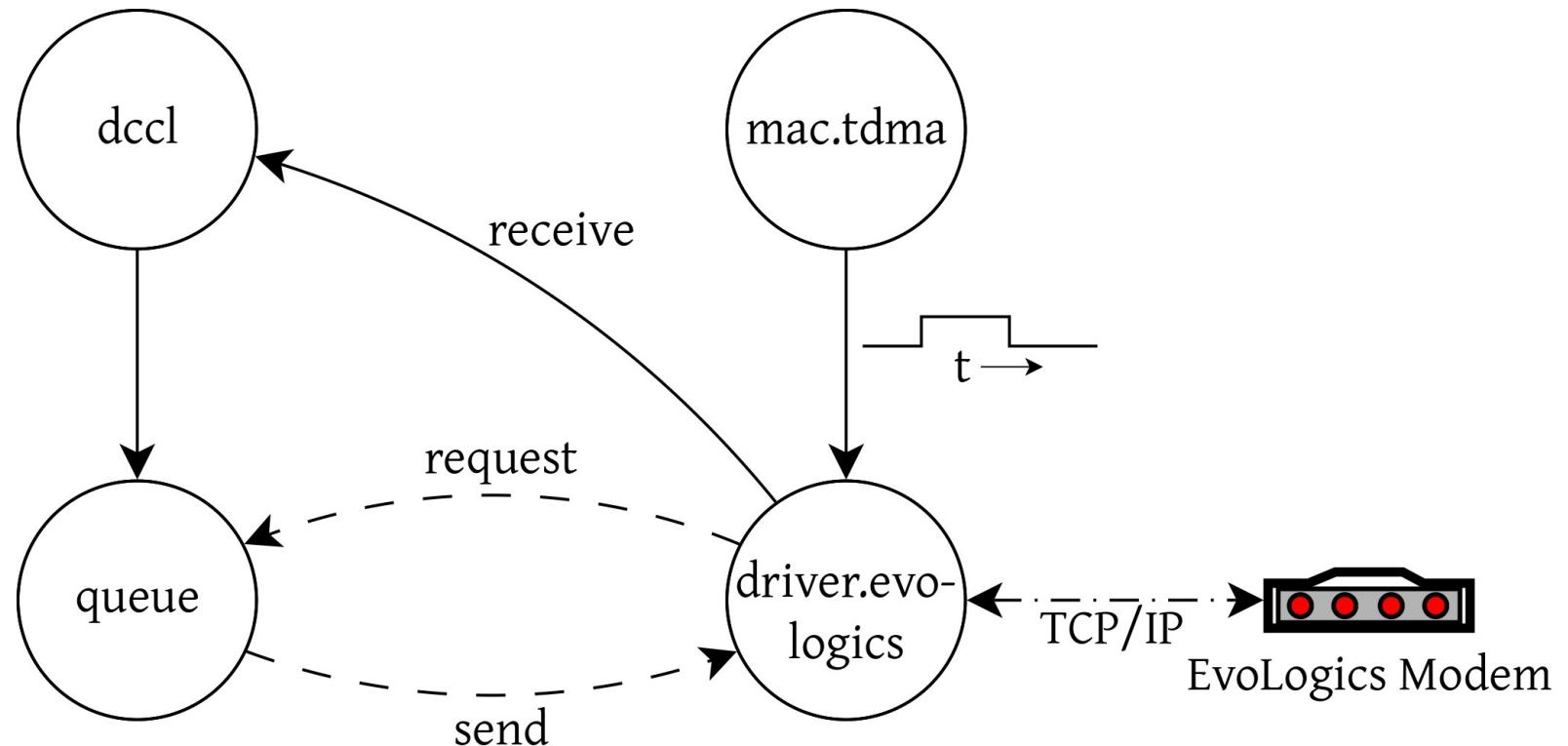
Two Modems, separate use
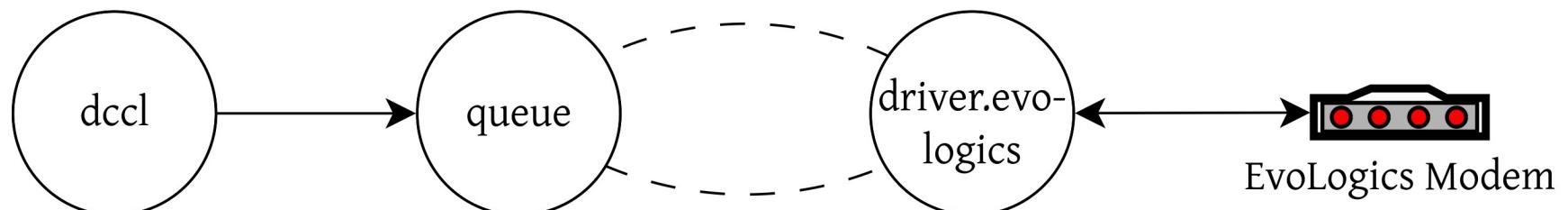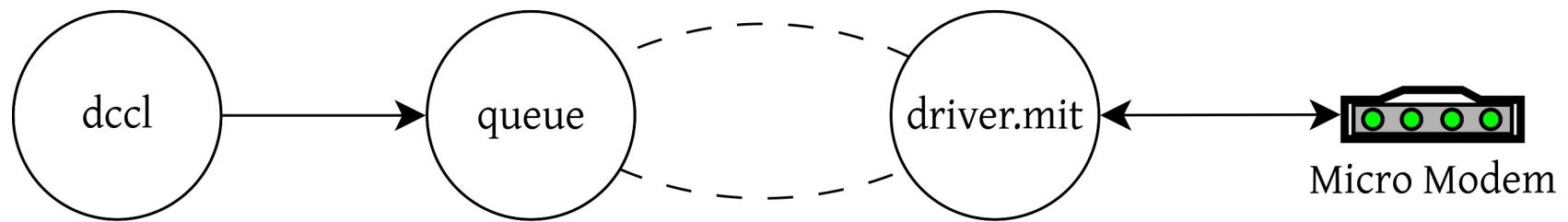
Two Modems, same DCCL
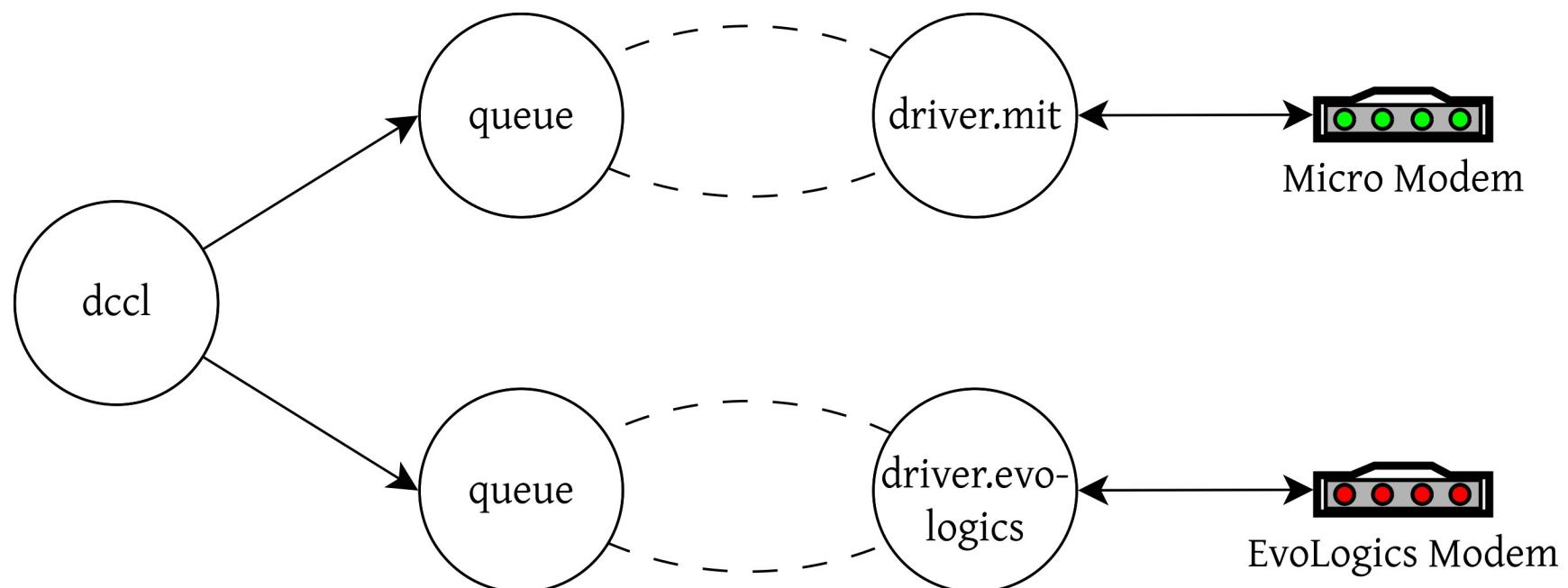
Two Modems, same queue

Simulation Setup

vehicle 1

vehicle 2

driver.evologics

driver.evologics

"water"

driver.nevologics

driver.nevologics

MOOSDB
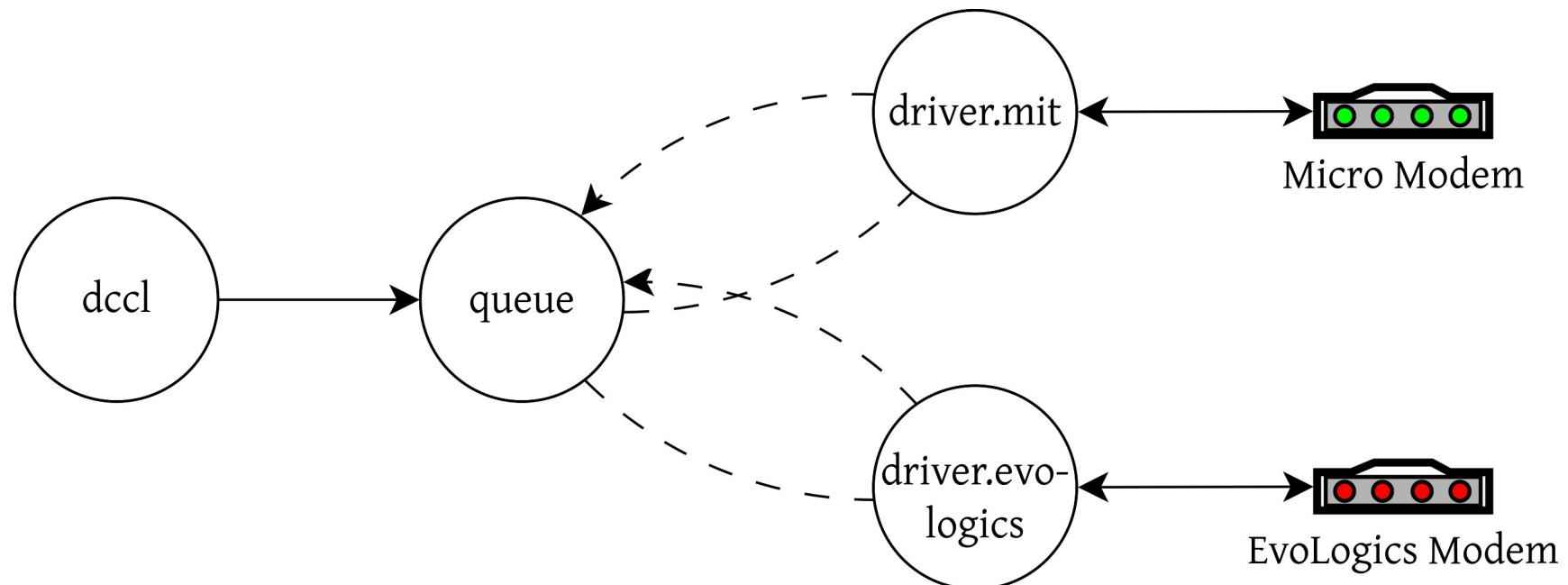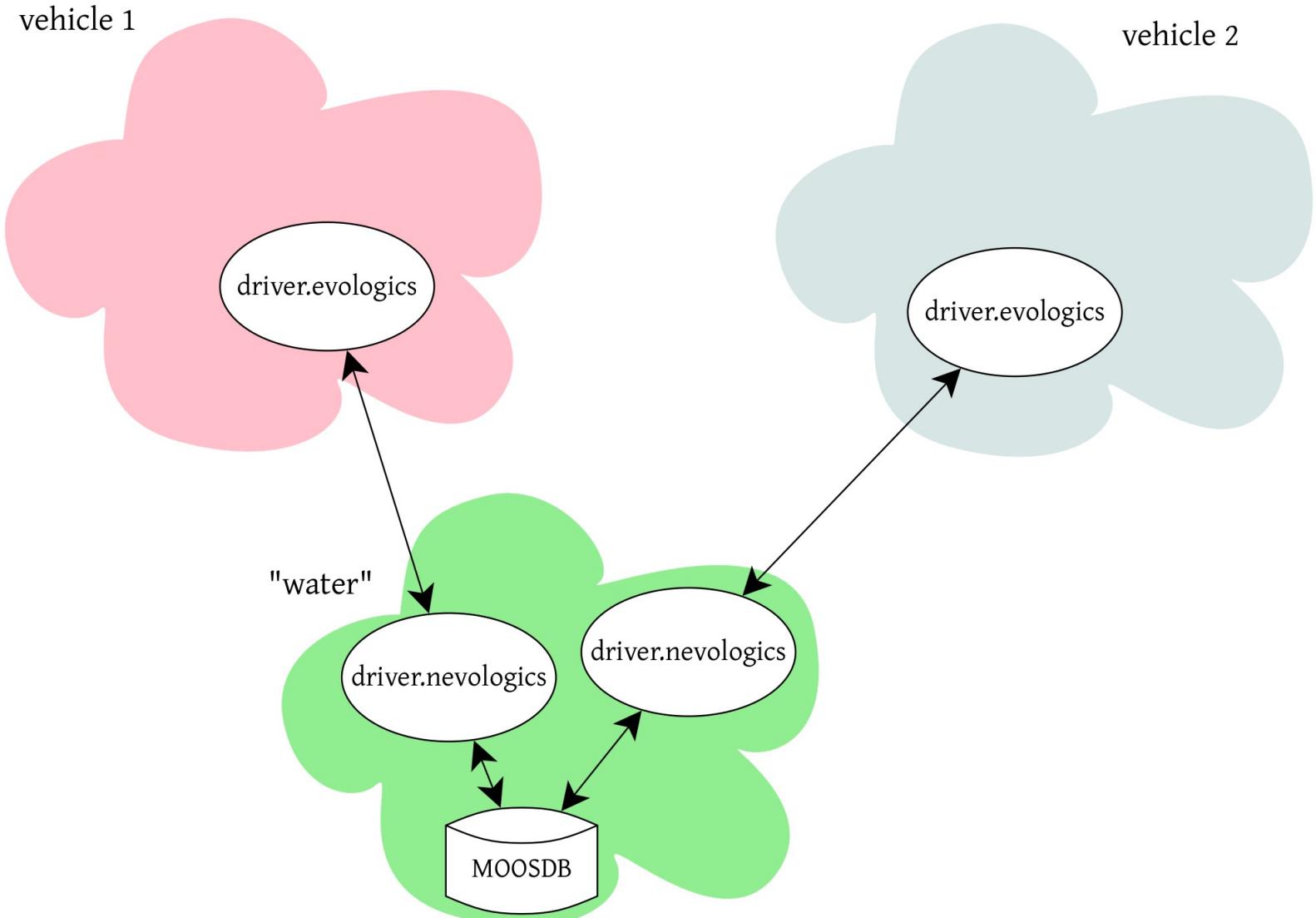
What does not work?

- `on_demand`

- Acknowledgement/Retry for EvoLogics

- Information display: uWitty

Some Initial Results

mission 20110615, messages received on Alliance

Legend:
- groucho micro modem (307)
- groucho evologics (446)
- harpo micro modem (306)
- harpo evologics (503)

x-axis: time (hour), from 10:00 to 20:00
y-axis: distance (meter), from 0 to 3000
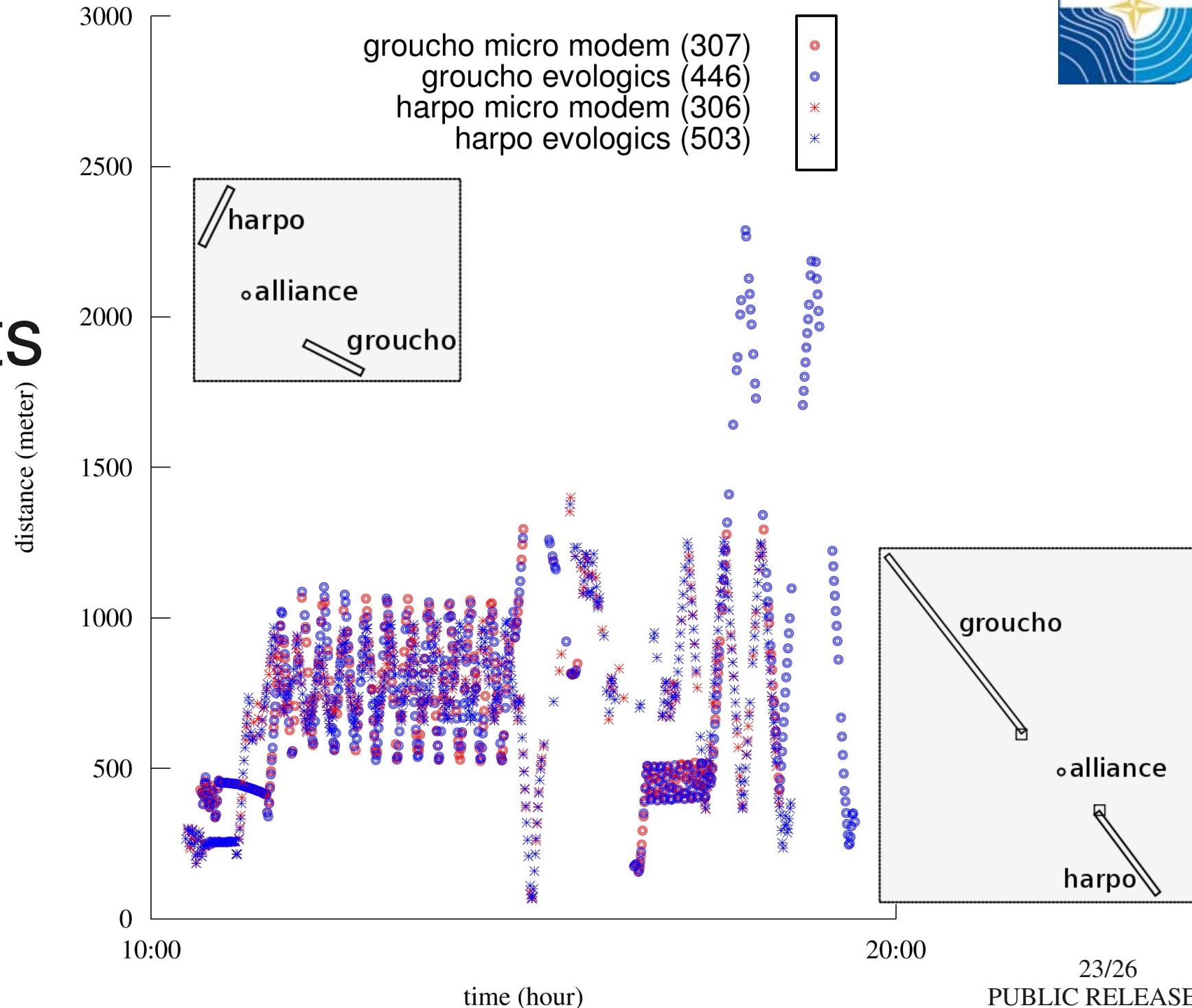
mission 20110615, messages received on Groucho

Some Initial Results (cont)

PUBLIC RELEASE
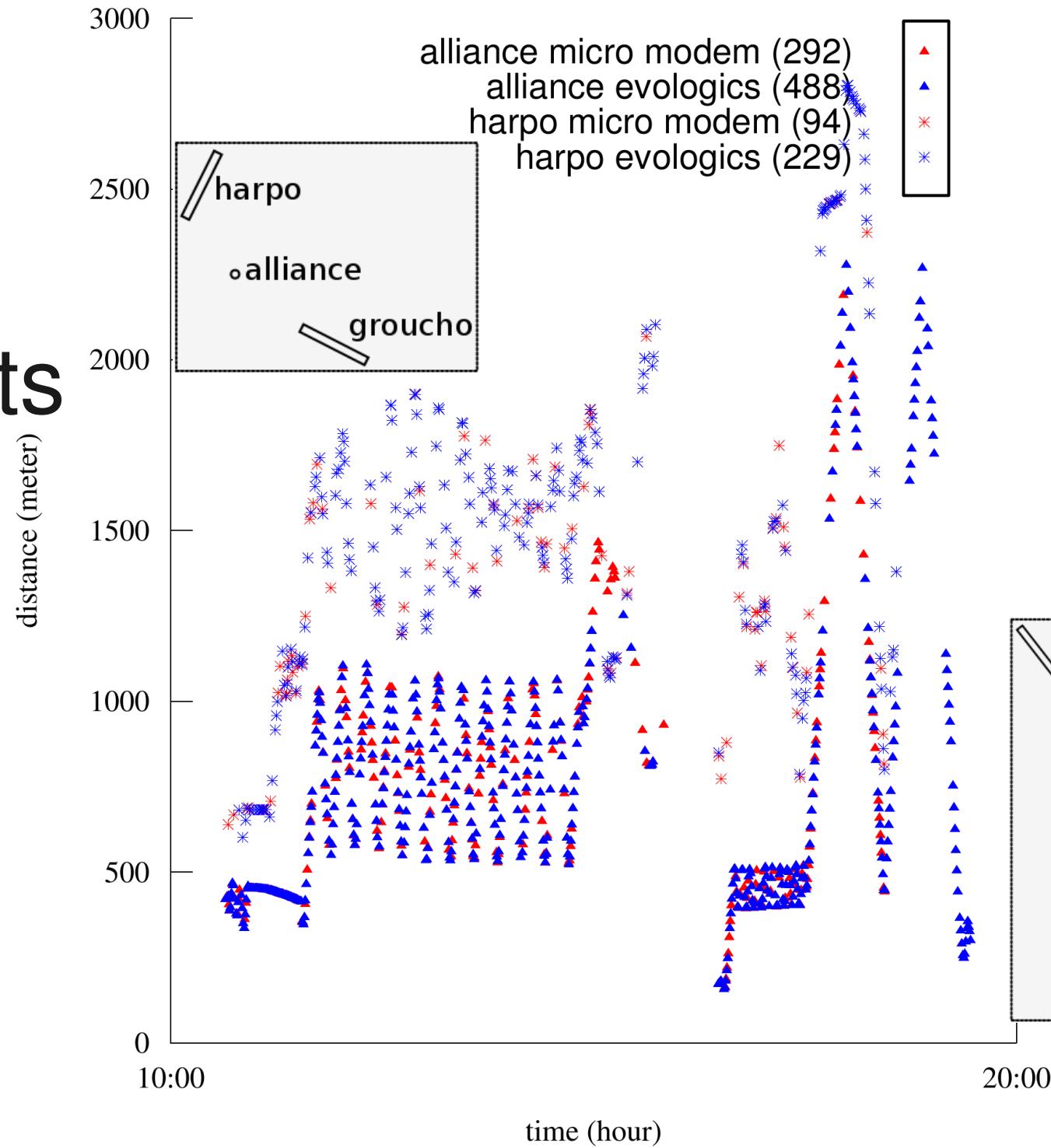
More Initial Results
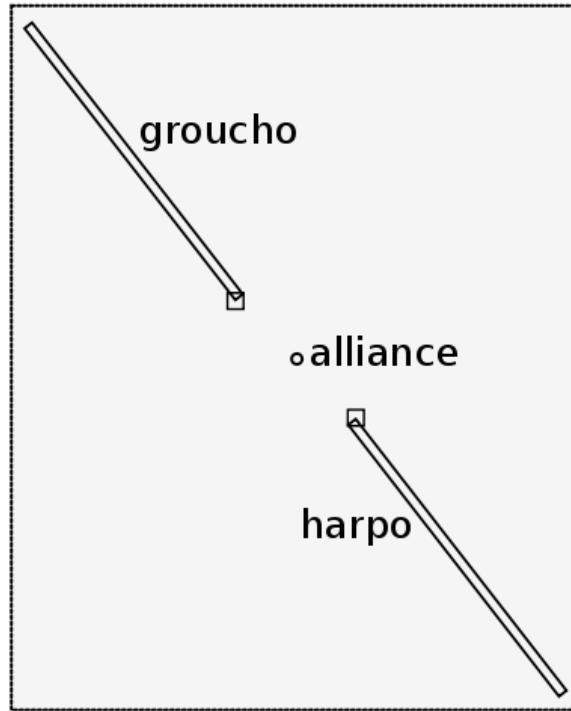
mission 20110617, messages received on Harpo

alliance evologics (360)
groucho evologics (252)

distance (meter)

time (hour)
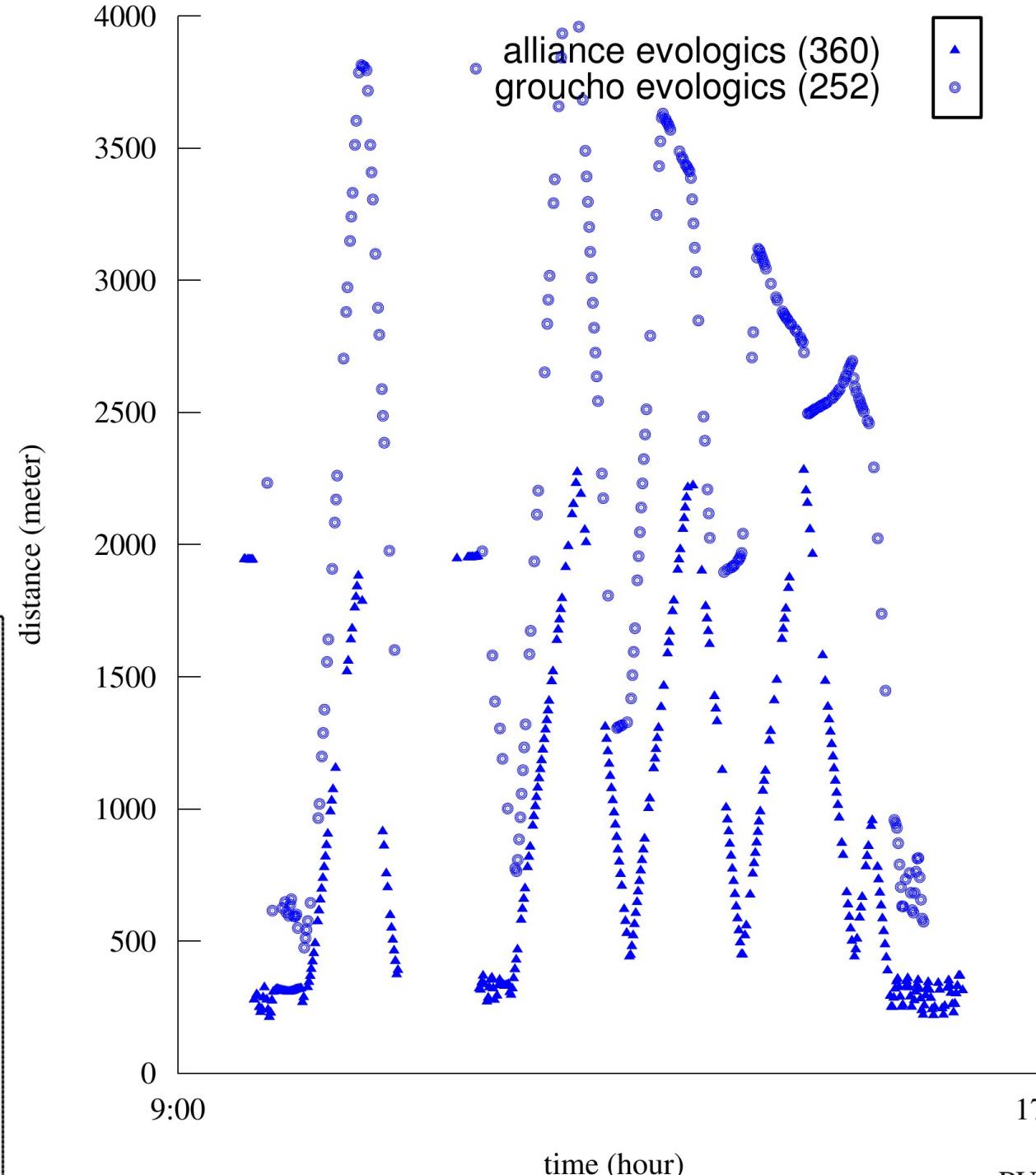
Distribution

- NEMO is a 'finished' product

- distributed to workshop participants

- please use it, and give feedback!

- merge back ideas into pAcommsHandler?