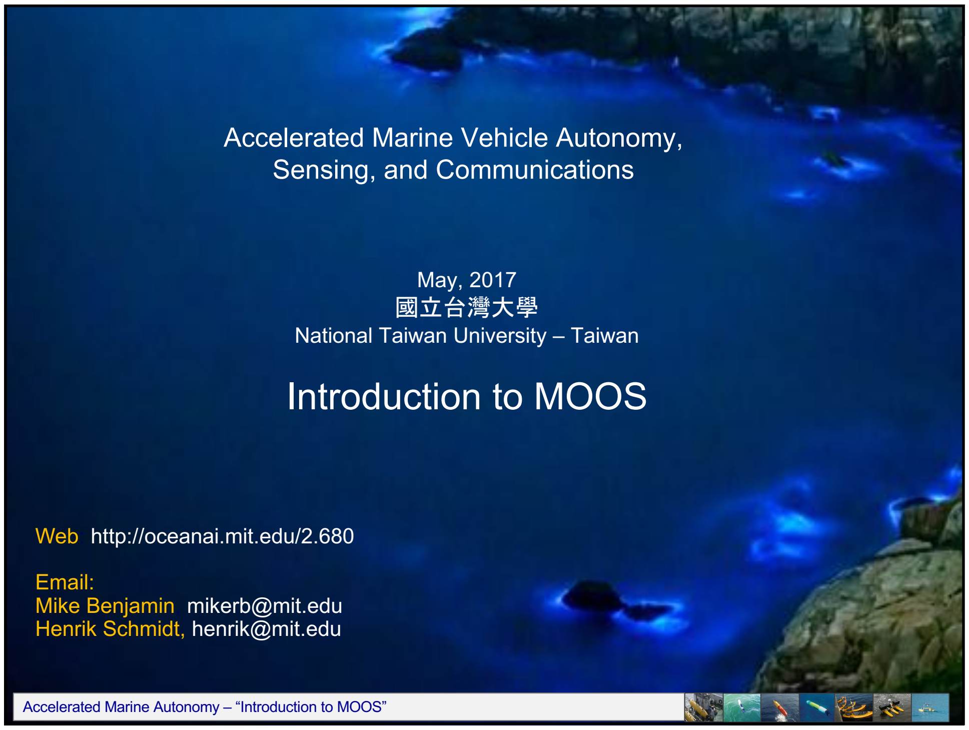


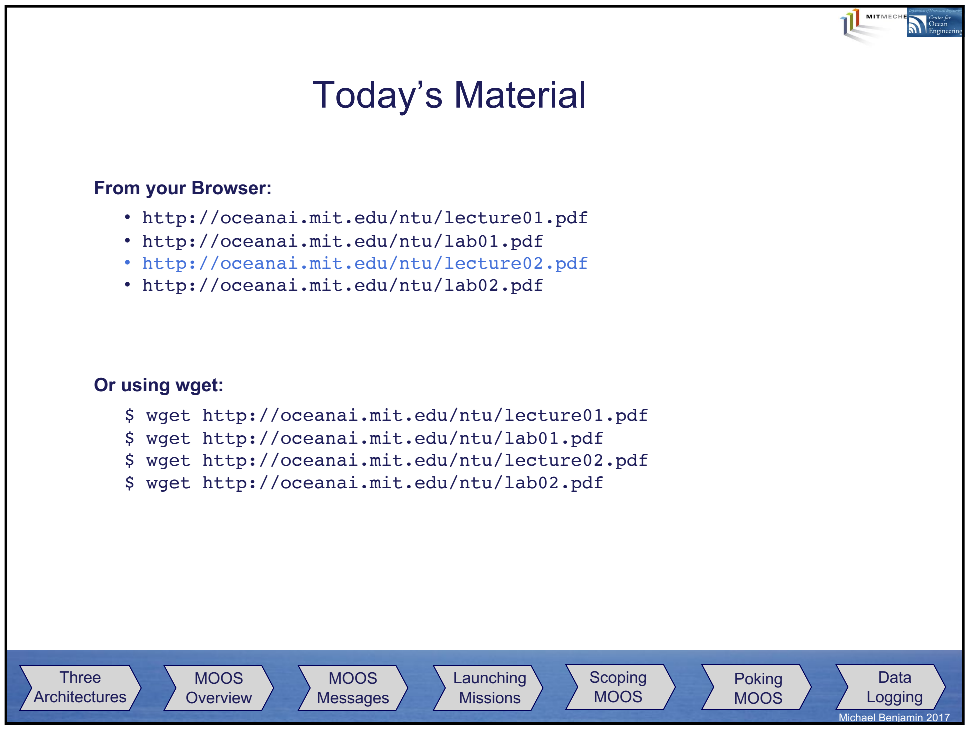
Accelerated Marine Vehicle Autonomy,
Sensing, and Communications

May, 2017
國立台灣大學
National Taiwan University – Taiwan

Introduction to MOOS

Web http://oceanai.mit.edu/2.680

Email:
Mike Benjamin mikerb@mit.edu
Henrik Schmidt, henrik@mit.edu



Today’s Material

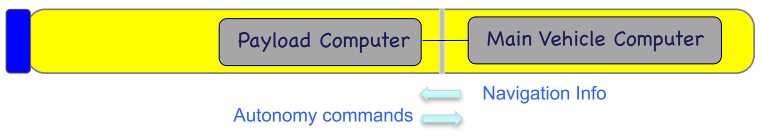
From your Browser:

- `http://oceanai.mit.edu/ntu/lecture01.pdf`
- `http://oceanai.mit.edu/ntu/lab01.pdf`
- `http://oceanai.mit.edu/ntu/lecture02.pdf`
- `http://oceanai.mit.edu/ntu/lab02.pdf`

Or using wget:

```
$ wget http://oceanai.mit.edu/ntu/lecture01.pdf
$ wget http://oceanai.mit.edu/ntu/lab01.pdf
$ wget http://oceanai.mit.edu/ntu/lecture02.pdf
$ wget http://oceanai.mit.edu/ntu/lab02.pdf
```

Payload UUV Autonomy
(3 Architecture Principles)



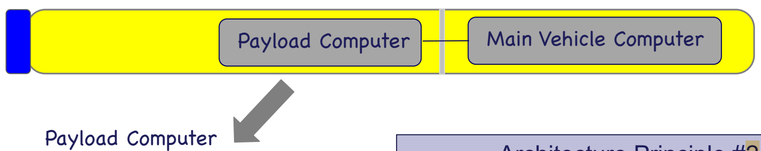
Architecture Principle #1
Payload Autonomy

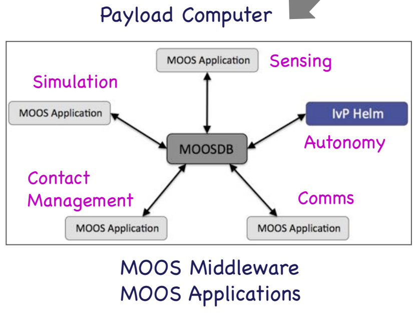
Decouple the Procurement of Hardware and Software

岸上的人- 岸上的電腦，接收現在船的狀態，下達一些簡單的指令如返航之類的
船 – 買來的，每一艘上面有不同的介面
船長 – Raspberry Pi 拿來跟船溝通middle ware(payload computer)

分開可以避免被敲詐，或是以後要換一艘硬體的時候比較方便

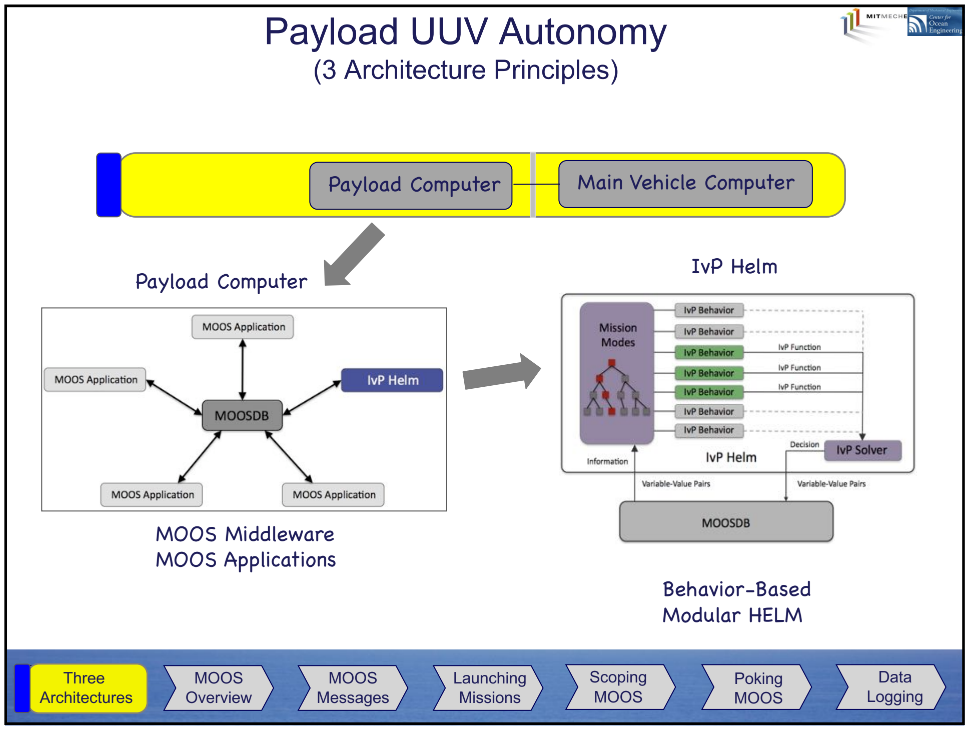
Payload UUV Autonomy
(3 Architecture Principles)





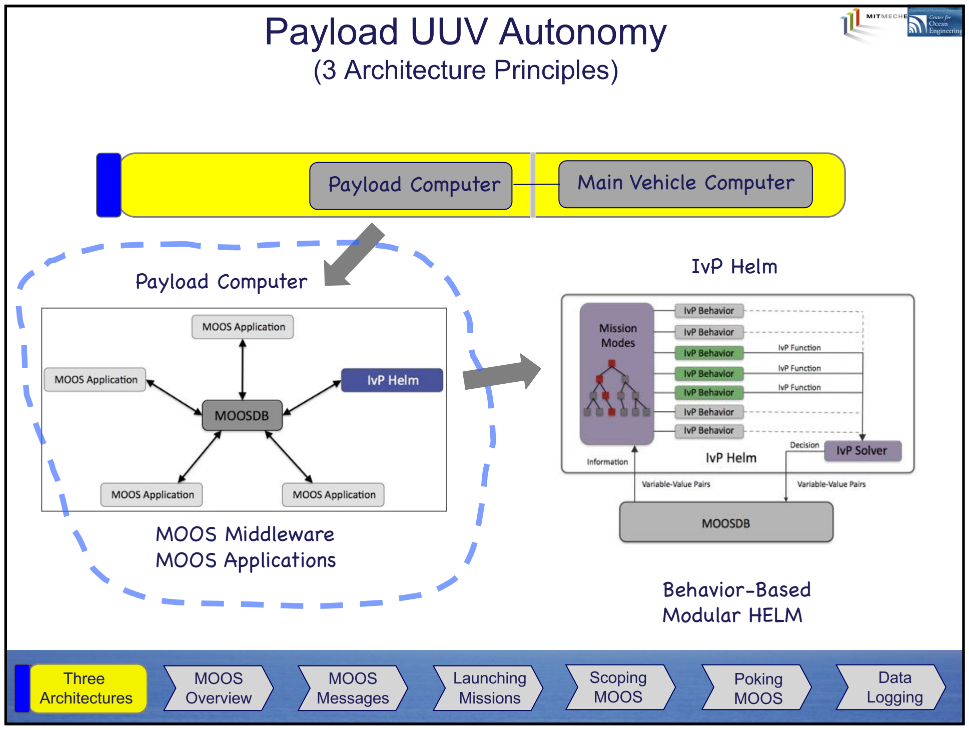
Architecture Principle #2
Autonomy System Middleware

De-couple Software Procurements
Sensing, Autonomy, Simulation, Comms...



Payload UUV Autonomy
(3 Architecture Principles)

Three Architectures | MOOS Overview | MOOS Messages | Launching Missions | Scoping MOOS | Poking MOOS | Data Logging



Payload UUV Autonomy
(3 Architecture Principles)

Three Architectures | MOOS Overview | MOOS Messages | Launching Missions | Scoping MOOS | Poking MOOS | Data Logging

MOOS Overview

可以聯絡多種軟體like ROS

- MOOS is a kind of Robot Middleware
- Developed by Paul Newman, as an MIT post-doc and now Oxford Professor
- Initial development 2000-2003 on Bluefin Odyssey II UUV owned by MIT

Italy, Summer 2002

Italy, Summer 2002

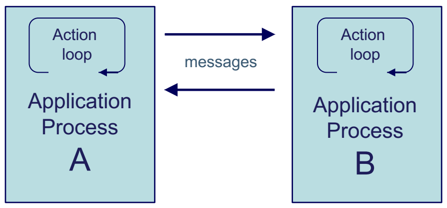
Three Architectures | MOOS Overview | MOOS Messages | Launching Missions | Scoping MOOS | Poking MOOS | Data Logging

Michael Benjamin 2017

MOOS Does Two Main Things

每個程式可以依據自己想要的速度(頻率)跑

1. It enables distinct applications to communicate
2. It enables users to control the frequency of each application’s action loop



Three Architectures | MOOS Overview | MOOS Messages | Launching Missions | Scoping MOOS | Poking MOOS | Data Logging

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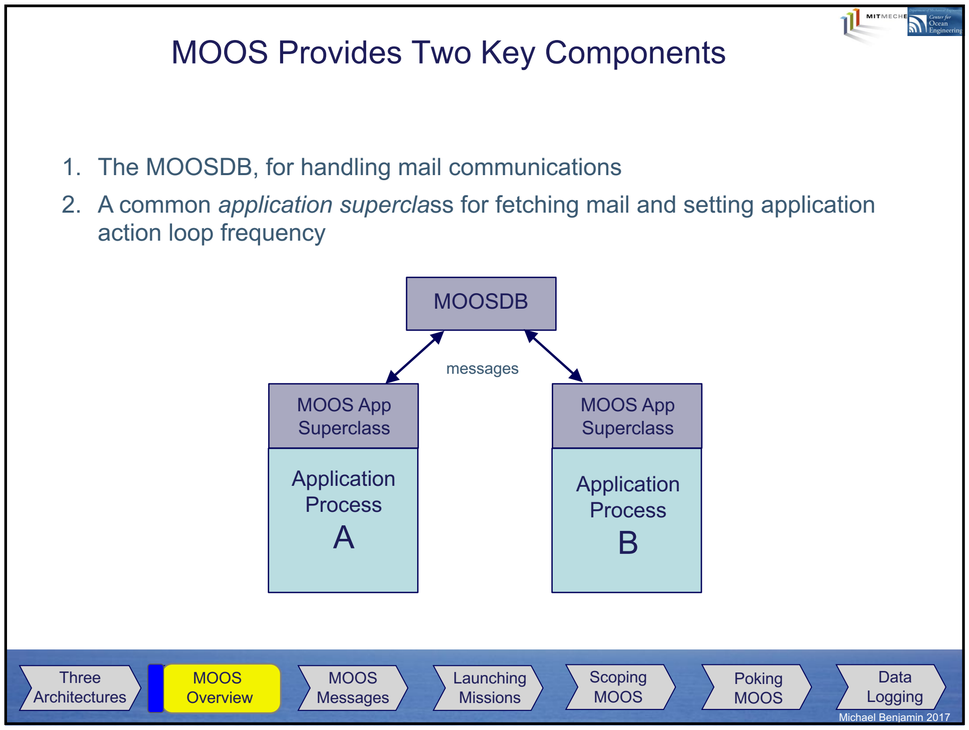
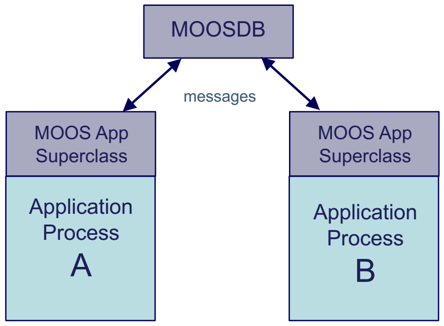
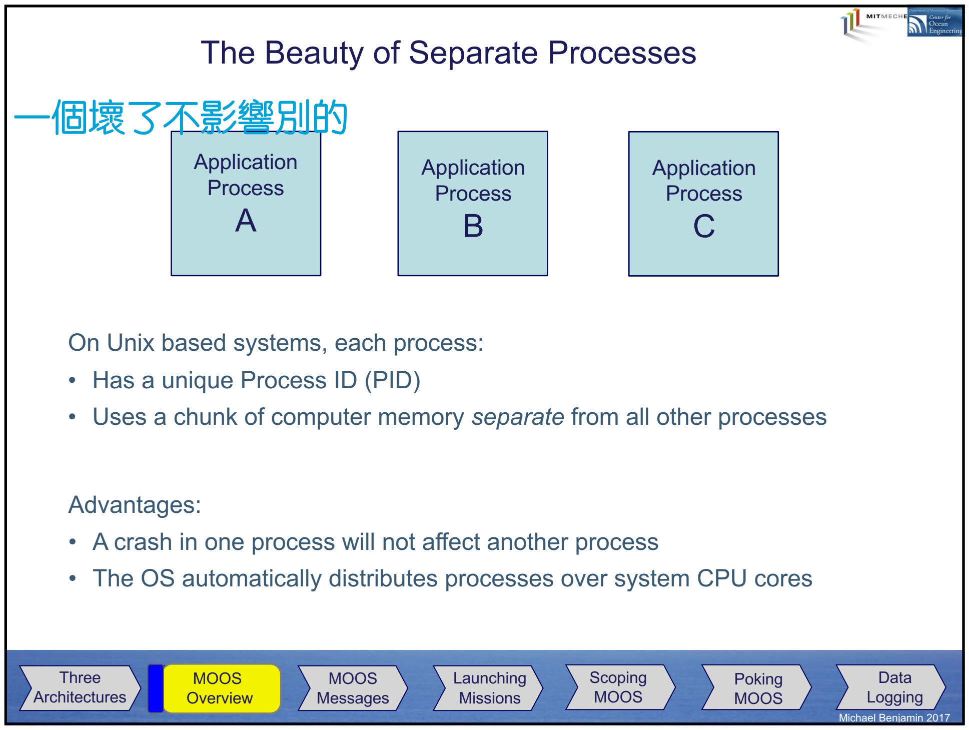


MOOS Provides Two Key Components

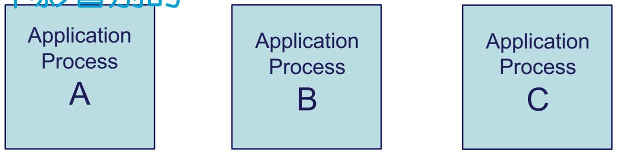
1. The MOOSDB, for handling mail communications
2. A common *application superclass* for fetching mail and setting application action loop frequency





The Beauty of Separate Processes

一個壞了不影響別的

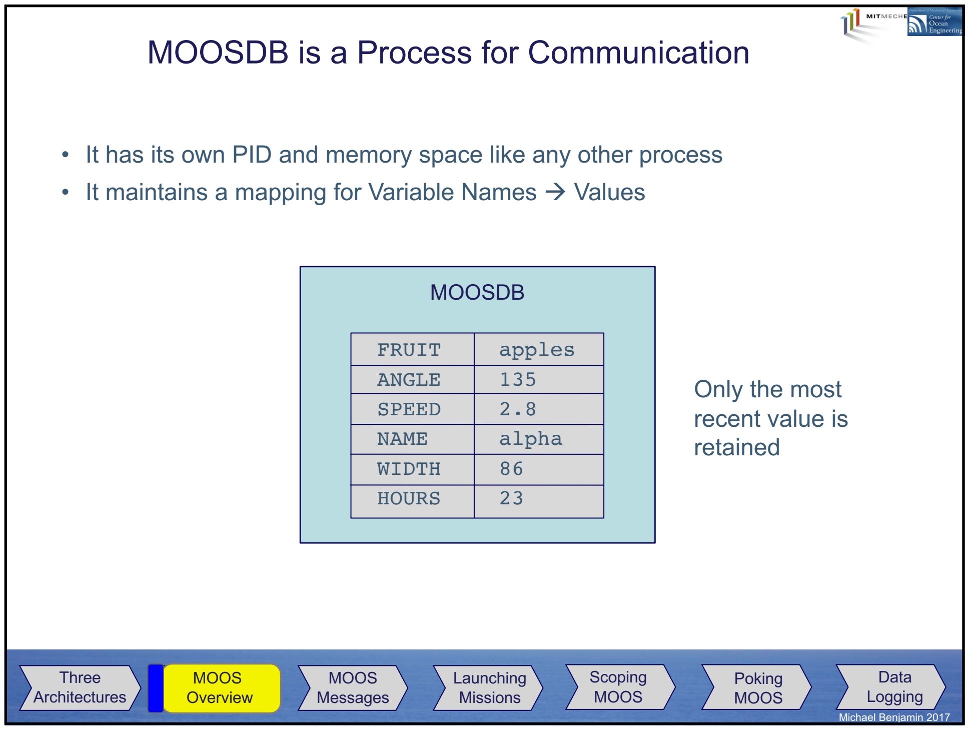


On Unix based systems, each process:

- Has a unique Process ID (PID)
- Uses a chunk of computer memory *separate* from all other processes

Advantages:

- A crash in one process will not affect another process
- The OS automatically distributes processes over system CPU cores



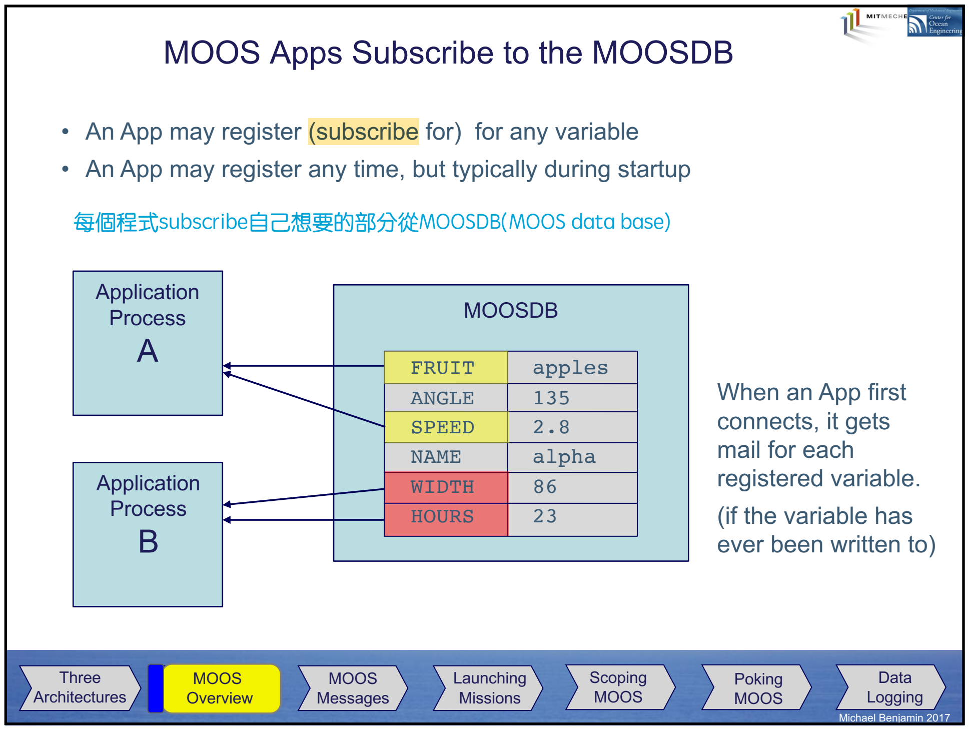
MOOSDB is a Process for Communication

- It has its own PID and memory space like any other process
- It maintains a mapping for Variable Names → Values

MOOSDB

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

Only the most recent value is retained



MOOS Apps Subscribe to the MOOSDB

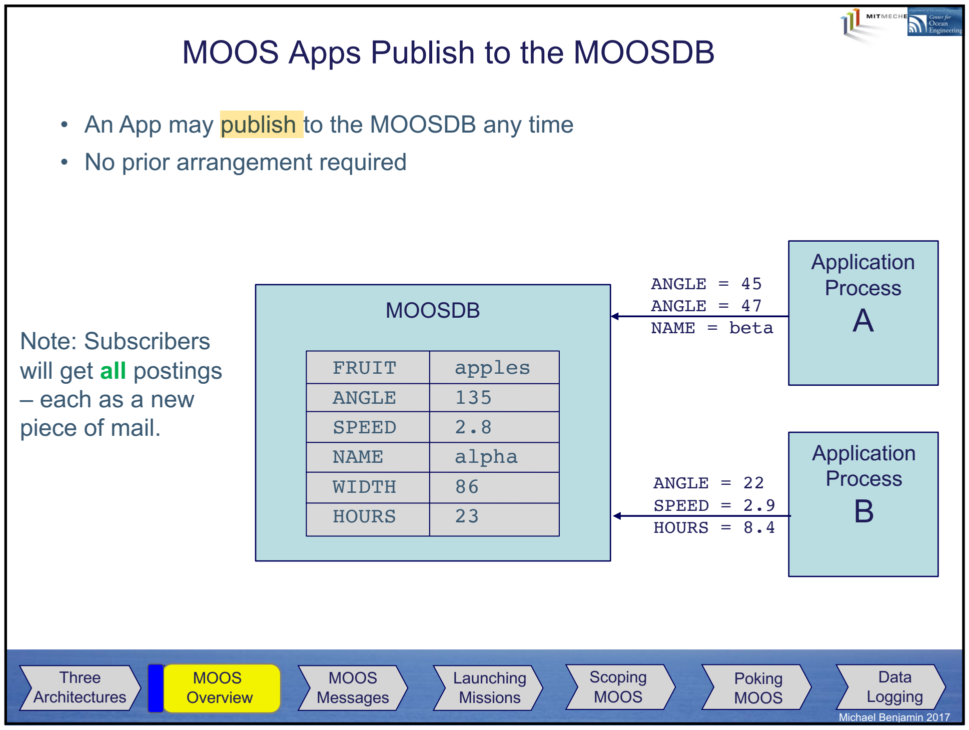
- An App may register (subscribe for) for any variable
- An App may register any time, but typically during startup

每個程式subscribe自己想要的部分從MOOSDB(MOOS data base)

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

When an App first connects, it gets mail for each registered variable.

(if the variable has ever been written to)



MOOS Apps Publish to the MOOSDB

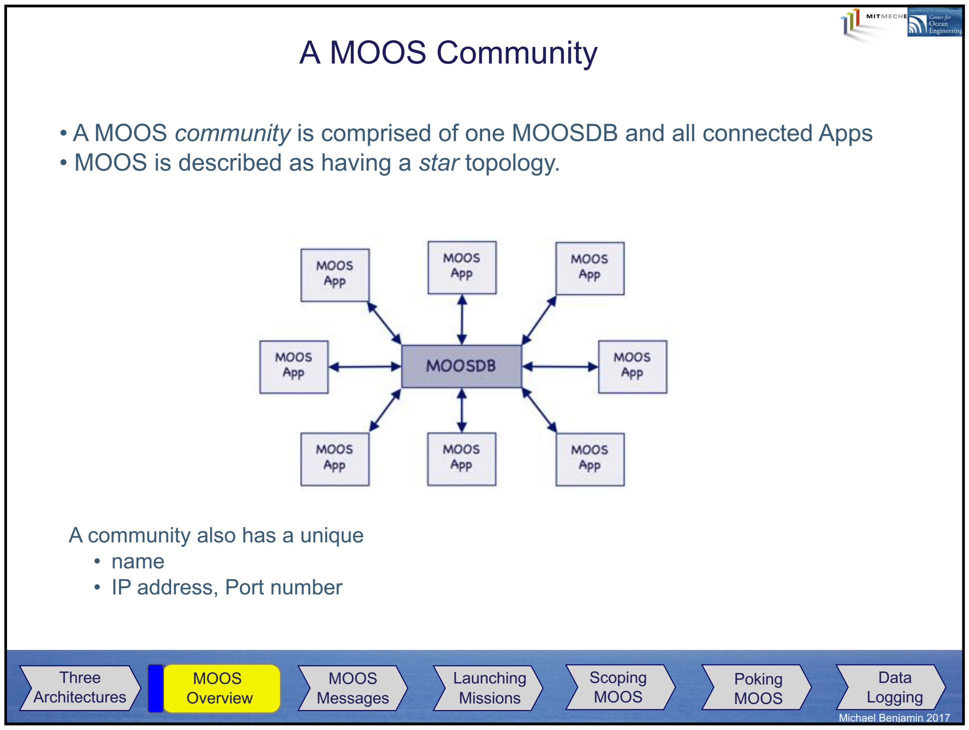
- An App may publish to the MOOSDB any time
- No prior arrangement required

Note: Subscribers will get **all** postings – each as a new piece of mail.

MOOSDB

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

ANGLE = 45
ANGLE = 47
NAME = beta
Application Process A
ANGLE = 22
SPEED = 2.9
HOURS = 8.4
Application Process B



A MOOS Community

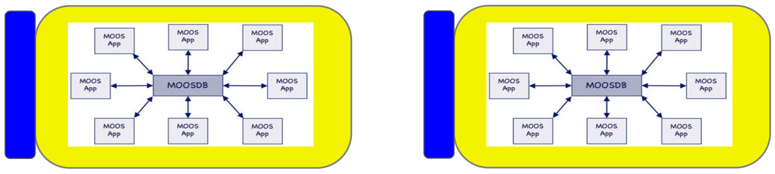
- A MOOS *community* is comprised of one MOOSDB and all connected Apps
- MOOS is described as having a *star* topology.

MOOS App
MOOS App
MOOS App
MOOS App
MOOSDB
MOOS App
MOOS App
MOOS App
MOOS App

A community also has a unique
- name
- IP address, Port number

A MOOS Community Per Robot

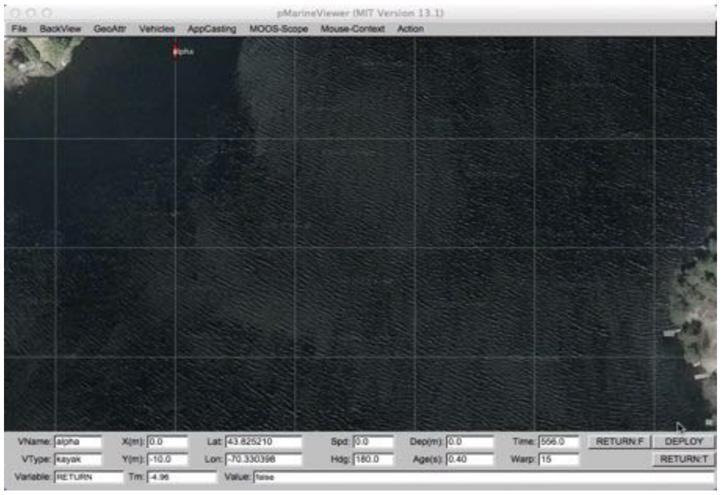
- Typically one community per vehicle/robot
- Sometimes multiple computers on one vehicle, each with a community



- Inter-community communications addressed later

Example: The Alpha Mission

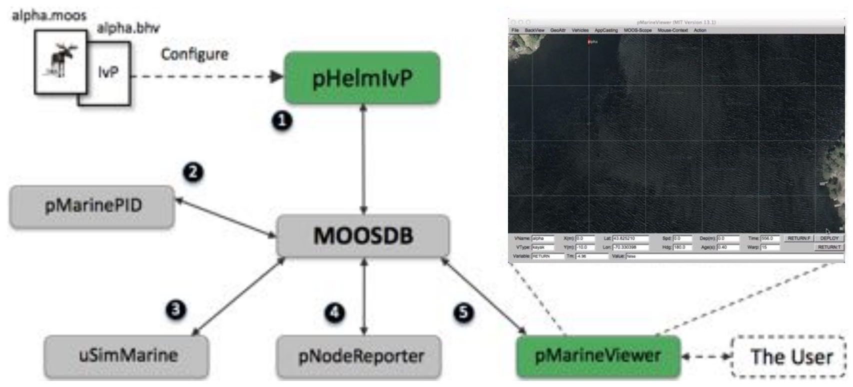
```
$ cd moos-ivp/ivp/missions/s1_alpha
$ ./launch.sh 10
```


pMarineViewer (MIT Version 13.1)
File BackView GeoAttr Vehicles AppCasting MOOS-Scope Mouse-Context Action
alpha
RETURN:F
DEPLOY
RETURN:T

VName: alpha X(m): 0.0 Lat: 43.825210 Spd: 0.0 Dep(m): 0.0 Time: 556.0
VType: kayak Y(m): -10.0 Lon: -70.330398 Hdg: 180.0 Age(s): 0.40 Warp: 15
Variable: RETURN Tm: -4.96 Value: false

Alpha Mission - Modules

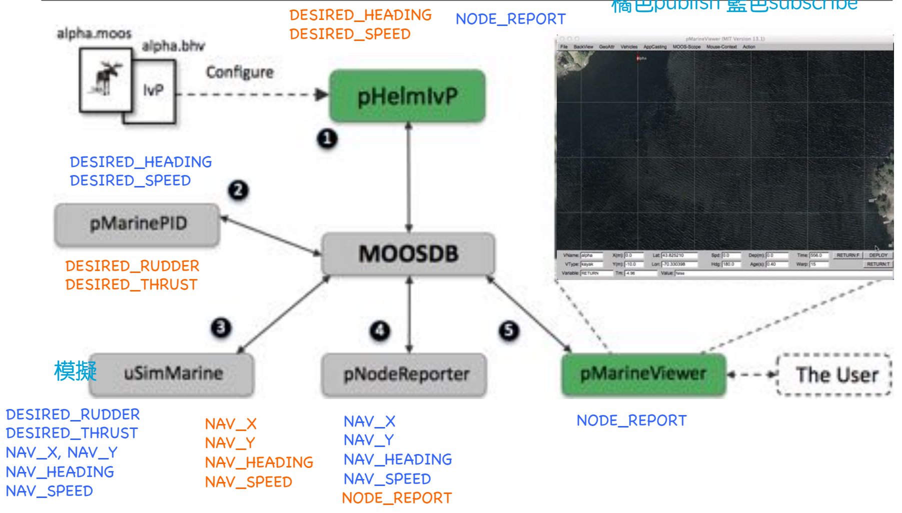
```
$ cd moos-ivp/ivp/missions/s1_alpha
$ ./launch.sh 10
```

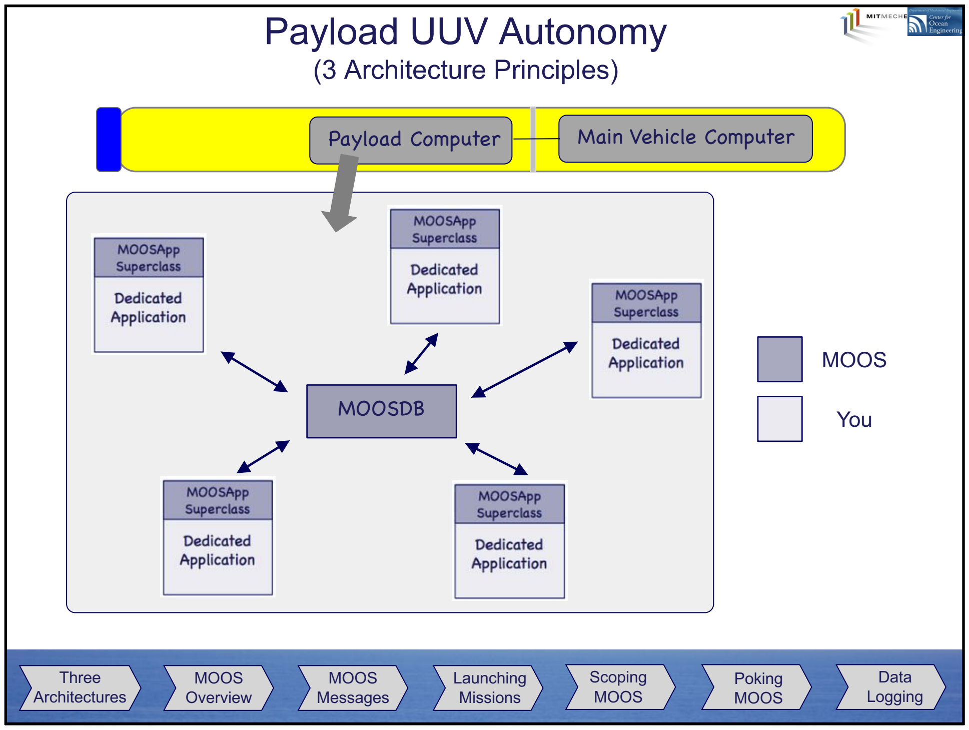


Alpha Mission

```
$ cd moos-ivp/ivp/missions/s1_alpha
$ ./launch.sh 10
```

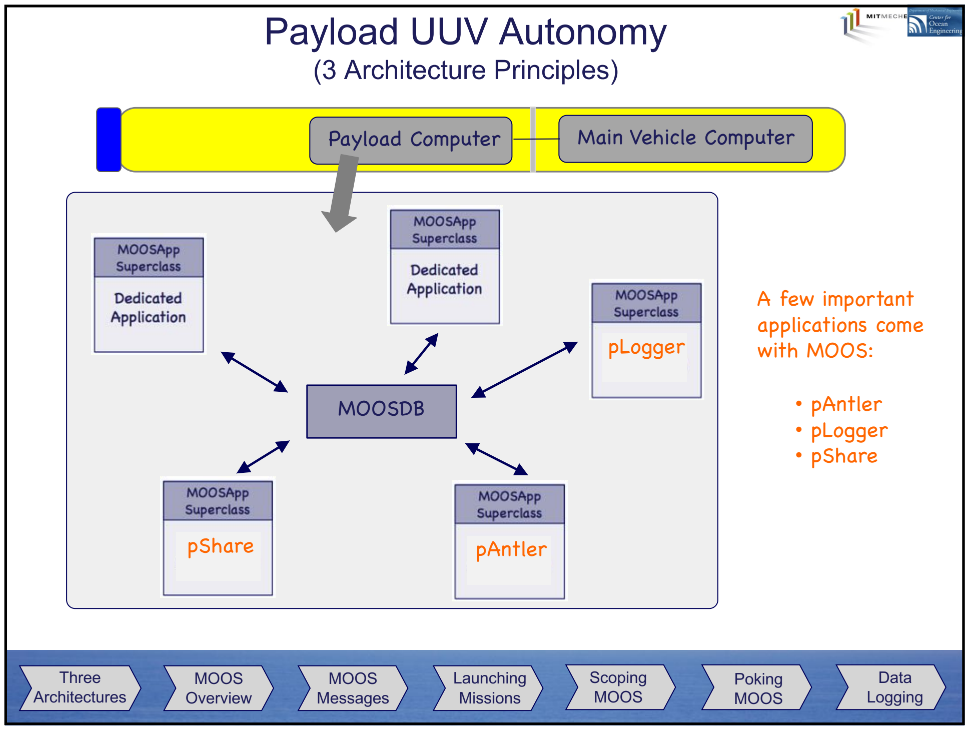
橘色publish 藍色subscribe





Payload UUV Autonomy

(3 Architecture Principles)



Payload UUV Autonomy

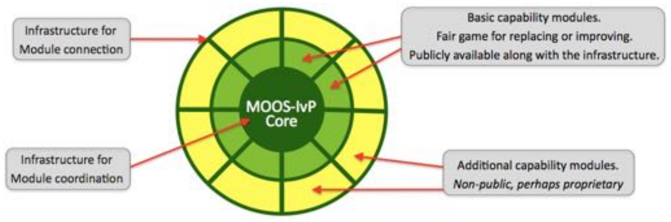
(3 Architecture Principles)

A few important applications come with MOOS:

- pAntler
- pLogger
- pShare

Public Infrastructure – Nested Capabilities

An autonomy system has components with different capabilities, and distribution access.
- Publicly accessible modules providing infrastructure, basic capabilities
- Restricted-access modules for developers of a particular project.


Infrastructure for Module connection
Basic capability modules. Fair game for replacing or improving. Publicly available along with the infrastructure.
MOOS-IvP Core
Infrastructure for Module coordination
Additional capability modules. Non-public, perhaps proprietary

Autonomy System = Infrastructure + Modules

Core Infrastructure. Open Source.

Project specific add-on modules. Non Open Source. 外層自己寫

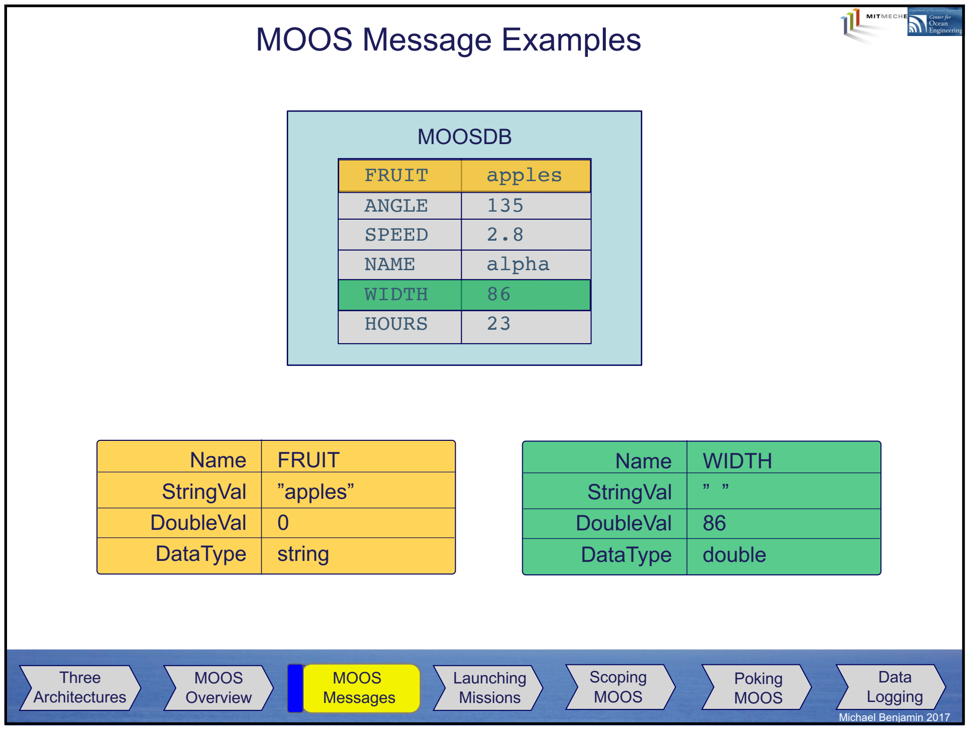
MOOS Messages

- Two primary message components: VARIABLE and VALUE
- Two primary message types: STRING and DOUBLE

MOOSDB

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

Name	The name of the data
StringVal	Data in human-readable string format, or raw binary data
DoubleVal	Numeric double float data



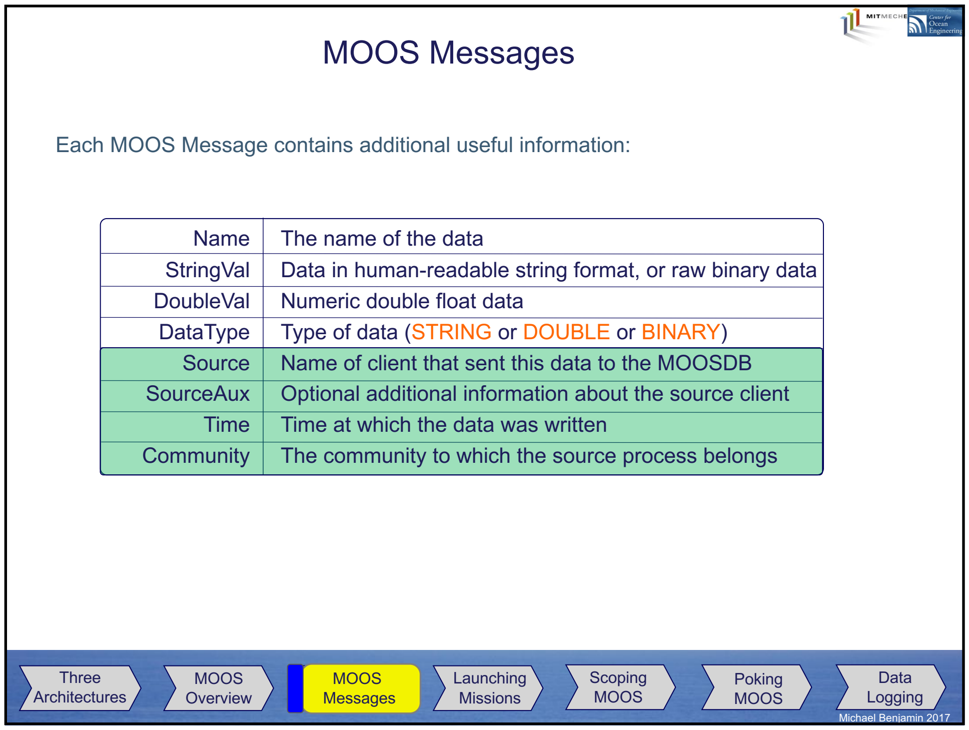
MOOS Message Examples

MOOSDB

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

Name	FRUIT
StringVal	”apples”
DoubleVal	0
DataType	string

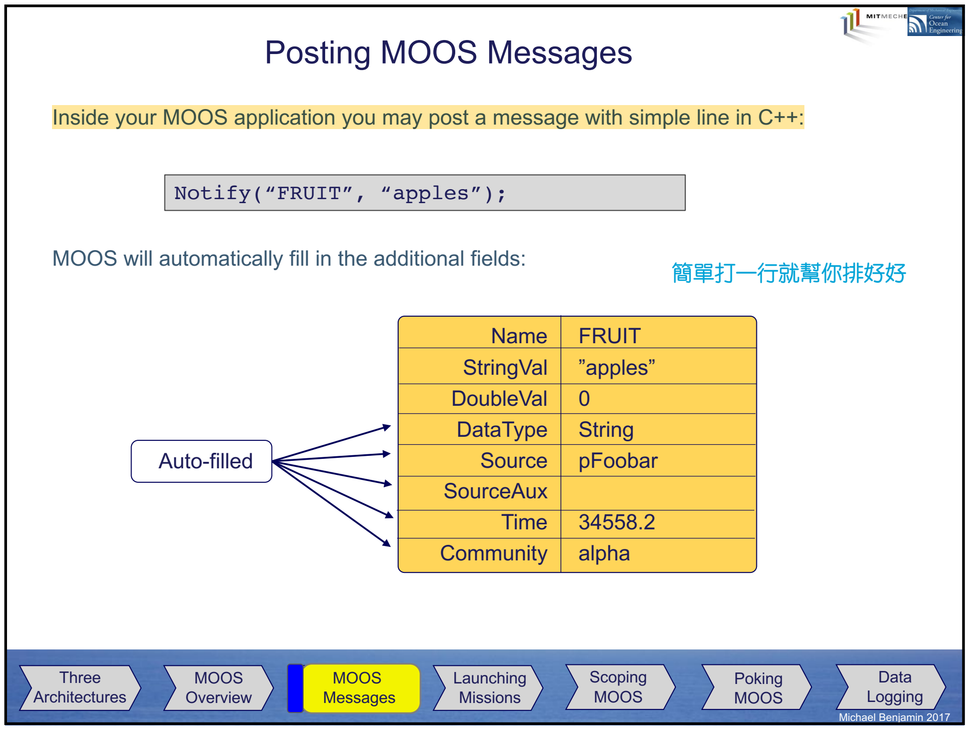
Name	WIDTH
StringVal	” ”
DoubleVal	86
DataType	double



MOOS Messages

Each MOOS Message contains additional useful information:

Name	The name of the data
StringVal	Data in human-readable string format, or raw binary data
DoubleVal	Numeric double float data
DataType	Type of data (STRING or DOUBLE or BINARY)
Source	Name of client that sent this data to the MOOSDB
SourceAux	Optional additional information about the source client
Time	Time at which the data was written
Community	The community to which the source process belongs



Posting MOOS Messages

Inside your MOOS application you may post a message with simple line in C++:

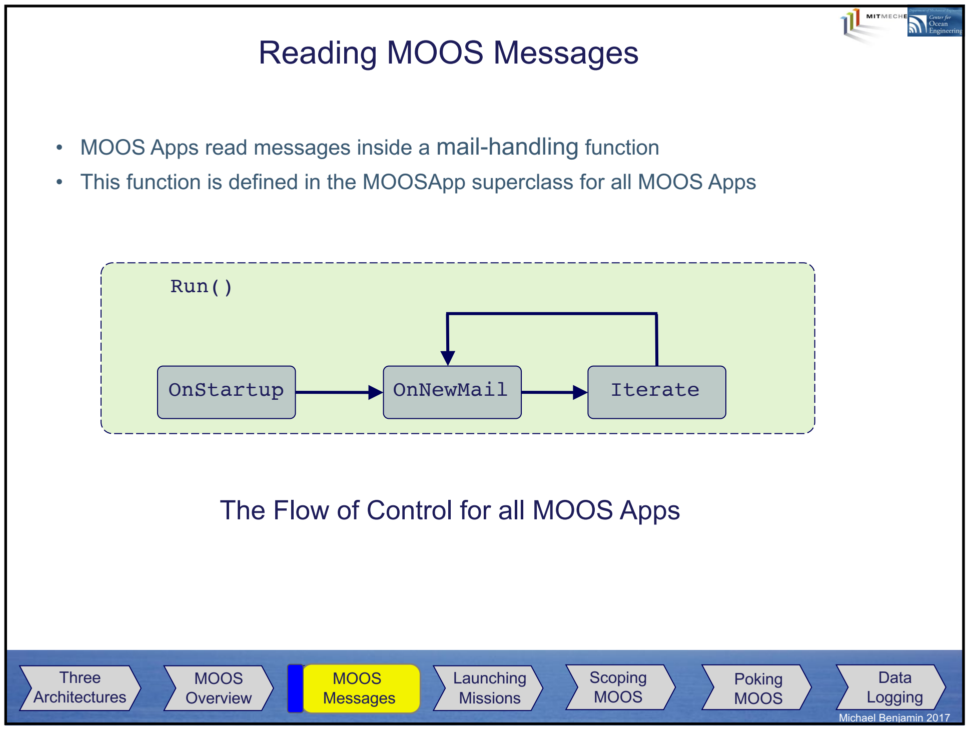
```
Notify("FRUIT", "apples");
```

MOOS will automatically fill in the additional fields:

簡單打一行就幫你排好好

Name	FRUIT
StringVal	"apples"
DoubleVal	0
DataType	String
Source	pFoobar
SourceAux	
Time	34558.2
Community	alpha

Auto-filled

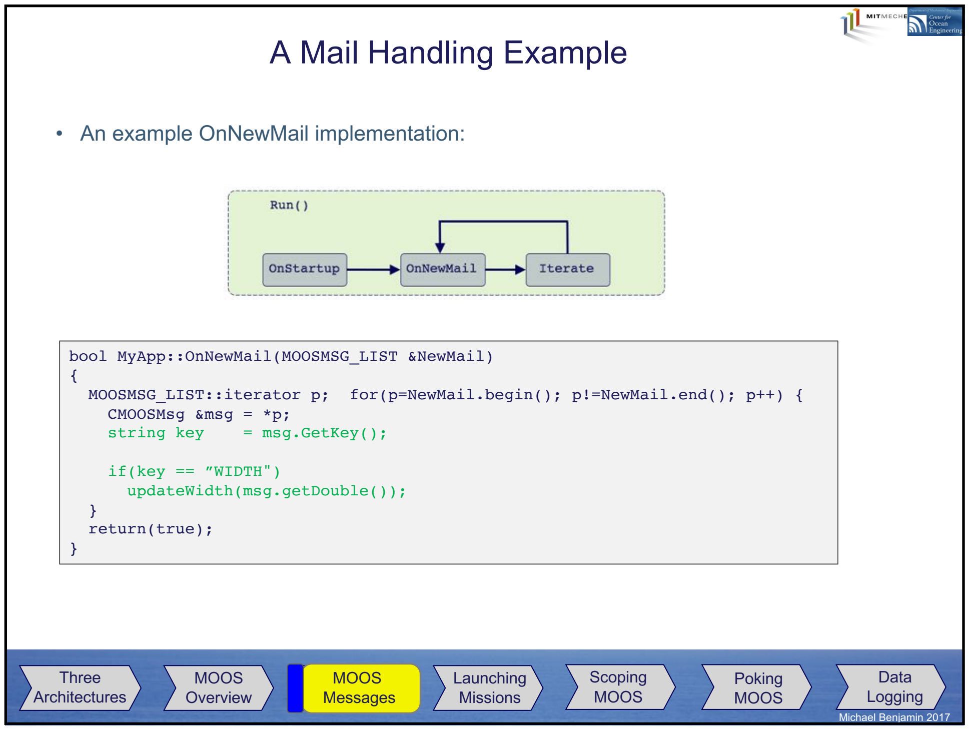


Reading MOOS Messages

- MOOS Apps read messages inside a mail-handling function
- This function is defined in the MOOSApp superclass for all MOOS Apps

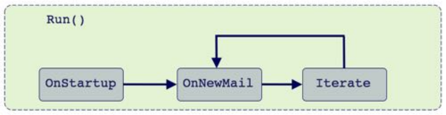
$$\begin{tikzcd} \texttt{OnStartup} \arrow[r] & \texttt{OnNewMail} \arrow[r] & \texttt{Iterate} \arrow[l, bend right] \end{tikzcd}$$

The Flow of Control for all MOOS Apps

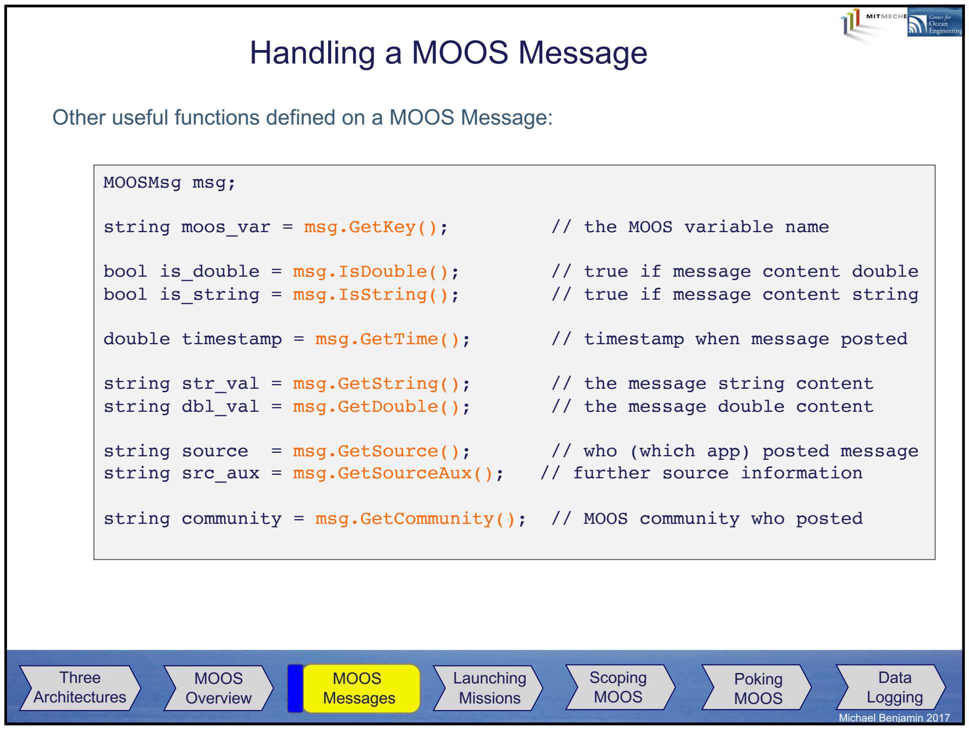


A Mail Handling Example

- An example OnNewMail implementation:



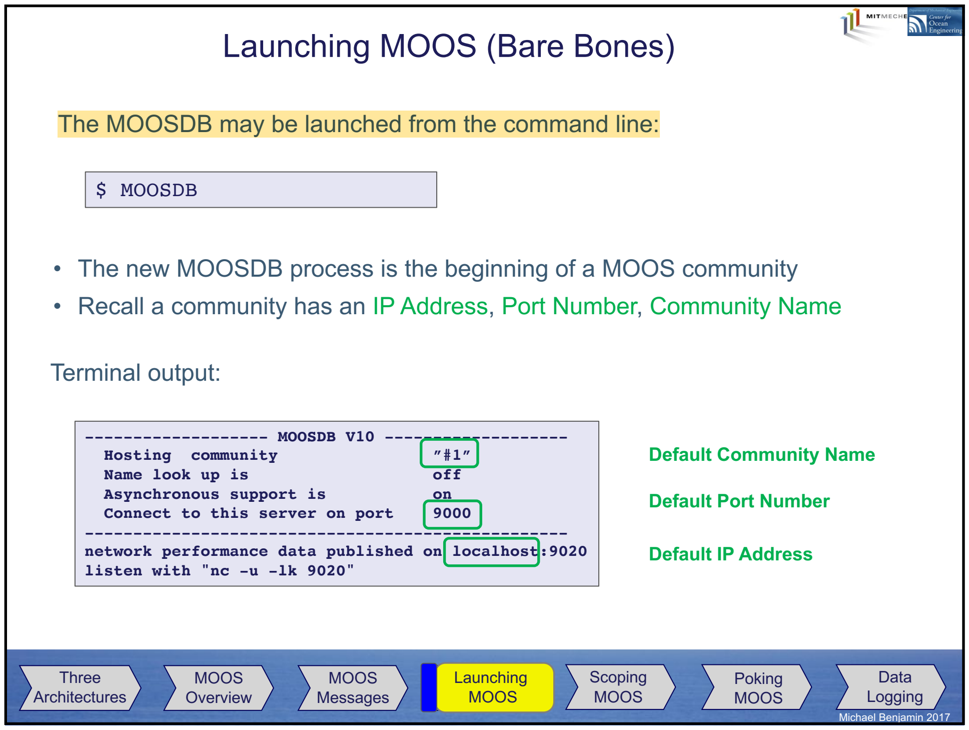
```
bool MyApp::OnNewMail(MOOSMSG_LIST &NewMail)
{
  MOOSMSG_LIST::iterator p;  for(p=NewMail.begin(); p!=NewMail.end(); p++) {
    CMOOSMsg &msg = *p;
    string key    = msg.GetKey();

    if(key == ”WIDTH")
      updateWidth(msg.getDouble());
  }
  return(true);
}
```



Handling a MOOS Message

Other useful functions defined on a MOOS Message:

```
MOOSMsg msg;

string moos_var = msg.GetKey();          // the MOOS variable name

bool is_double = msg.IsDouble();         // true if message content double
bool is_string = msg.IsString();         // true if message content string

double timestamp = msg.GetTime();        // timestamp when message posted

string str_val = msg.GetString();        // the message string content
string dbl_val = msg.GetDouble();        // the message double content

string source  = msg.GetSource();        // who (which app) posted message
string src_aux = msg.GetSourceAux();    // further source information

string community = msg.GetCommunity();   // MOOS community who posted
```



Launching MOOS (Bare Bones)

The MOOSDB may be launched from the command line:

```
$ MOOSDB
```

- The new MOOSDB process is the beginning of a MOOS community
- Recall a community has an IP Address, Port Number, Community Name

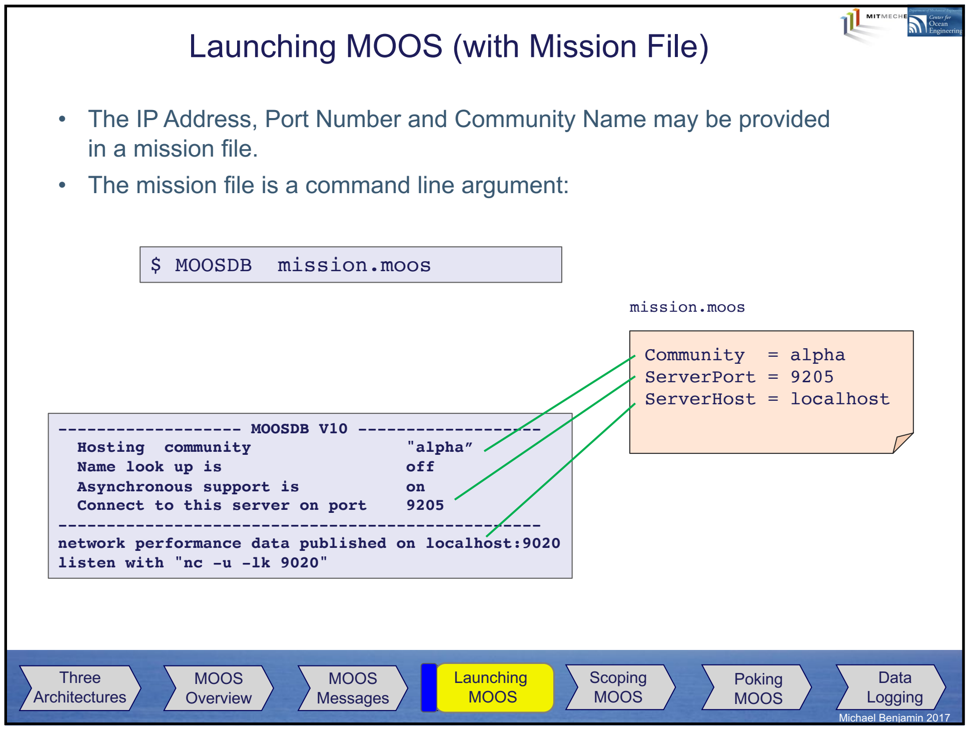
Terminal output:

```
------------------- MOOSDB V10 -------------------
  Hosting  community                    "#1"
  Name look up is                       off
  Asynchronous support is               on
  Connect to this server on port        9000
--------------------------------------------------
network performance data published on localhost:9020
listen with "nc -u -lk 9020"
```

Default Community Name

Default Port Number

Default IP Address



Launching MOOS (with Mission File)

- The IP Address, Port Number and Community Name may be provided in a mission file.
- The mission file is a command line argument:

```
$ MOOSDB  mission.moos
```

mission.moos

```
Community  = alpha
ServerPort = 9205
ServerHost = localhost
```

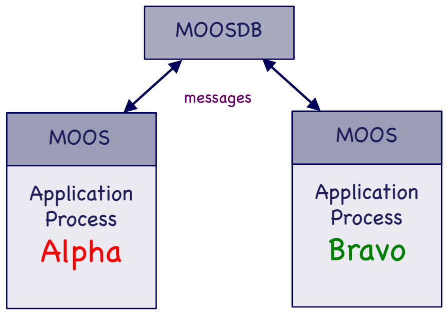
```
------------------- MOOSDB V10 -------------------
  Hosting  community                "alpha"
  Name look up is                   off
  Asynchronous support is           on
  Connect to this server on port    9205
--------------------------------------------------
network performance data published on localhost:9020
listen with "nc -u -lk 9020"
```

Launching MOOS and Mission Configuration

- A mission file may also hold configuration parameters for MOOS apps
- Each application has a dedicated configuration block.

mission.moos

```
Global
parameters

ProcessConfig = alpha
{
   alpha parameters
}


ProcessConfig = bravo
{
   alpha parameters
}
```



MOOS Mission Configuration

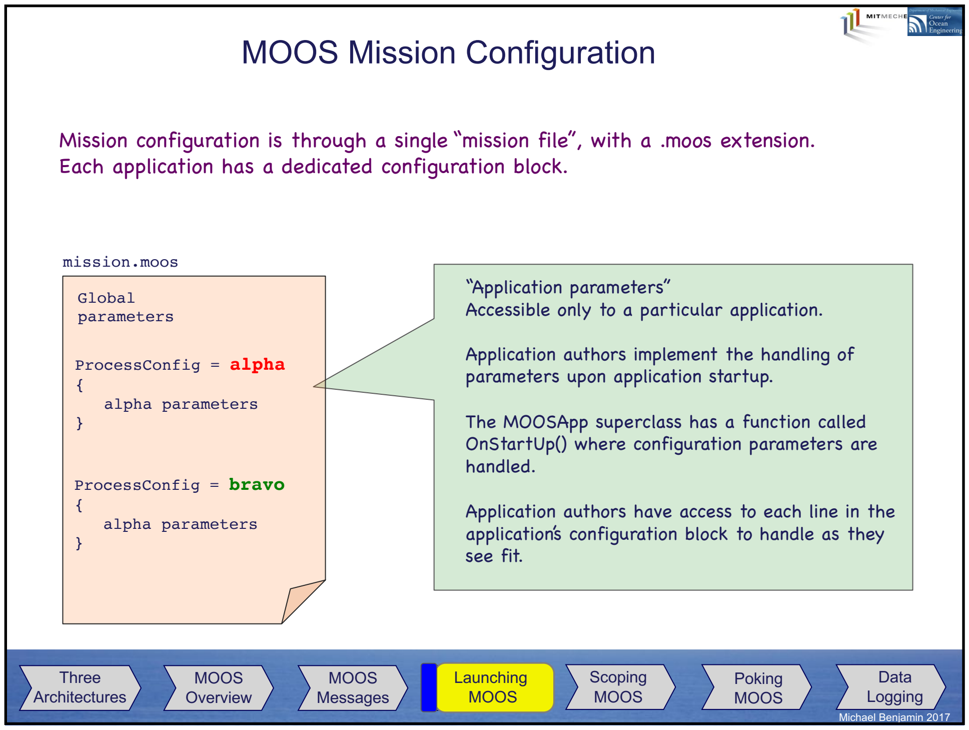
Mission configuration is through a single "mission file", with a .moos extension.
Each application has a dedicated configuration block.

mission.moos

```
Global
parameters

ProcessConfig = alpha
{
   alpha parameters
}


ProcessConfig = bravo
{
   alpha parameters
}
```

"Global parameters"
are accessible to all MOOS applications. They include things like:

- MOOSDB server IP address and port number.
- Local datum (0,0) in lat/lon coordinates.
- Name of the MOOS community.



MOOS Mission Configuration

Mission configuration is through a single "mission file", with a .moos extension.
Each application has a dedicated configuration block.

mission.moos

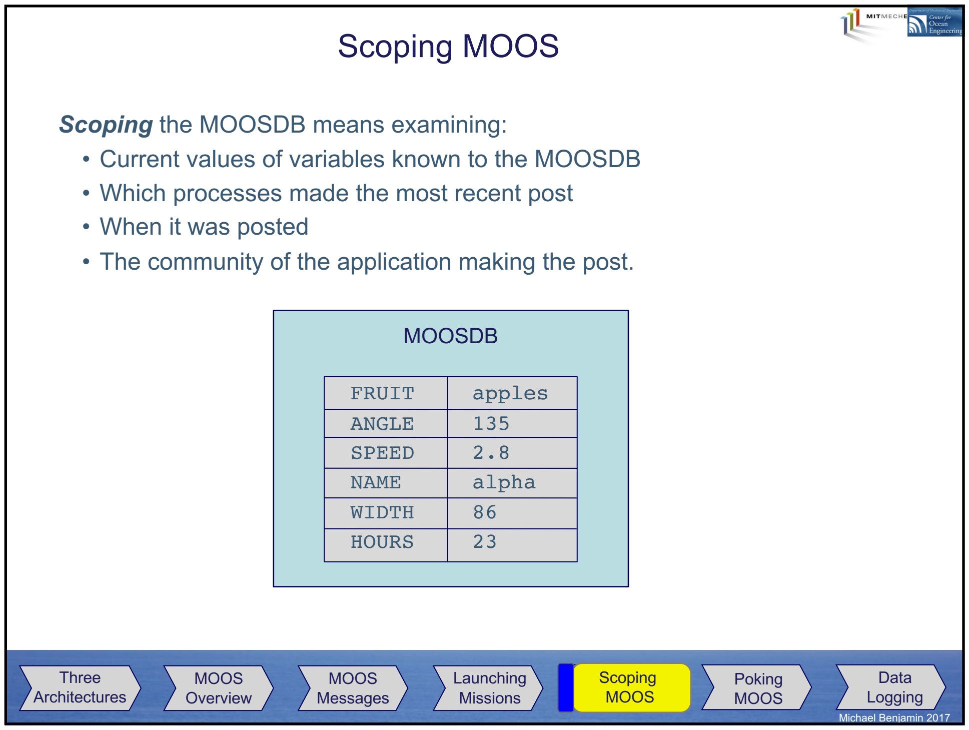
```
Global
parameters

ProcessConfig = alpha
{
   alpha parameters
}

ProcessConfig = bravo
{
   alpha parameters
}
```

"Application parameters"
Accessible only to a particular application.

Application authors implement the handling of parameters upon application startup.

The MOOSApp superclass has a function called OnStartUp() where configuration parameters are handled.

Application authors have access to each line in the application's configuration block to handle as they see fit.



Scoping MOOS

Scoping the MOOSDB means examining:

- Current values of variables known to the MOOSDB
- Which processes made the most recent post
- When it was posted
- The community of the application making the post.

MOOSDB

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

Scoping MOOS

Scoping the MOOSDB means examining:

- Current values of variables known to the MOOSDB
- Which processes made the most recent post
- When it was posted
- The community of the application making the post.

Scoping 告訴你更完整的資訊

MOOSDB

VarName	Source	Community	Time	VarValue
FRUIT	pFruit	alpha	143.21	apples
ANGLE	uMeasure	alpha	1873.24	135
SPEED	uMeasure	alpha	62.11	2.8
NAME	pIdentity	gamma	3.91	alpha
WIDTH	uMeasure	alpha	1873.24	86
HOURS	uMeasure	alpha	1873.25	23

The uXMS Scope List

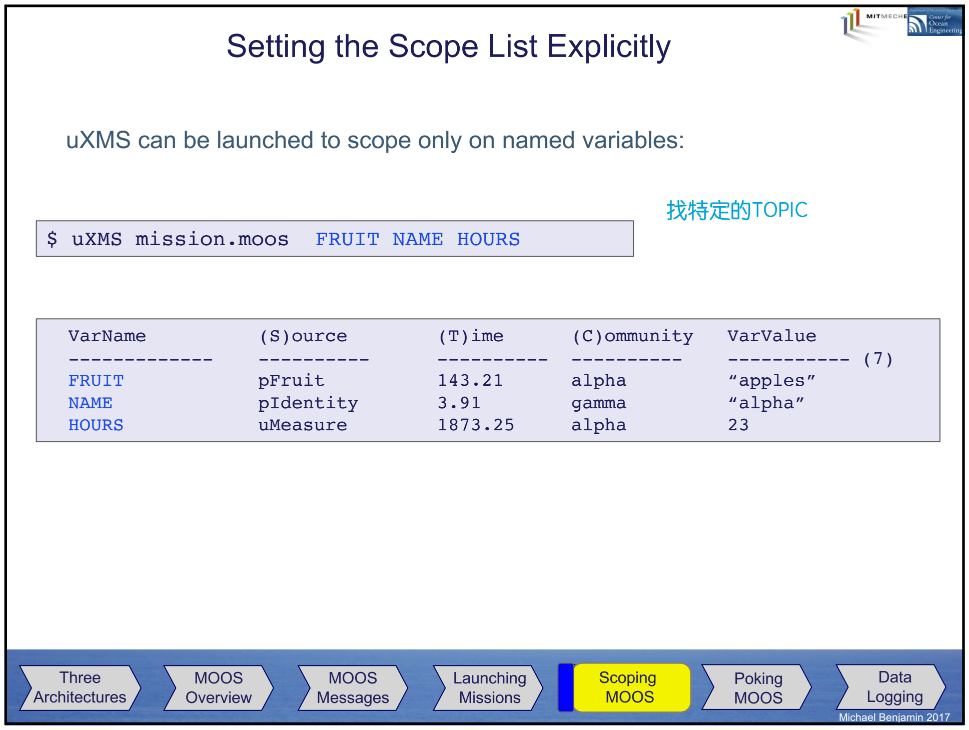
uXMS is a simple scoping utility launched from the command line

```
$ uXMS mission.moos --all
```

看看現在有哪些在跑

By default, the screen will refresh whenever one variable value changes

```
VarName             (S)ource        (T)ime      (C)ommunity   VarValue
----------------    ----------      ----------  ----------    ----------- (7)
DB_CLIENTS          MOOSDB_alpha    106.2       alpha         "uXMS,DBWebServer,"
DB_TIME             MOOSDB_alpha    107.2       alpha         1325701208.08963
DB_UPTIME           MOOSDB_alpha    107.2       alpha         107.20791
FRUIT               pFruit          143.21      alpha         “apples”
ANGLE               uMeasure        107.2       alpha         135
SPEED               uMeasure        107.2       alpha         2.8
NAME                pIdentity       3.91        gamma         “alpha”
WIDTH               uMeasure        1873.24     alpha         86
HOURS               uMeasure        1873.25     alpha         23
-- displaying all variables --
```



Setting the Scope List Explicitly

uXMS can be launched to scope only on named variables:

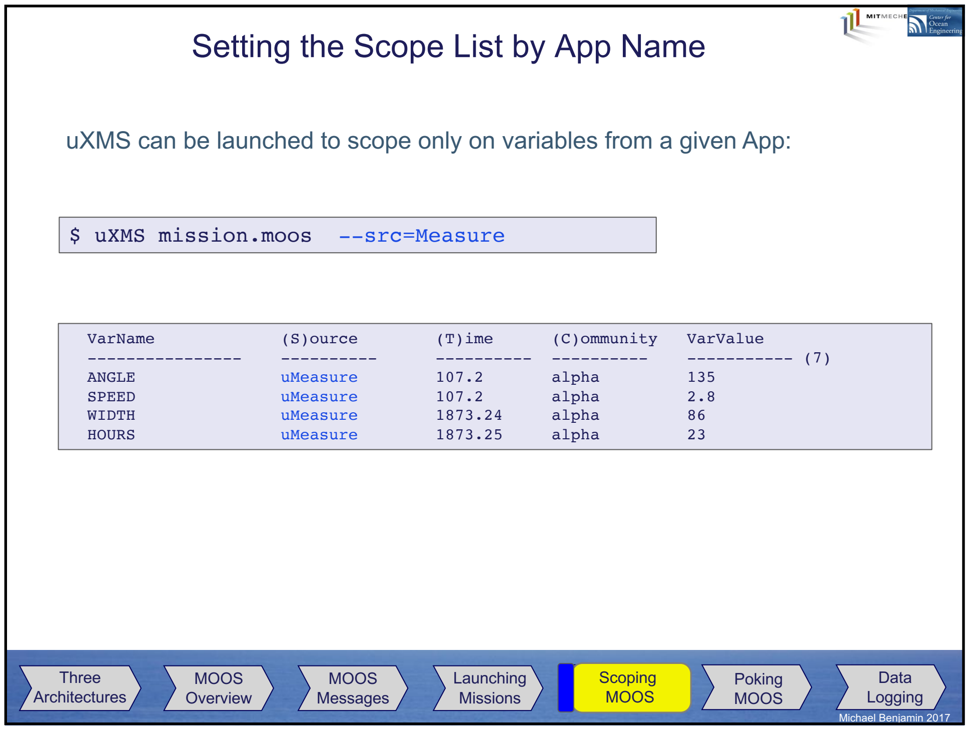
找特定的TOPIC

```
$ uXMS mission.moos  FRUIT NAME HOURS
```

```
VarName             (S)ource        (T)ime        (C)ommunity    VarValue
-------------       ----------      ----------    ----------     ----------- (7)
FRUIT               pFruit          143.21        alpha          “apples”
NAME                pIdentity       3.91          gamma          “alpha”
HOURS               uMeasure        1873.25       alpha          23
```

Three Architectures | MOOS Overview | MOOS Messages | Launching Missions | Scoping MOOS | Poking MOOS | Data Logging

Michael Benjamin 2017



Setting the Scope List by App Name

uXMS can be launched to scope only on variables from a given App:

```
$ uXMS mission.moos  --src=Measure
```

```
VarName                 (S)ource        (T)ime        (C)ommunity    VarValue
----------------        ----------      ----------    ----------     ----------- (7)
ANGLE                   uMeasure        107.2         alpha          135
SPEED                   uMeasure        107.2         alpha          2.8
WIDTH                   uMeasure        1873.24       alpha          86
HOURS                   uMeasure        1873.25       alpha          23
```

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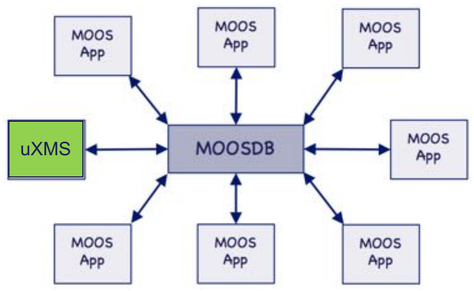
Scoping LOCALLY

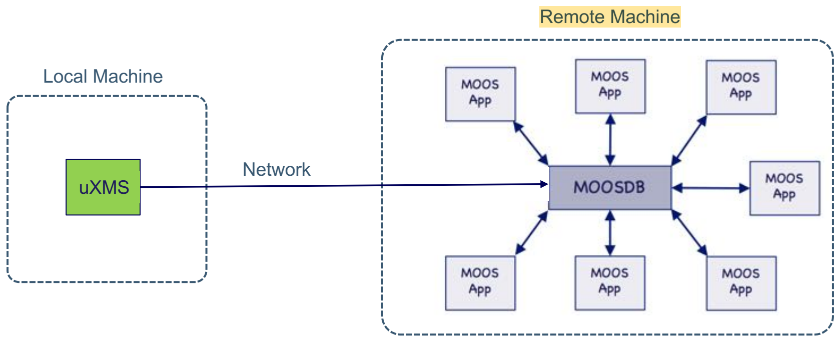
- Typically a scope is run on the same machine as the rest of the MOOS Community.

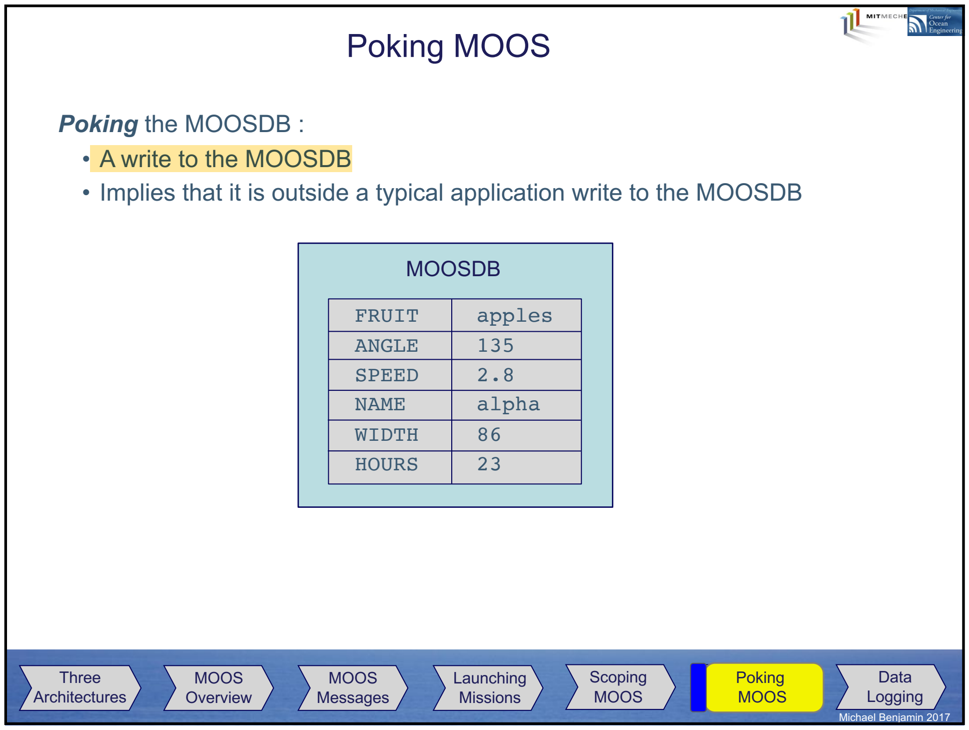


Scoping REMOTELY

- A scope may also connect to a remote machine
- Need to specify IP Address, Port Number:

```
$ uXMS mission.moos  --serverhost 18.231.8.45 --serverport=9200
```





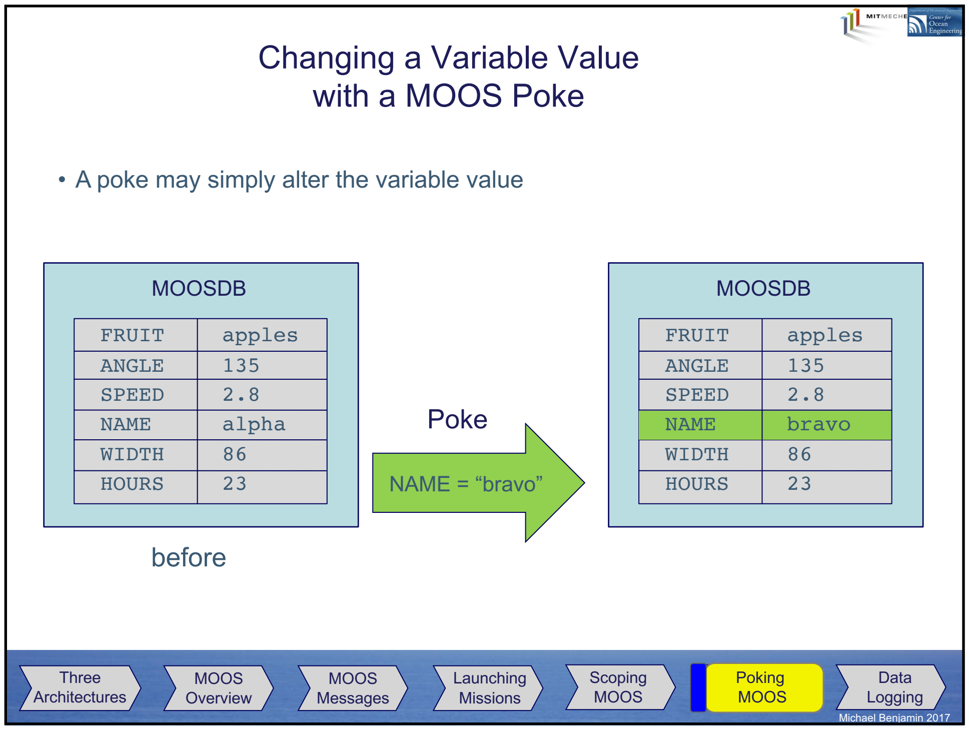
Poking MOOS

Poking the MOOSDB :

- A write to the MOOSDB
- Implies that it is outside a typical application write to the MOOSDB

MOOSDB

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23



Changing a Variable Value with a MOOS Poke

- A poke may simply alter the variable value

MOOSDB (before)

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

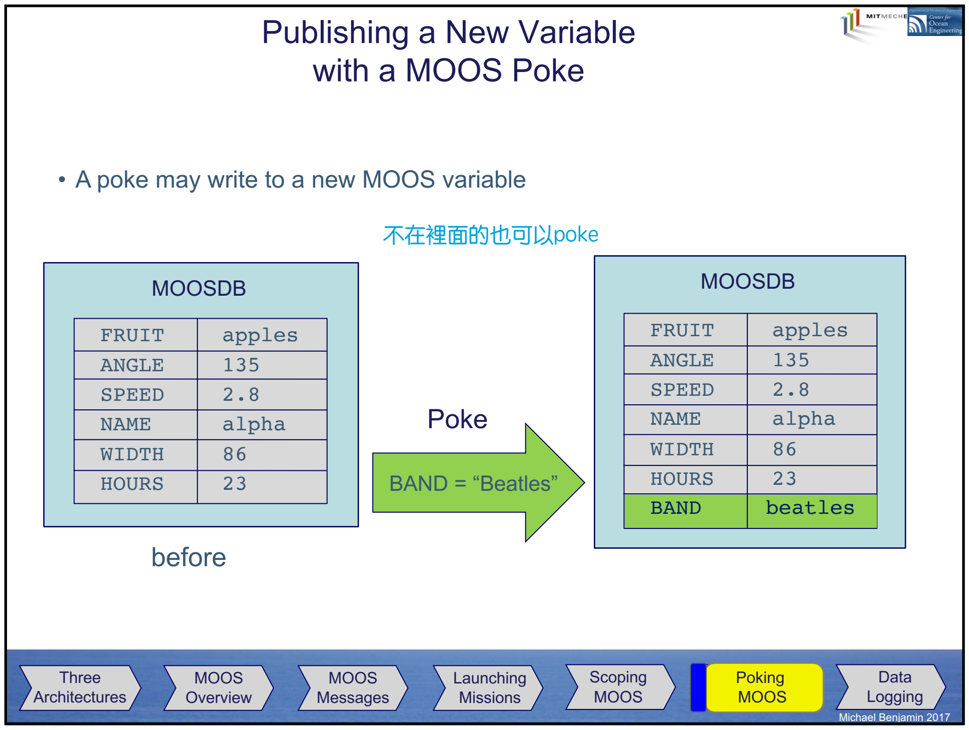
Poke

NAME = “bravo”

MOOSDB

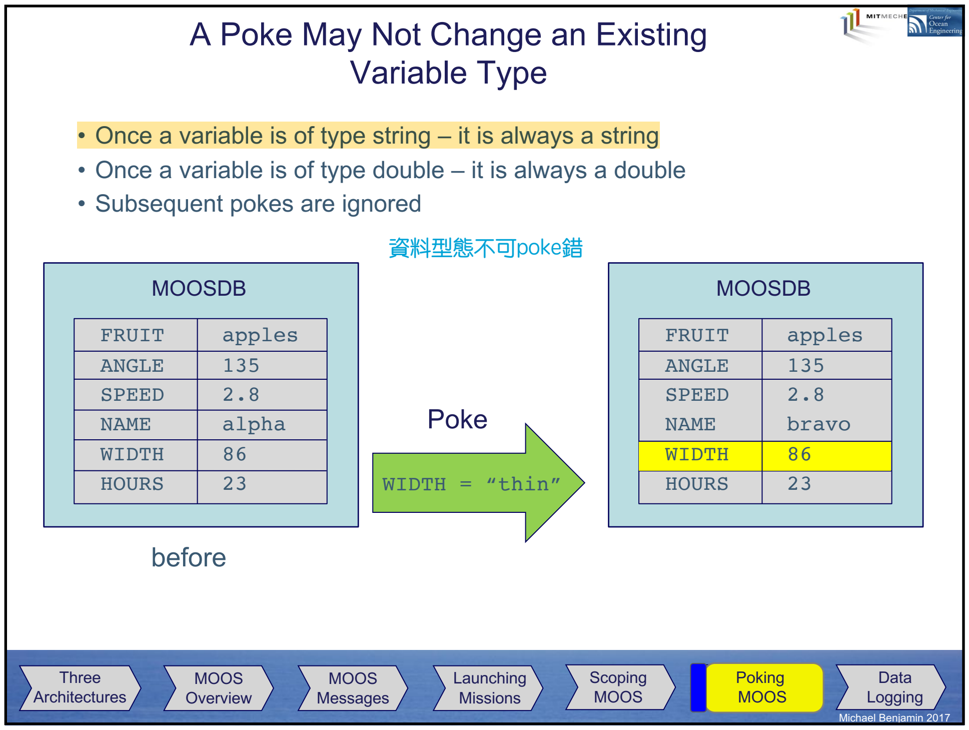
FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	bravo
WIDTH	86
HOURS	23

before



Publishing a New Variable with a MOOS Poke

- A poke may write to a new MOOS variable



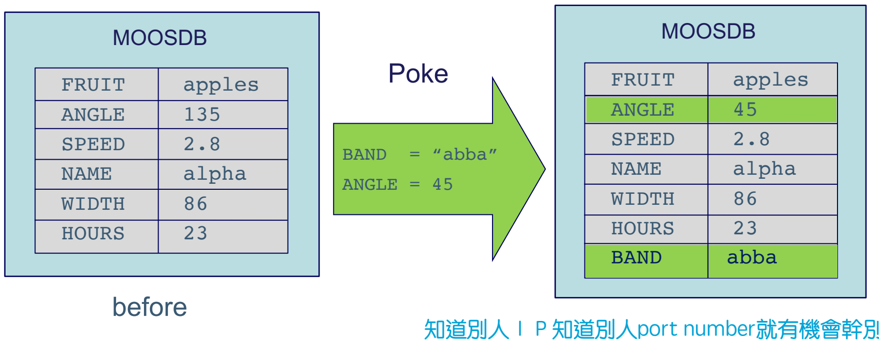
A Poke May Not Change an Existing Variable Type

- Once a variable is of type string – it is always a string
- Once a variable is of type double – it is always a double
- Subsequent pokes are ignored

Poking with uXMS

- uXMS is a command line tool for poking the MOOSDB

```
$ uPokeDB mission.moos  BAND="abba"  ANGLE=45
```



MOOSDB

FRUIT	apples
ANGLE	135
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23

Poke

```
BAND  = "abba"
ANGLE = 45
```

MOOSDB

FRUIT	apples
ANGLE	45
SPEED	2.8
NAME	alpha
WIDTH	86
HOURS	23
BAND	abba

before

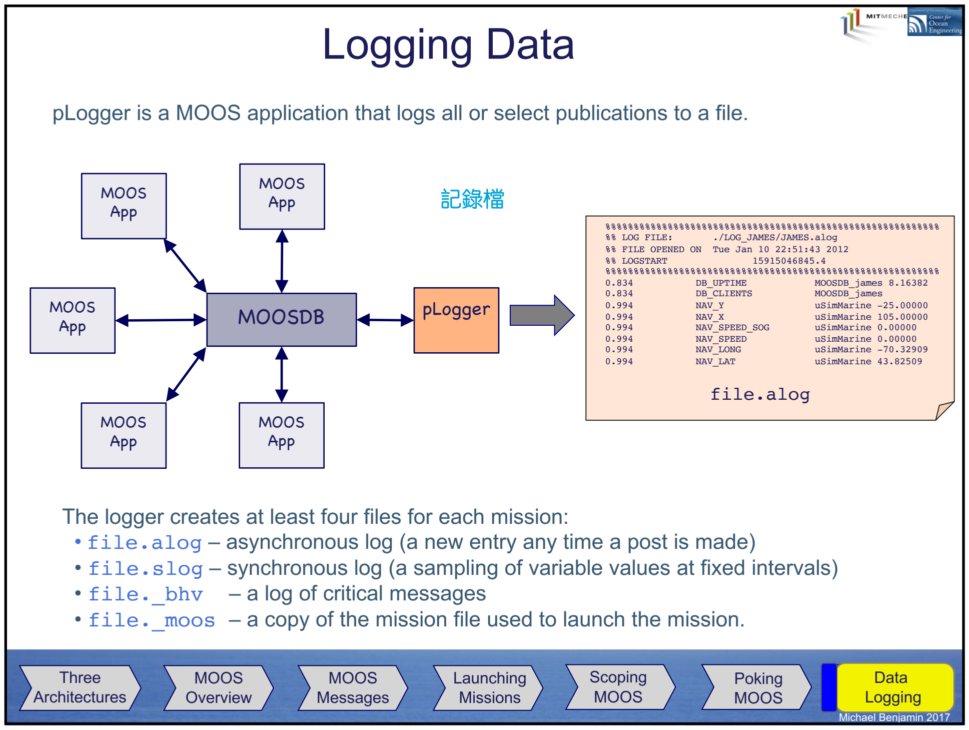
知道別人ＩＰ知道別人port number就有機會幹別人機器人

MOOS Conventions

MOOS Variables are
- Typically uppercase
- seldom use numbers
- Never have white space
- Only special character is the underscore '_'

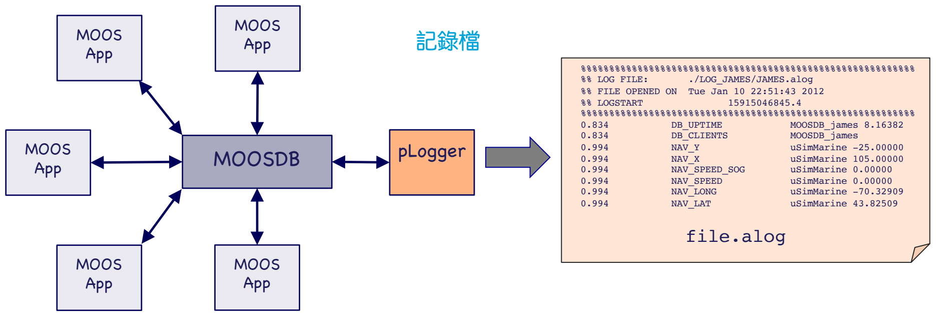
Nice Variables:
- NAV_HEADING
- TOTAL_POINTS
- DESIRED_SPEED
- CLIENTS

Ugly Variables:
- TIME OF DAY
- basic_value
- #ofdays
- SLIP-JOINT



Logging Data

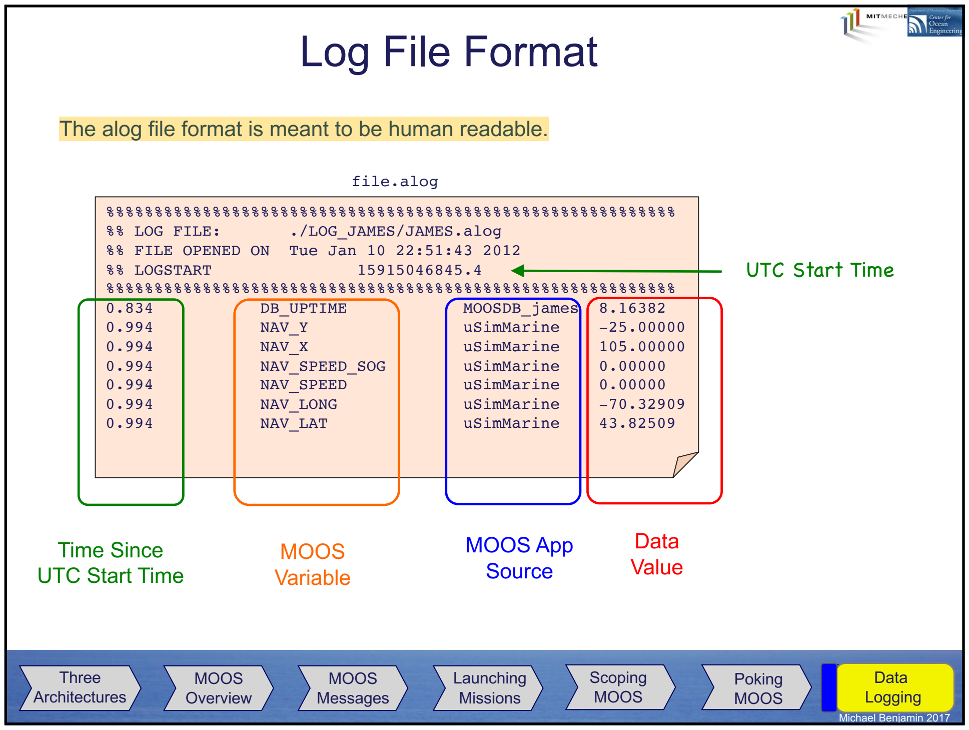
pLogger is a MOOS application that logs all or select publications to a file.



```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% LOG FILE:       ./LOG_JAMES/JAMES.alog
%% FILE OPENED ON  Tue Jan 10 22:51:43 2012
%% LOGSTART               15915046845.4
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
0.834          DB_UPTIME           MOOSDB_james 8.16382
0.834          DB_CLIENTS          MOOSDB_james
0.994          NAV_Y               uSimMarine -25.00000
0.994          NAV_X               uSimMarine 105.00000
0.994          NAV_SPEED_SOG       uSimMarine 0.00000
0.994          NAV_SPEED           uSimMarine 0.00000
0.994          NAV_LONG            uSimMarine -70.32909
0.994          NAV_LAT             uSimMarine 43.82509

            file.alog
```

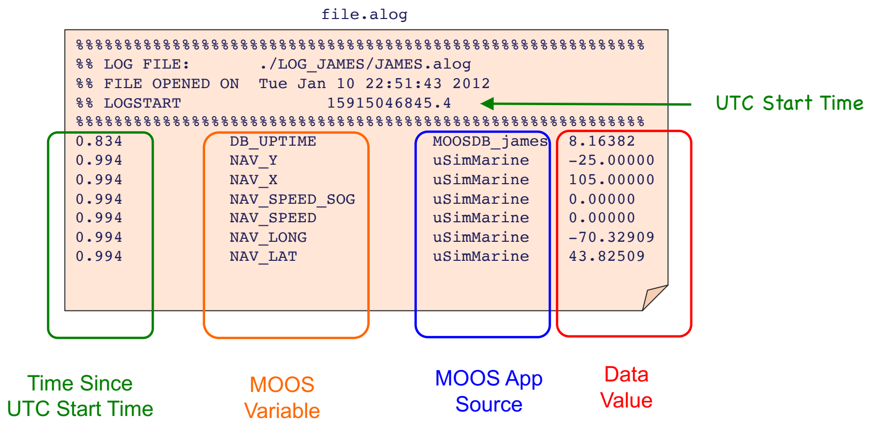
The logger creates at least four files for each mission:

- `file.alog` – asynchronous log (a new entry any time a post is made)
- `file.slog` – synchronous log (a sampling of variable values at fixed intervals)
- `file._bhv` – a log of critical messages
- `file._moos` – a copy of the mission file used to launch the mission.

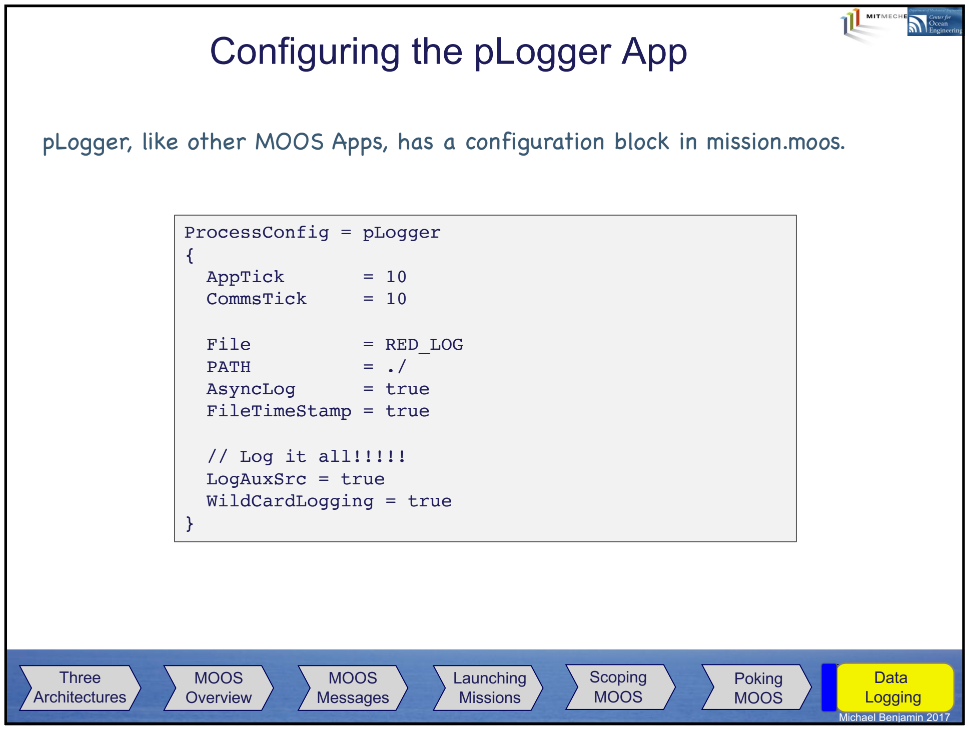


Log File Format

The alog file format is meant to be human readable.



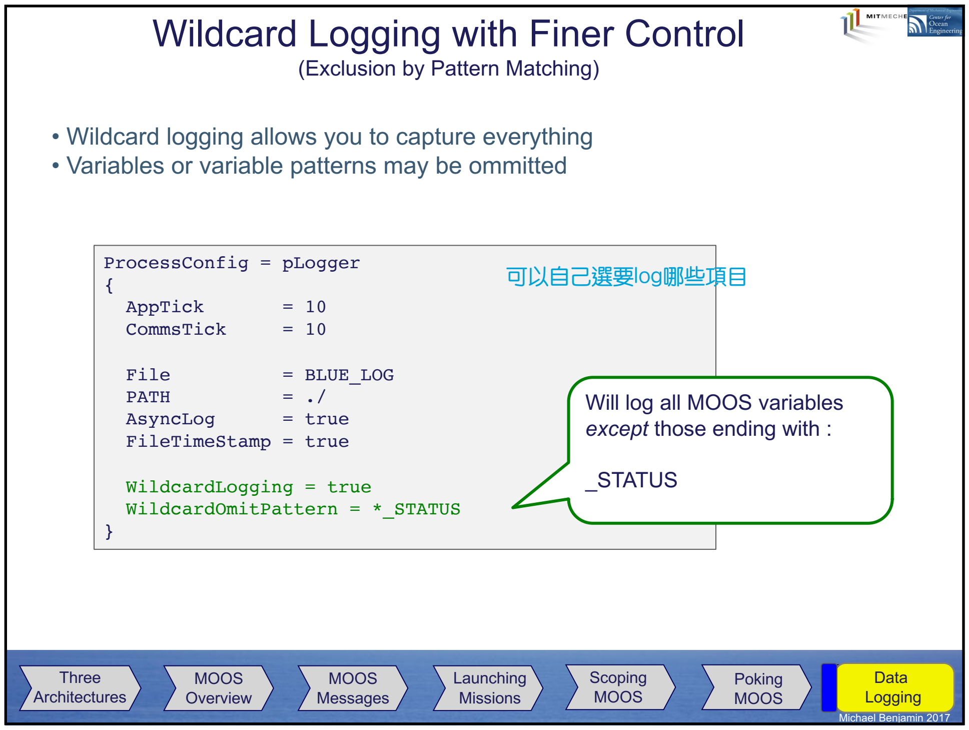
```
file.alog
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% LOG FILE:       ./LOG_JAMES/JAMES.alog
%% FILE OPENED ON  Tue Jan 10 22:51:43 2012
%% LOGSTART               15915046845.4
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
0.834          DB_UPTIME           MOOSDB_james   8.16382
0.994          NAV_Y               uSimMarine     -25.00000
0.994          NAV_X               uSimMarine     105.00000
0.994          NAV_SPEED_SOG       uSimMarine     0.00000
0.994          NAV_SPEED           uSimMarine     0.00000
0.994          NAV_LONG            uSimMarine     -70.32909
0.994          NAV_LAT             uSimMarine     43.82509
```



Configuring the pLogger App

pLogger, like other MOOS Apps, has a configuration block in mission.moos.

```
ProcessConfig = pLogger
{
  AppTick       = 10
  CommsTick     = 10

  File          = RED_LOG
  PATH          = ./
  AsyncLog      = true
  FileTimeStamp = true

  // Log it all!!!!!
  LogAuxSrc = true
  WildCardLogging = true
}
```



Wildcard Logging with Finer Control

(Exclusion by Pattern Matching)

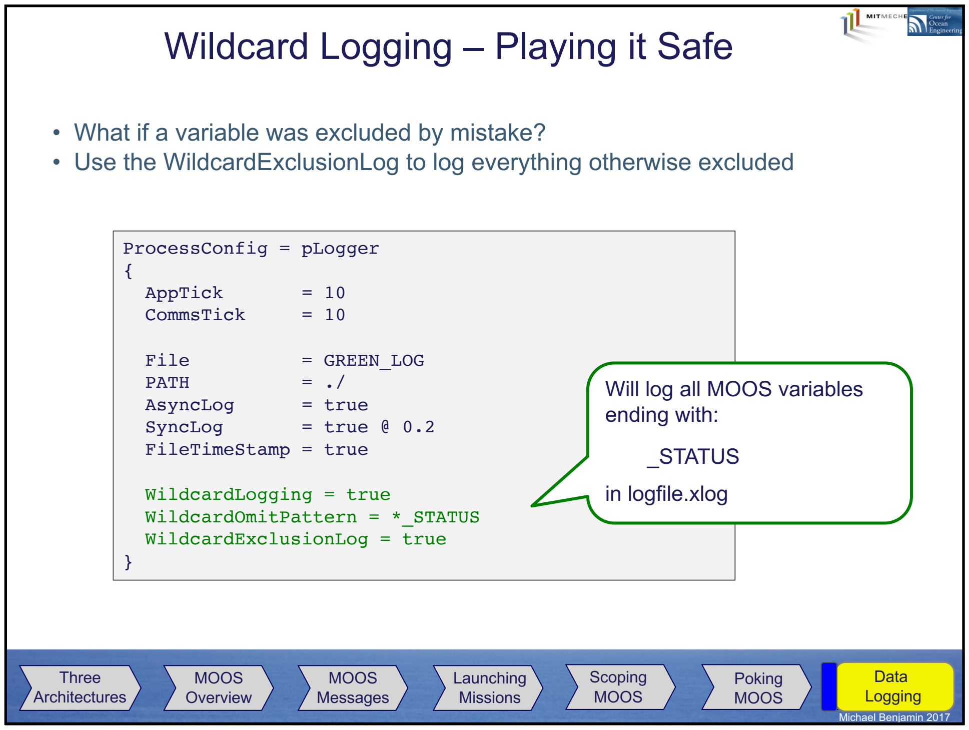
- Wildcard logging allows you to capture everything
- Variables or variable patterns may be ommitted

```
ProcessConfig = pLogger
{
  AppTick       = 10
  CommsTick     = 10

  File          = BLUE_LOG
  PATH          = ./
  AsyncLog      = true
  FileTimeStamp = true

  WildcardLogging = true
  WildcardOmitPattern = *_STATUS
}
```

可以自己選要log哪些項目

Will log all MOOS variables *except* those ending with :

_STATUS



Wildcard Logging – Playing it Safe

- What if a variable was excluded by mistake?
- Use the WildcardExclusionLog to log everything otherwise excluded

```
ProcessConfig = pLogger
{
  AppTick       = 10
  CommsTick     = 10

  File          = GREEN_LOG
  PATH          = ./
  AsyncLog      = true
  SyncLog       = true @ 0.2
  FileTimeStamp = true

  WildcardLogging = true
  WildcardOmitPattern = *_STATUS
  WildcardExclusionLog = true
}
```

Will log all MOOS variables ending with:

_STATUS

in logfile.xlog

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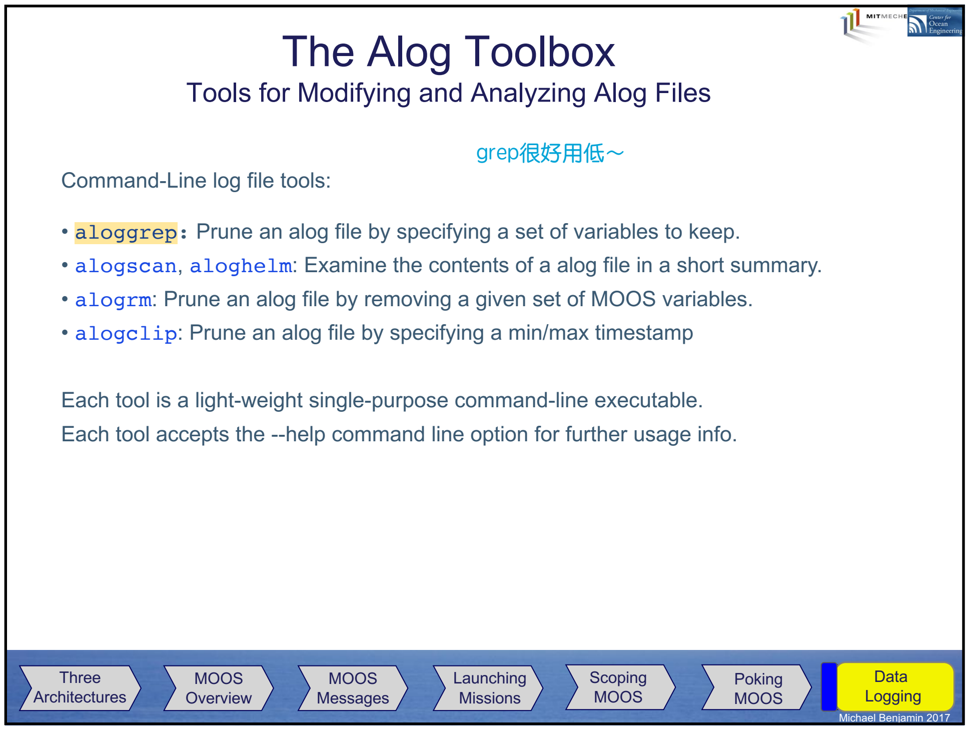

The Alog Toolbox

Tools for Modifying and Analyzing Alog Files

grep很好用低~

Command-Line log file tools:

- `aloggrep`: Prune an alog file by specifying a set of variables to keep.
- `alogscan`, `aloghelm`: Examine the contents of a alog file in a short summary.
- `alogrm`: Prune an alog file by removing a given set of MOOS variables.
- `alogclip`: Prune an alog file by specifying a min/max timestamp

Each tool is a light-weight single-purpose command-line executable.
Each tool accepts the --help command line option for further usage info.

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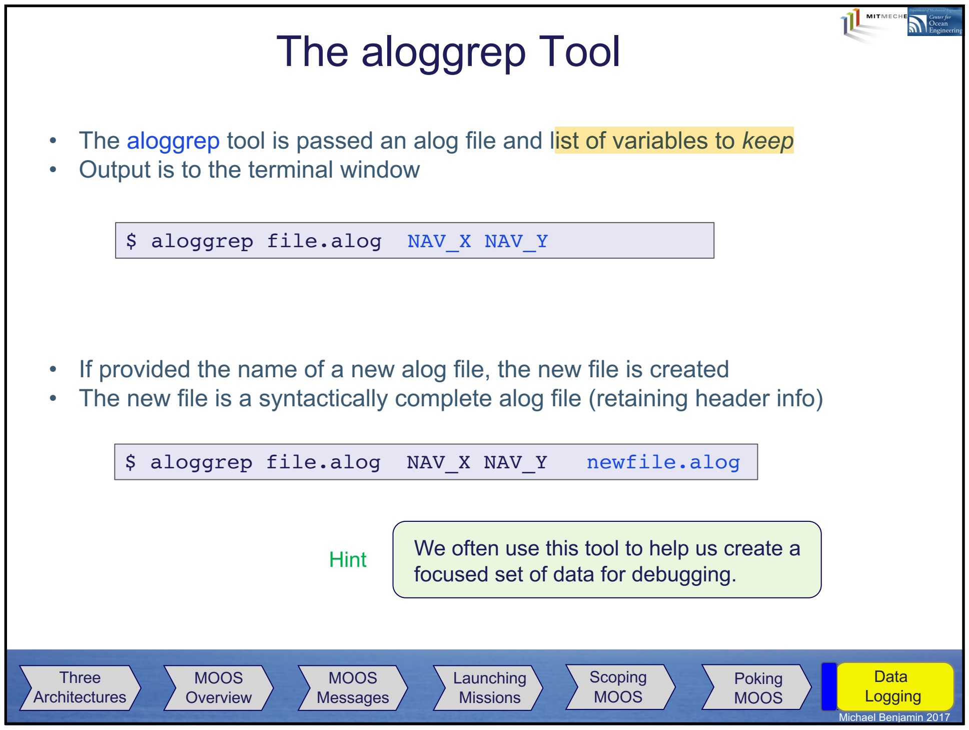

The aloggrep Tool

- The aloggrep tool is passed an alog file and list of variables to *keep*
- Output is to the terminal window

```
$ aloggrep file.alog  NAV_X NAV_Y
```

- If provided the name of a new alog file, the new file is created
- The new file is a syntactically complete alog file (retaining header info)

```
$ aloggrep file.alog  NAV_X NAV_Y   newfile.alog
```

Hint

We often use this tool to help us create a focused set of data for debugging.

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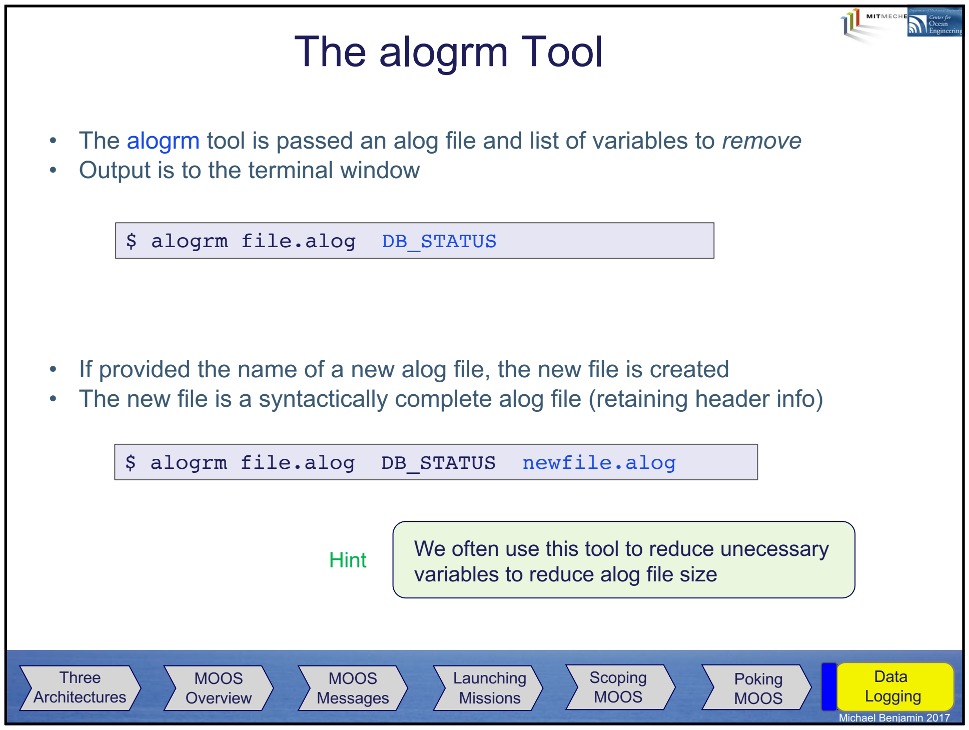

The alogrm Tool

- The alogrm tool is passed an alog file and list of variables to *remove*
- Output is to the terminal window

```
$ alogrm file.alog  DB_STATUS
```

- If provided the name of a new alog file, the new file is created
- The new file is a syntactically complete alog file (retaining header info)

```
$ alogrm file.alog  DB_STATUS  newfile.alog
```

Hint

We often use this tool to reduce unecessary variables to reduce alog file size

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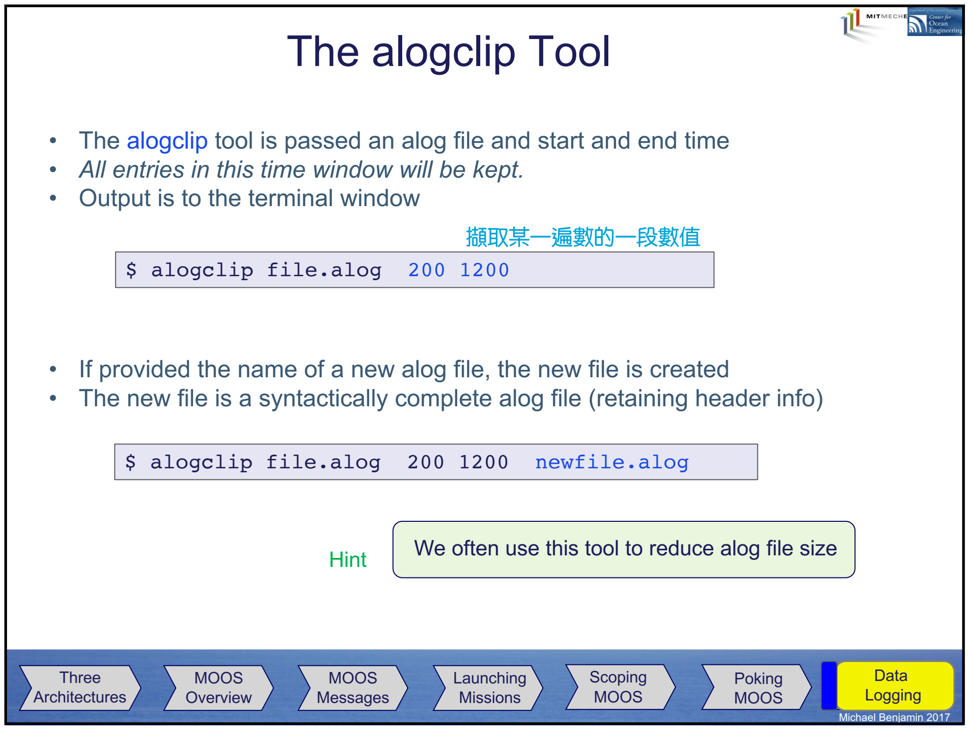


The alogclip Tool

- The alogclip tool is passed an alog file and start and end time
- *All entries in this time window will be kept.*
- Output is to the terminal window

擷取某一遍數的一段數值

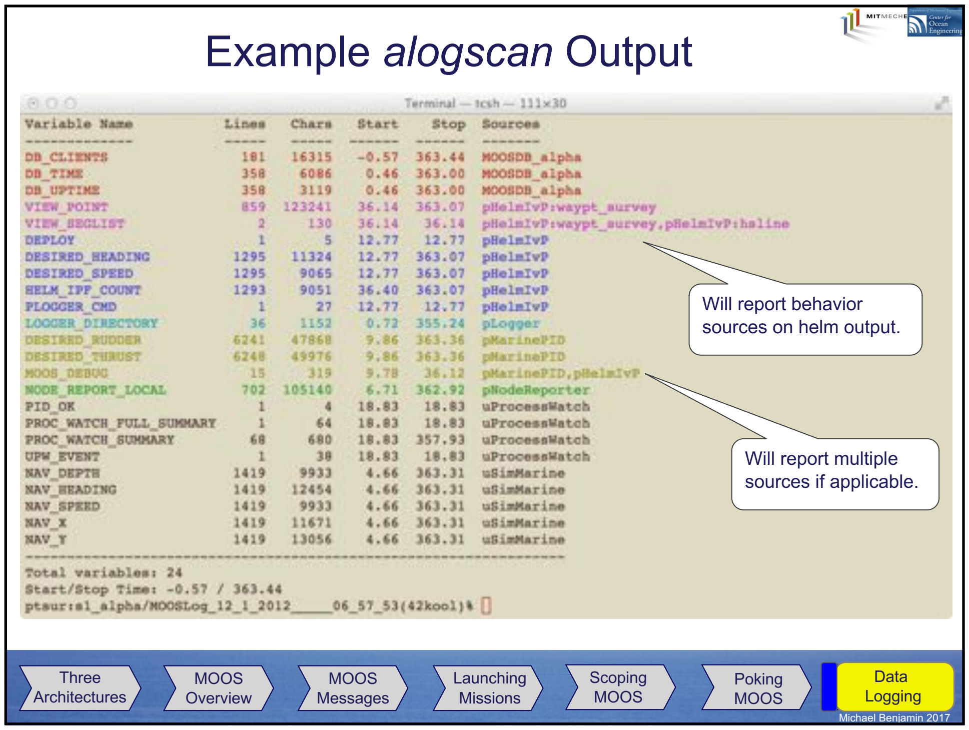
```
$ alogclip file.alog  200 1200
```

- If provided the name of a new alog file, the new file is created
- The new file is a syntactically complete alog file (retaining header info)

```
$ alogclip file.alog  200 1200  newfile.alog
```

Hint

We often use this tool to reduce alog file size



Example *alogscan* Output

```
Variable Name              Lines   Chars   Start    Stop  Sources
-------------              -----   -----  ------  ------  -------
DB_CLIENTS                   181   16315   -0.57  363.44  MOOSDB_alpha
DB_TIME                      358    6086    0.46  363.00  MOOSDB_alpha
DB_UPTIME                    358    3119    0.46  363.00  MOOSDB_alpha
VIEW_POINT                   859  123241   36.14  363.07  pHelmIvP:waypt_survey
VIEW_SEGLIST                   2     130   36.14   36.14  pHelmIvP:waypt_survey,pHelmIvP:hsline
DEPLOY                         1       5   12.77   12.77  pHelmIvP
DESIRED_HEADING             1295   11324   12.77  363.07  pHelmIvP
DESIRED_SPEED               1295    9065   12.77  363.07  pHelmIvP
HELM_IPF_COUNT              1293    9051   36.40  363.07  pHelmIvP
PLOGGER_CMD                    1      27   12.77   12.77  pHelmIvP
LOGGER_DIRECTORY              36    1152    0.72  355.24  pLogger
DESIRED_RUDDER              6241   47868    9.86  363.36  pMarinePID
DESIRED_THRUST              6248   49976    9.86  363.36  pMarinePID
MOOS_DEBUG                    15     319    9.78   36.12  pMarinePID,pHelmIvP
NODE_REPORT_LOCAL            702  105140    6.71  362.92  pNodeReporter
PID_OK                         1       4   18.83   18.83  uProcessWatch
PROC_WATCH_FULL_SUMMARY        1      64   18.83   18.83  uProcessWatch
PROC_WATCH_SUMMARY            68     680   18.83  357.93  uProcessWatch
UPW_EVENT                      1      38   18.83   18.83  uProcessWatch
NAV_DEPTH                   1419    9933    4.66  363.31  uSimMarine
NAV_HEADING                 1419   12454    4.66  363.31  uSimMarine
NAV_SPEED                   1419    9933    4.66  363.31  uSimMarine
NAV_X                       1419   11671    4.66  363.31  uSimMarine
NAV_Y                       1419   13056    4.66  363.31  uSimMarine
------------------------------------------------------------------------
Total variables: 24
Start/Stop Time: -0.57 / 363.44
ptsur:s1_alpha/MOOSLog_12_1_2012_____06_57_53(42kool)%
```

Terminal — tcsh — 111x30
Will report behavior sources on helm output.
Will report multiple sources if applicable.

END

svn update 玩壞的時候可以刪掉打這行，就又跟新的一樣摟～