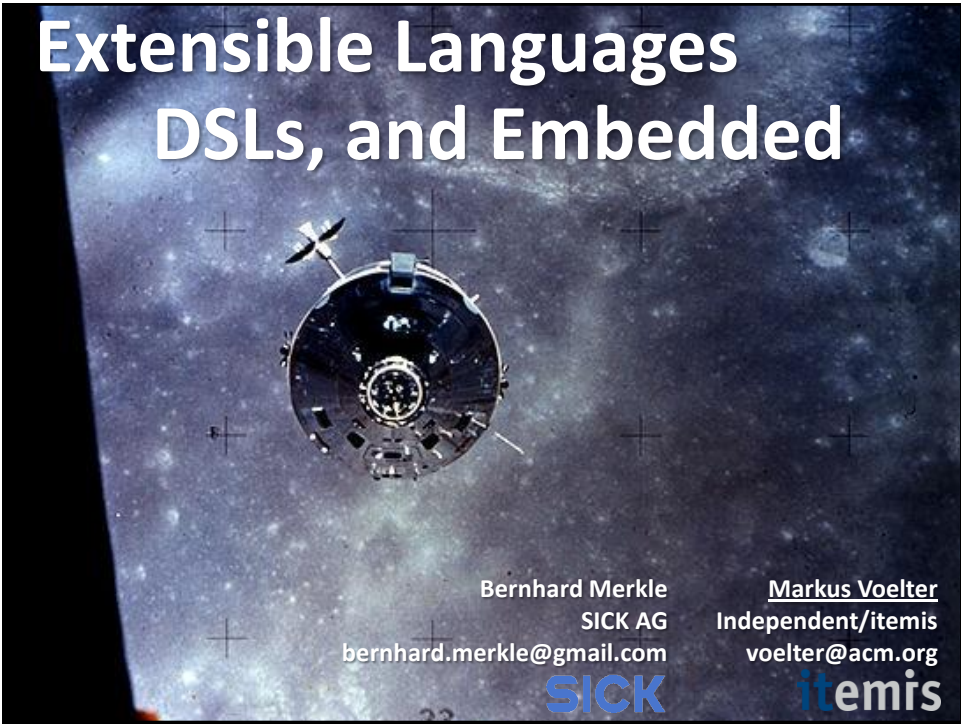


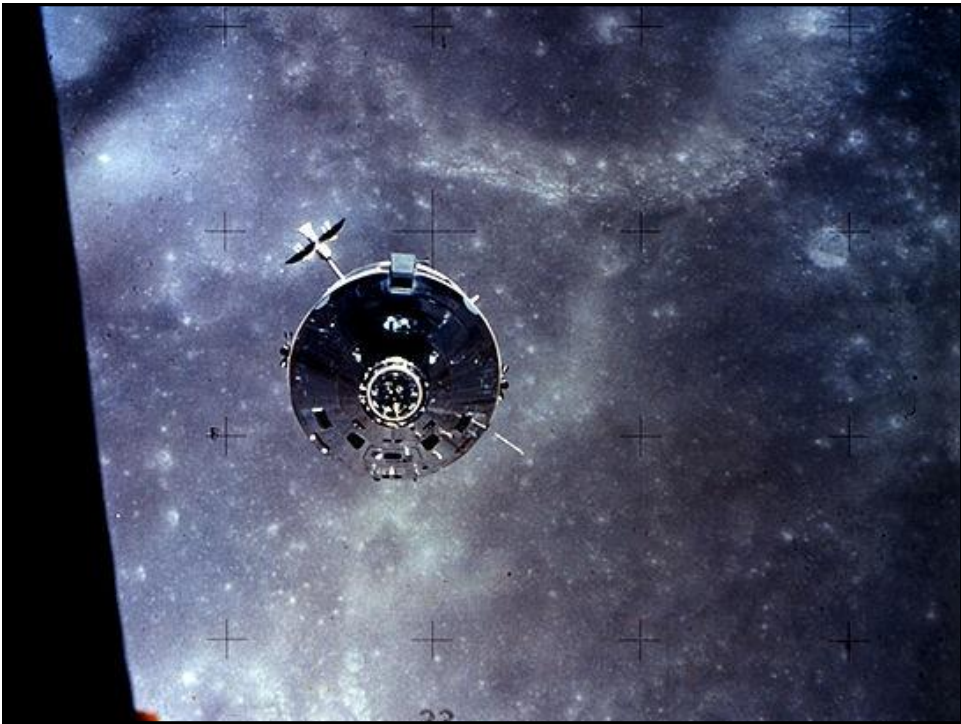
# Extensible Languages DSLs, and Embedded

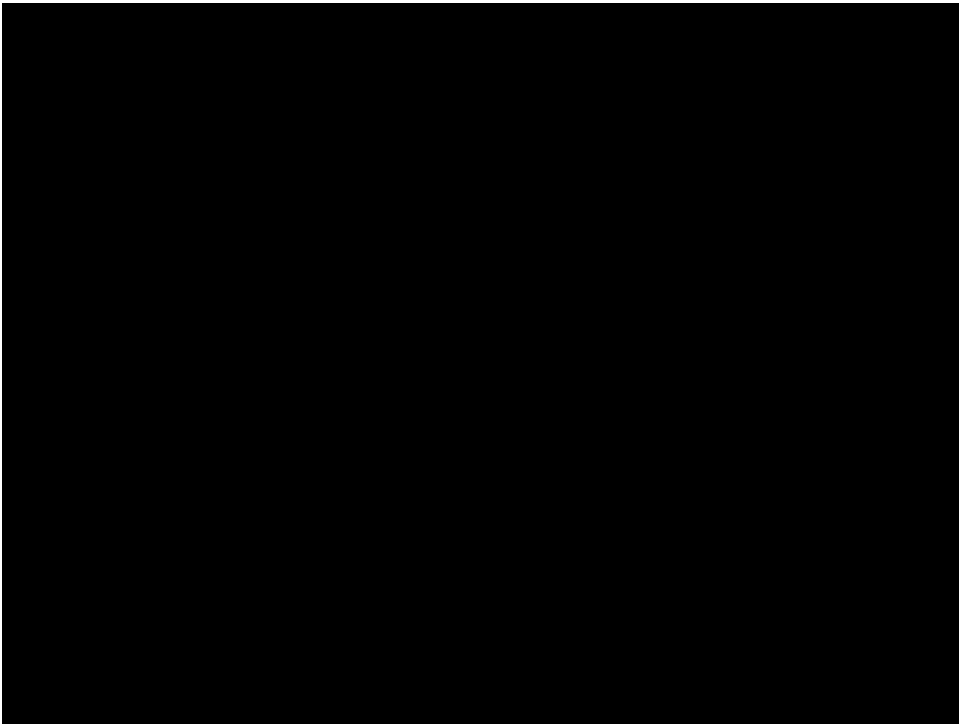


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Independent/itemis  
voelter@acm.org





## Two Classes in Embedded Systems Development



(yes, this is a slight simplification)

**Plan Oriented  
Top Down  
Big Systems  
Big Companies**

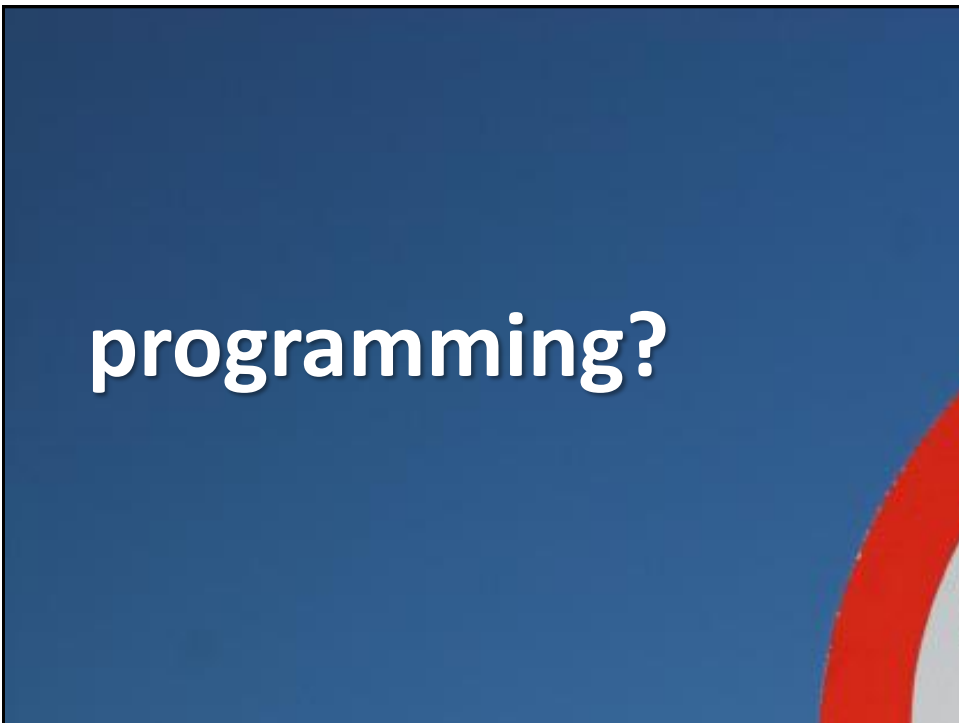
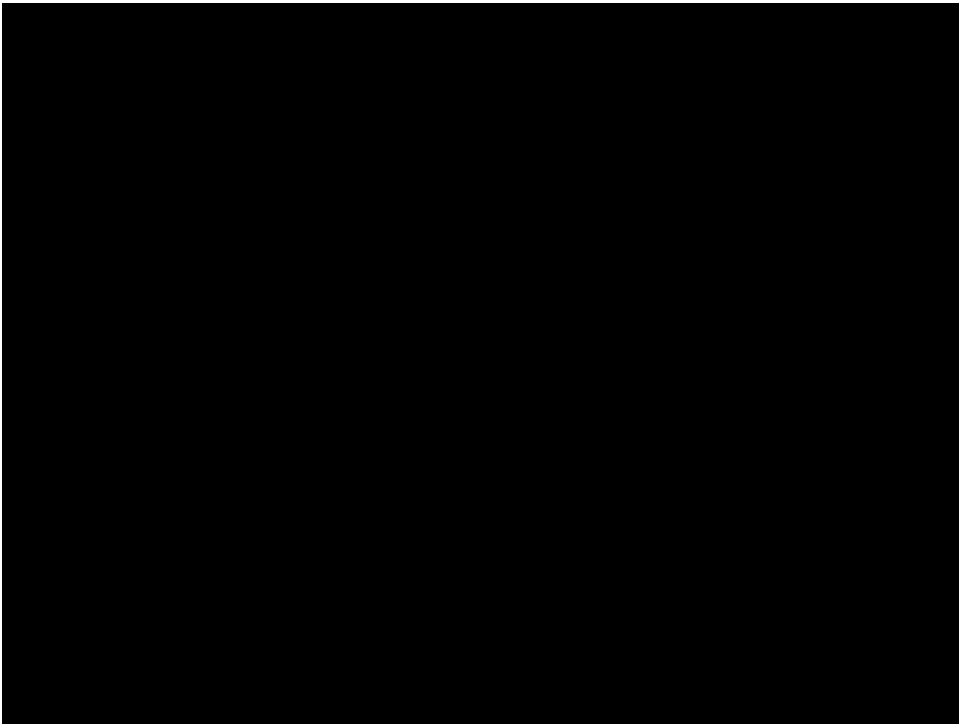


**Modeling**

**Grown  
Bottom Up  
Small/Medium Systems  
Smaller Companies**



**C Code**



**modelling?**

**programming?**  
**vs.**  
**modelling?**

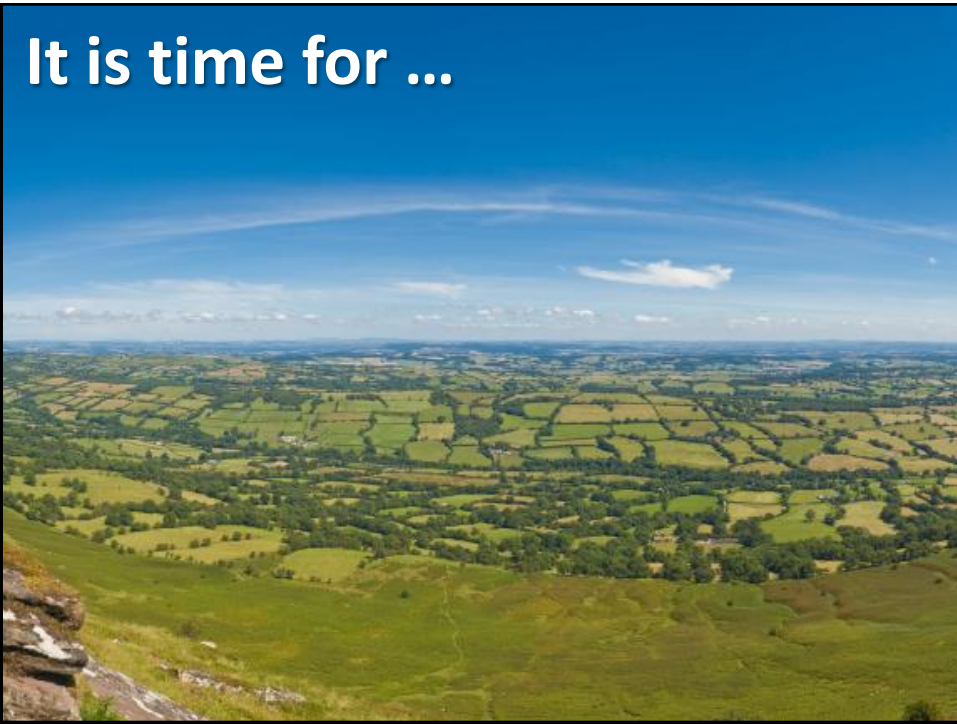
**different?  
the same?**

**Why  
the difference?**



**Why  
the difference?**

**It is time for ...**



**... a Different Perspective**





We don't want to  
**model,**  
we want to  
**program!**

We don't want to  
**model,**  
we want to  
**program!**

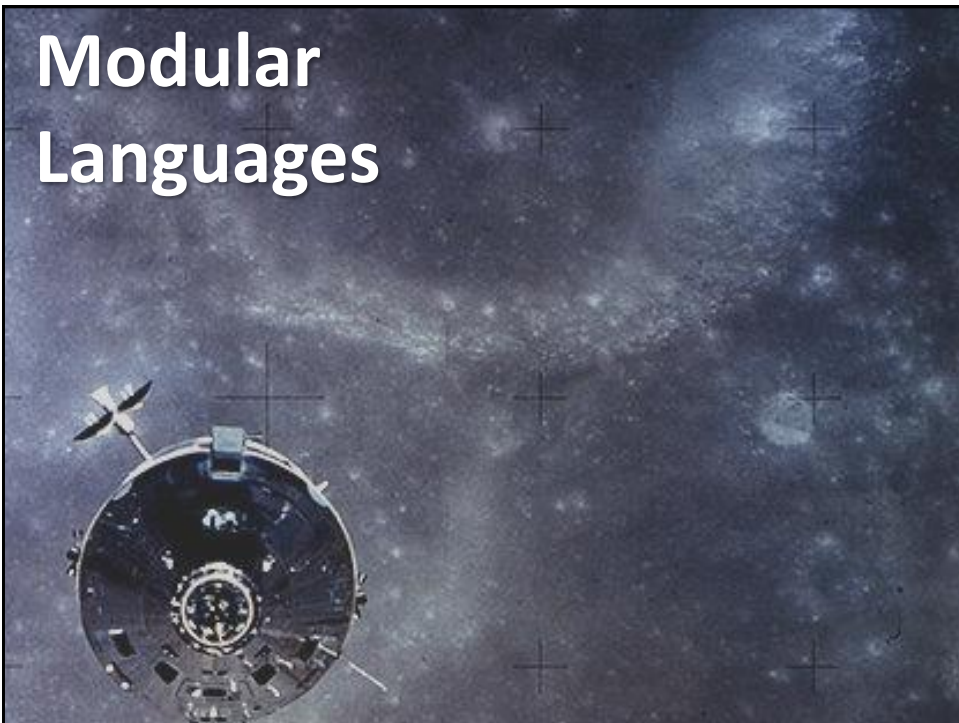
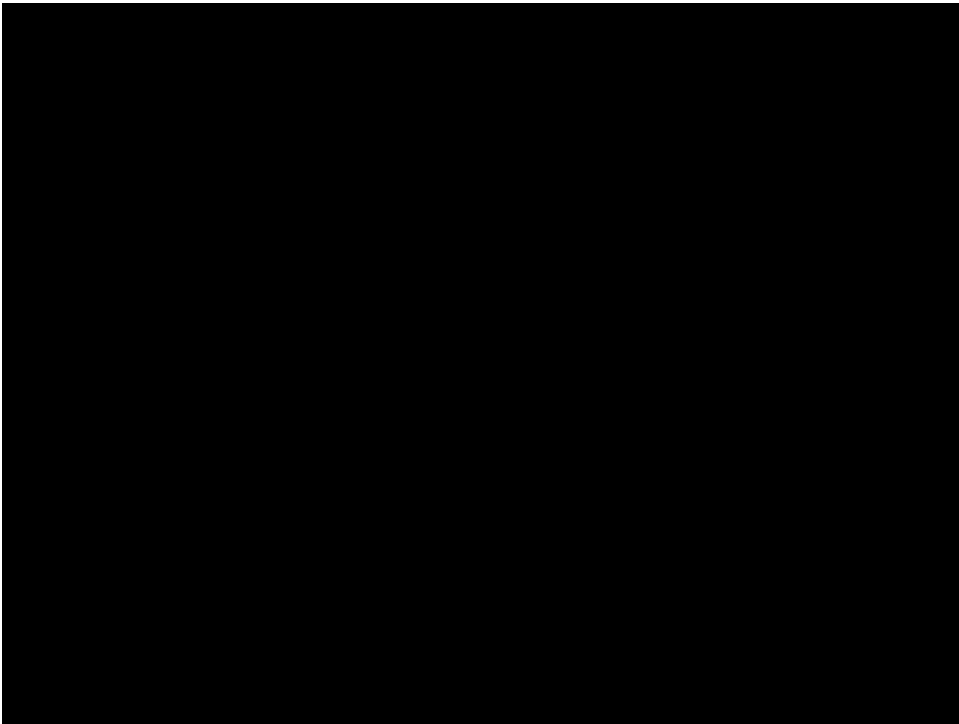
... at different levels of **abstraction**  
... from different **viewpoints**  
... **integrated!**

We don't want to  
**model,**  
we want to  
**program!**

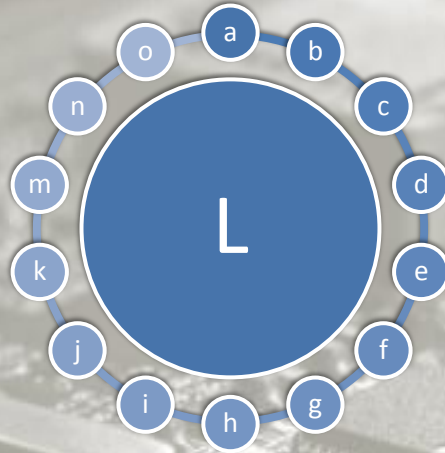
- ... with different degrees of **domain-specificity**
- ... with suitable **notations**
- ... with suitable **expressiveness**

We don't want to  
**model,**  
we want to  
**program!**

And always:  
**precise** and **tool processable**

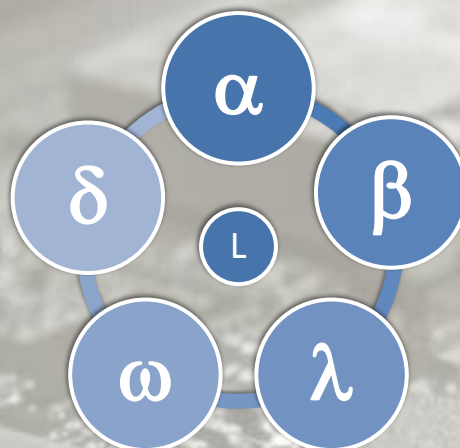


## Big Language?



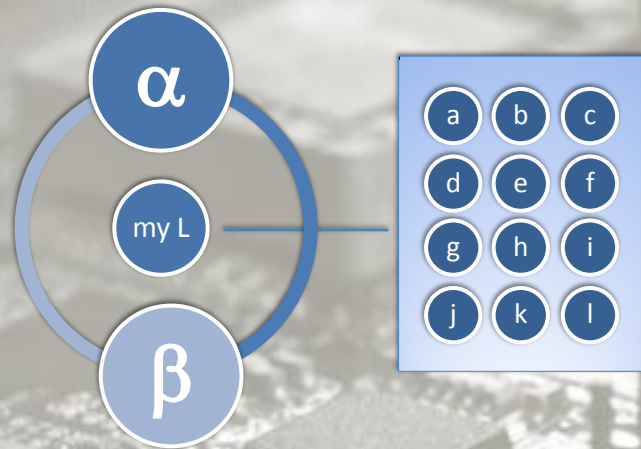
with **many** first class concepts!

## Small Language?



with a **few, orthogonal**  
and **powerful** concepts

## Modular Language



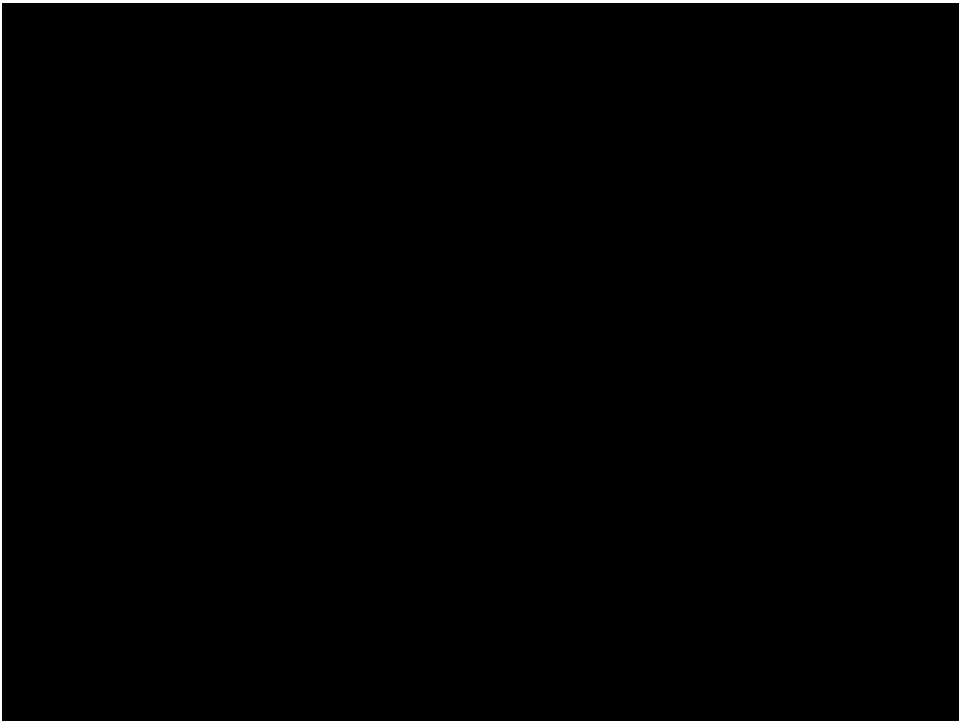
with many **optional,**  
**composable** concepts


## Modular Language

Like frameworks  
and libraries,

# Modular Language

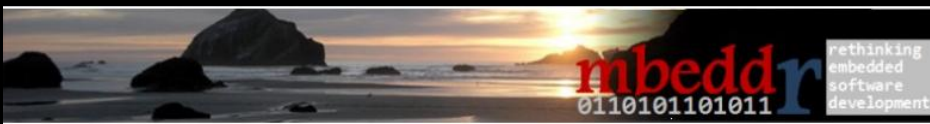
Like frameworks  
and libraries,  
but with syntax  
and IDE support






**mbeddr** rethinking  
0110101101011 embedded  
development

# Incremental Extension of **C**



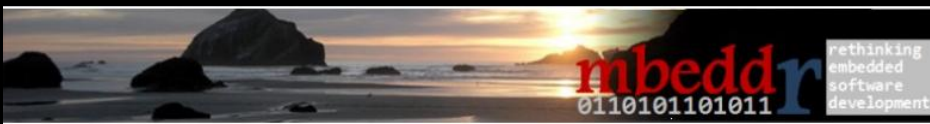
**mbeddr** rethinking  
0110101101011 embedded  
development

# Incremental Extension of **C** Components Tasks State Machines Physical Units Special Data Types



**mbeddr** 0110101101011 rethinking embedded software development

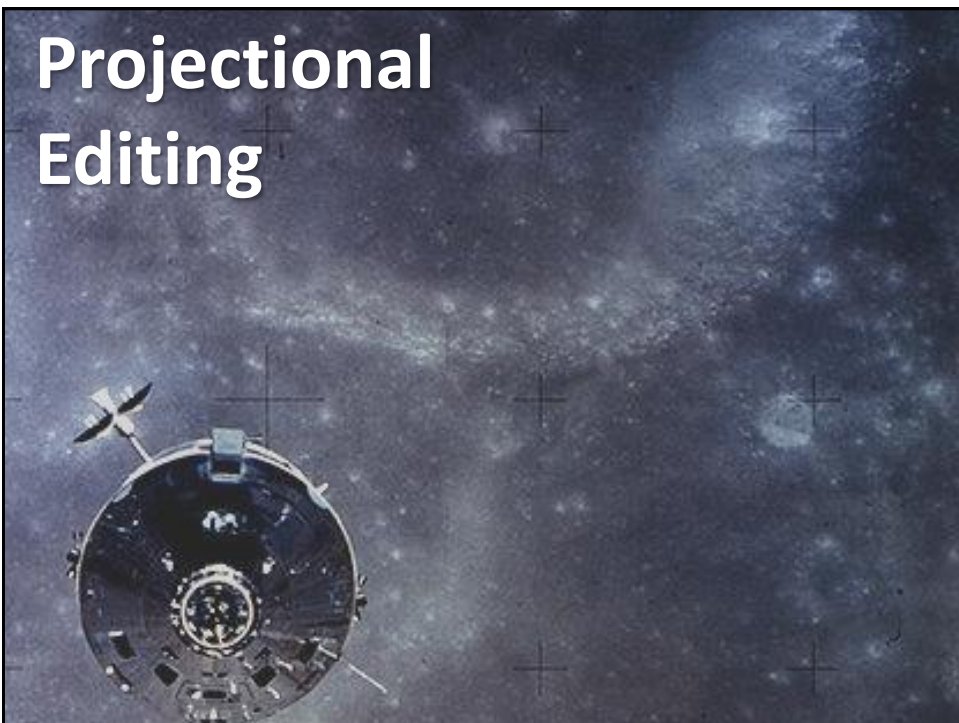
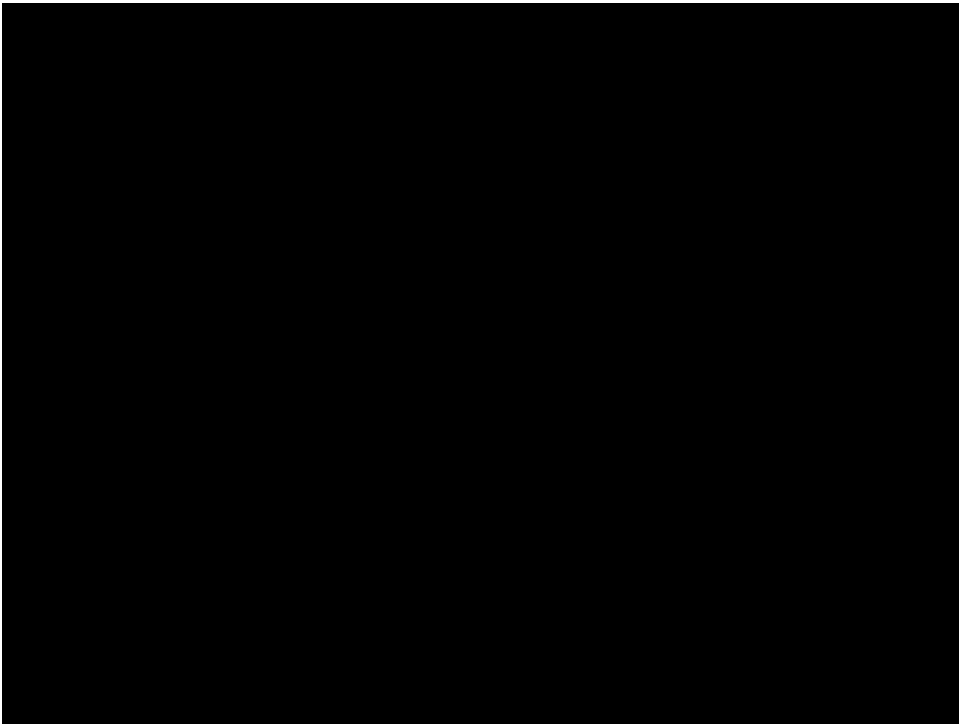
Incremental Extension  
of **C** syntactically  
and semantically  
integrated



**mbeddr** 0110101101011 rethinking embedded software development

Incremental Extension  
of **C** extensible with  
domain-specific  
constructs (DSLs)



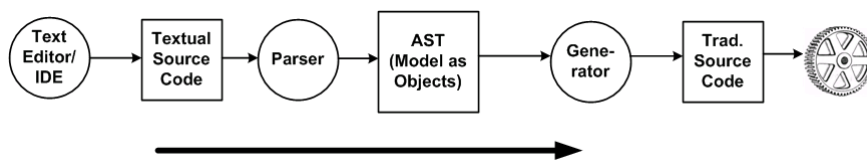


# Parser-based

**text**

**... to tree**

**... to text**



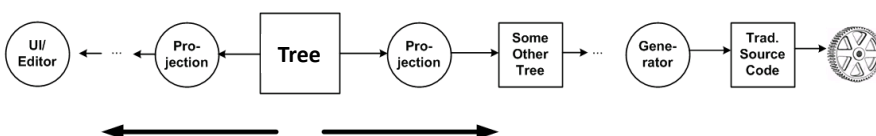
# Projectional

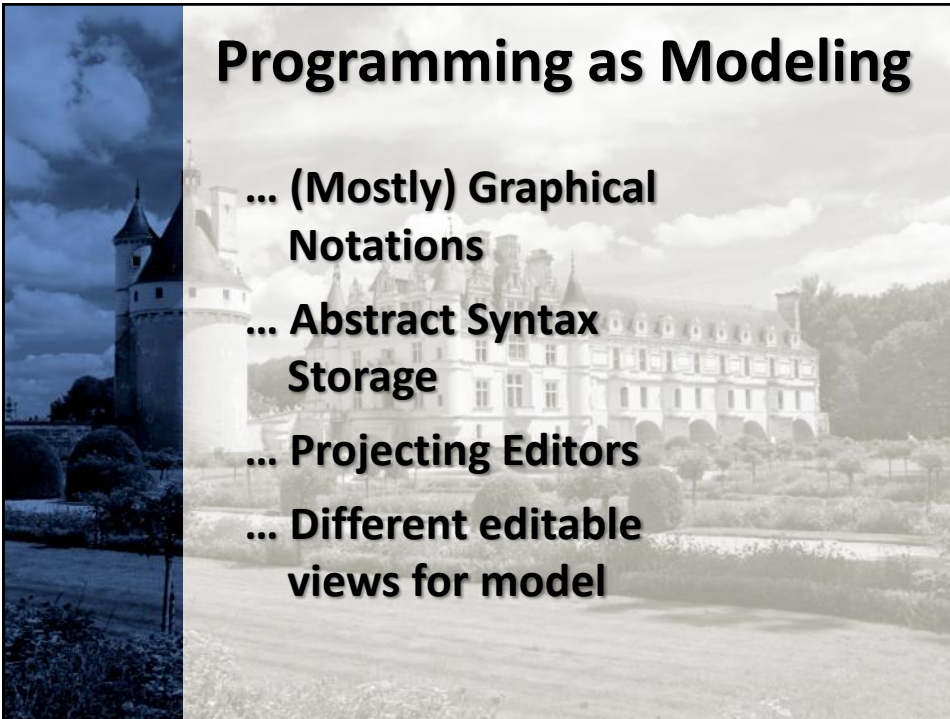
**tree**

**... to text-lookalike (editor)**

**... to other trees ... [\*]**

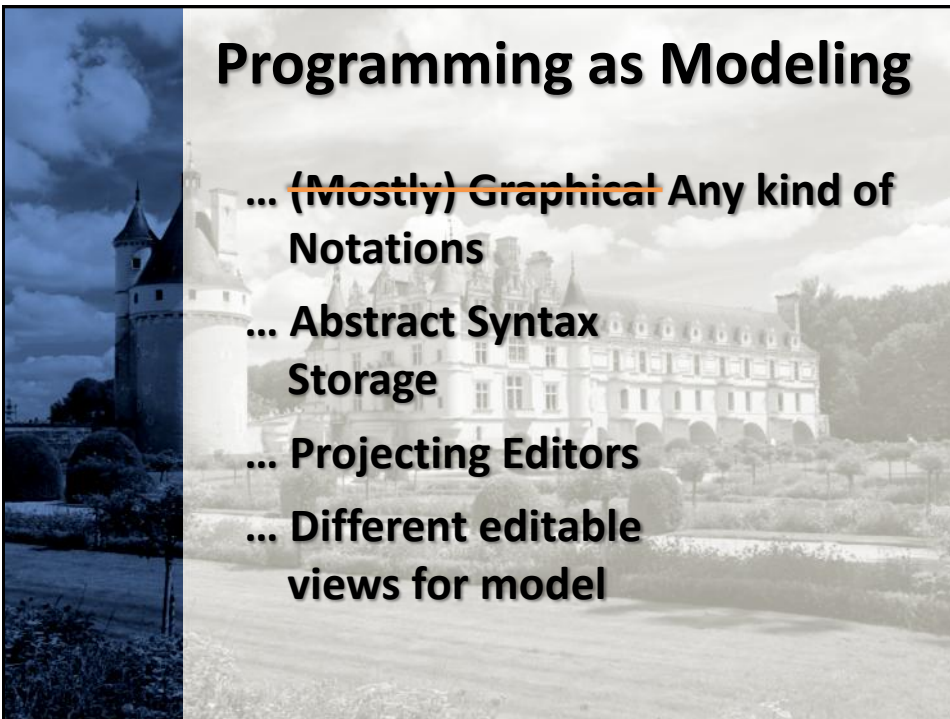
**... to text**





## Programming as Modeling

- ... (Mostly) Graphical Notations
- ... Abstract Syntax Storage
- ... Projecting Editors
- ... Different editable views for model



## Programming as Modeling

- ... ~~(Mostly) Graphical~~ Any kind of Notations
- ... Abstract Syntax Storage
- ... Projecting Editors
- ... Different editable views for model

# Language Composition

**There's no parsing.**

**Unique Language Element Identity.**

**Unlimited language composition.**

# Flexible Notations

**Textual**

like ASCII

**Graphical**

box & line

**Semi-Graphical**

mathematical



**treated the same**

**can be mixed**

# Automatic IDE Extension

**tool support is inherent  
for languages build with  
projectional tools**

language definition  
implies  
IDE definition

# Multiple Notations

**... for the same concepts**

**e.g. in different contexts  
or for different tasks**

# Partial Projections

- ... **different views**
- ... **for different roles/people**
- ... **only a particular variant**

# Storage != Schema

- ... **store arbitrary meta data**
  - change log
  - conflicting information
  - variability annotations
- ... **independent of language schema!**
- ... **„aspects“, overlay**

# Live Programs

**think: spreadsheet**

**a change to one part of program  
can lead to (dependent) changes  
in other parts**

# Tree Editing

**... is different from editing text**

**... try to make it feel like text**

**... takes some getting used to**

**but: for more flexible notations  
a more general editing paradigm  
is needed**

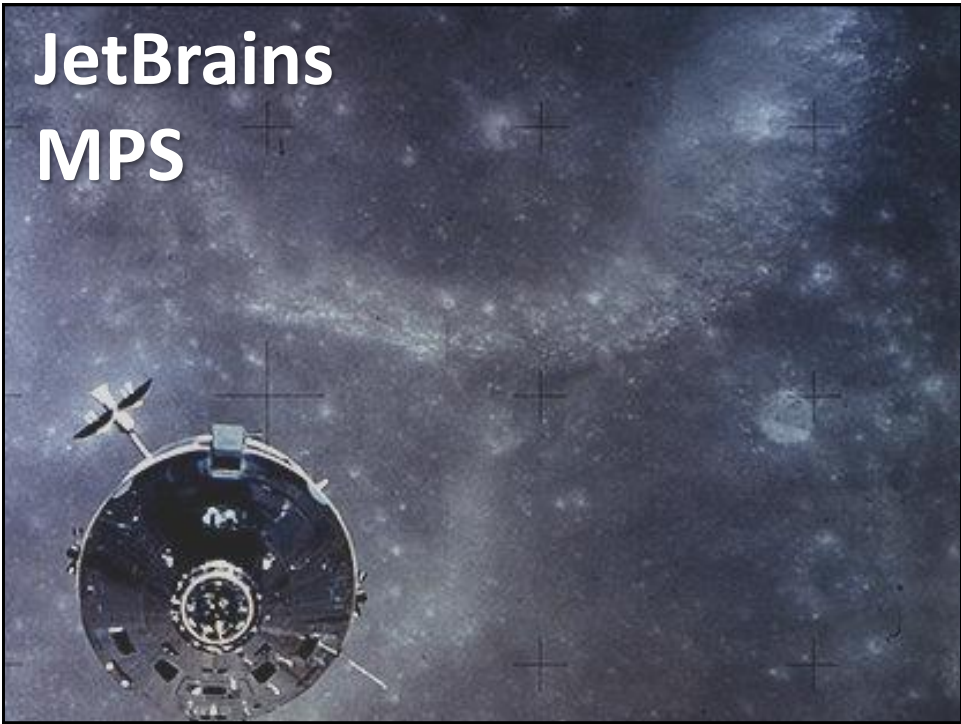
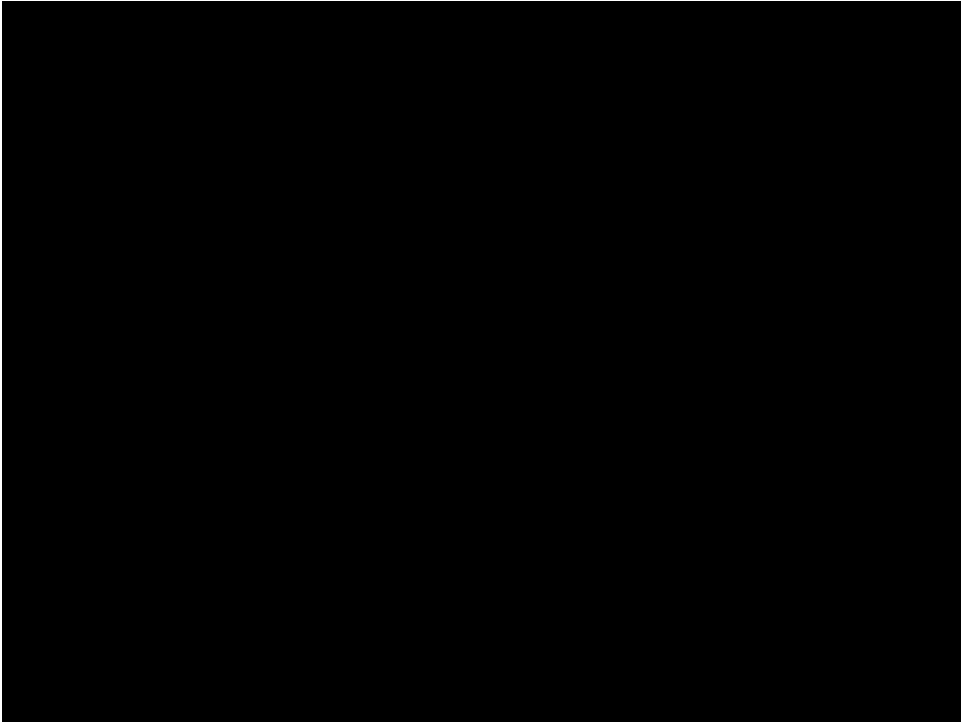
# Infrastructure Integration

- ... **storage is not text**
- ... **diff/merge must be in tool**
- ... **existing text tools don't work**

# Proprietary Tools

- ... **no standards**
- ... **no interop**







also do...

# IntelliJ IDEA Resharper



released in



# Q3 2009

currently

# 1.5.1

April 2011

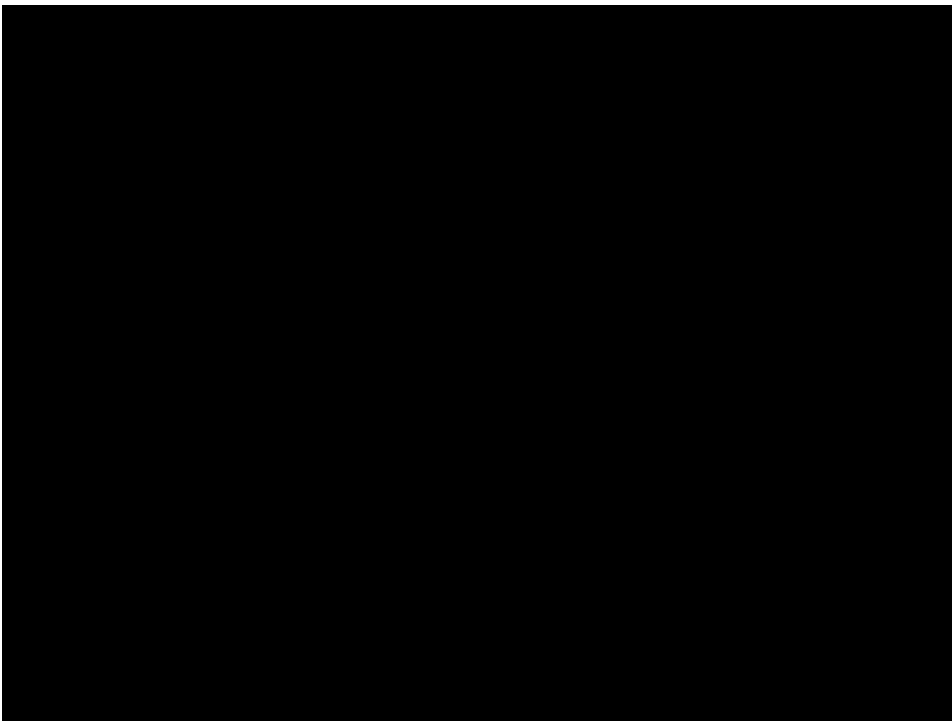
# 2.0



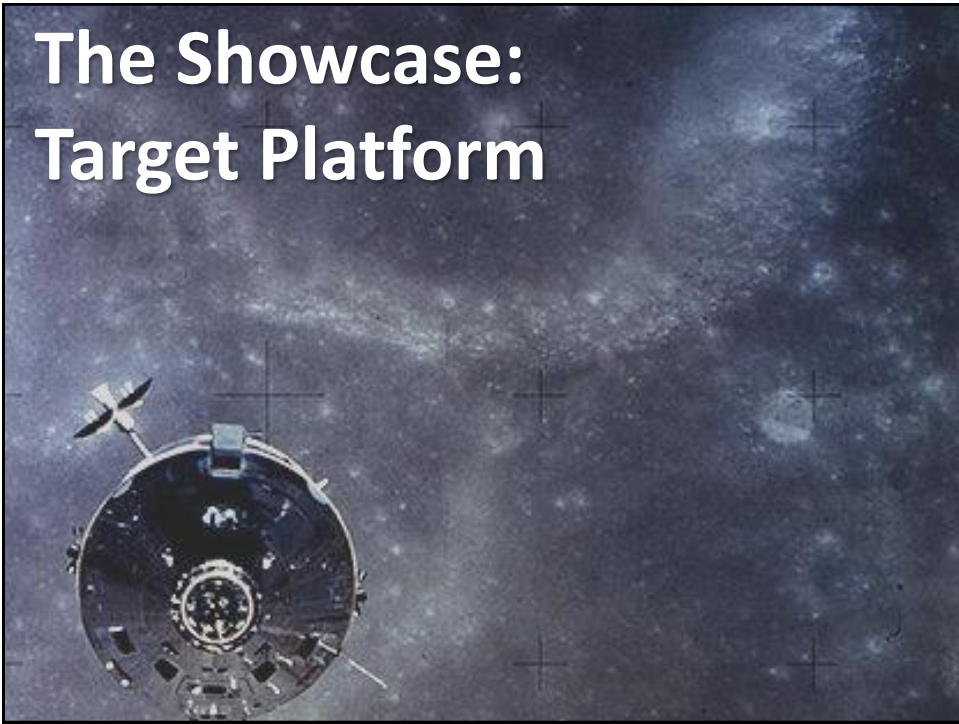
# Open Source

licensed under

# Apache 2.0



# The Showcase: Target Platform



# NXT Brick

32-bit ARM7@48MHz

256kB Flash

64kB RAM



# NXT Brick

100x64 LCD

USB 2.0

Bluetooth



# NXT Brick



**Sensors**

# NXT Brick



**Actors**

# OSEK/VDX

**Embedded OS used in (small) automotive systems**

# OSEK/VDX

- Communication  
(data exchange within and between control units)
- Operating System  
(real-time execution of ECU software and base for the other OSEK/VDX modules)
- Network Management  
(Configuration determination and monitoring)

# helloworld.c

```

/* helloworld.c */
#include "kernel.h"
#include "ecrobot_interface.h"

/* nxtOSEK hook to be invoked from an ISR in category 2 */
void user_lms_isr_type2(void) { /* do nothing */ }

TASK(OSEK_Task_Background)
{
    while(1) {
        ecrobot_status_monitor("Hello, World!");
        systick_wait_ms(500); /* 500msec wait */
    }
}

```

# implementation.oil

```

#include "implementation.oil"

CPU ATMEL_AT91SAM7S256
{
    OS LEJOS_OSEK
    {
        STATUS = EXTENDED
        STARTUPHOOK = FALSE
        ERRORHOOK = FALSE
        SHUTDOWNHOOK = FALSE
        PRETASKHOOK = FALSE
        POSTTASKHOOK = FALSE
        USEGETSERVICEID = FALSE
        USEPARAMETERACCESS = FALSE
        USERSSCHEDULER = FALSE
    };

    /* Definition of application mode */
    APPMODE appmode1();

    /* Definition of OSEK_Task_Background */
    TASK OSEK_Task_Background
    {
        AUTOSTART = TRUE
        {
            APPMODE = appmode1;
        };
        PRIORITY = 1; /* lowest priority */
        ACTIVATION = 1;
        SCHEDULE = FULL;
        STACKSIZE = 512;
    };
};

```

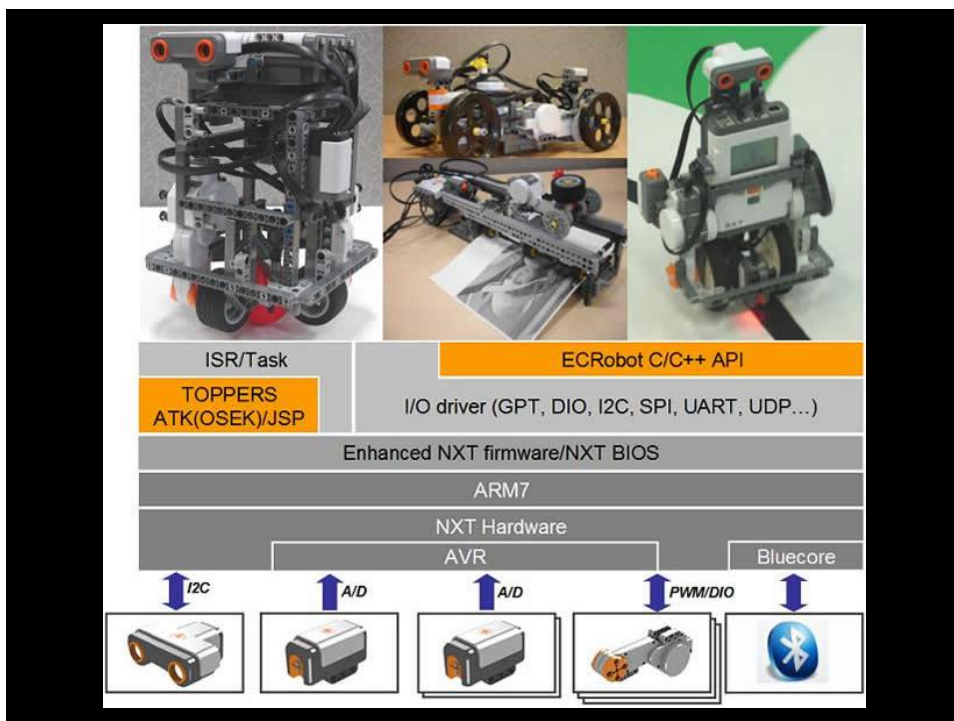


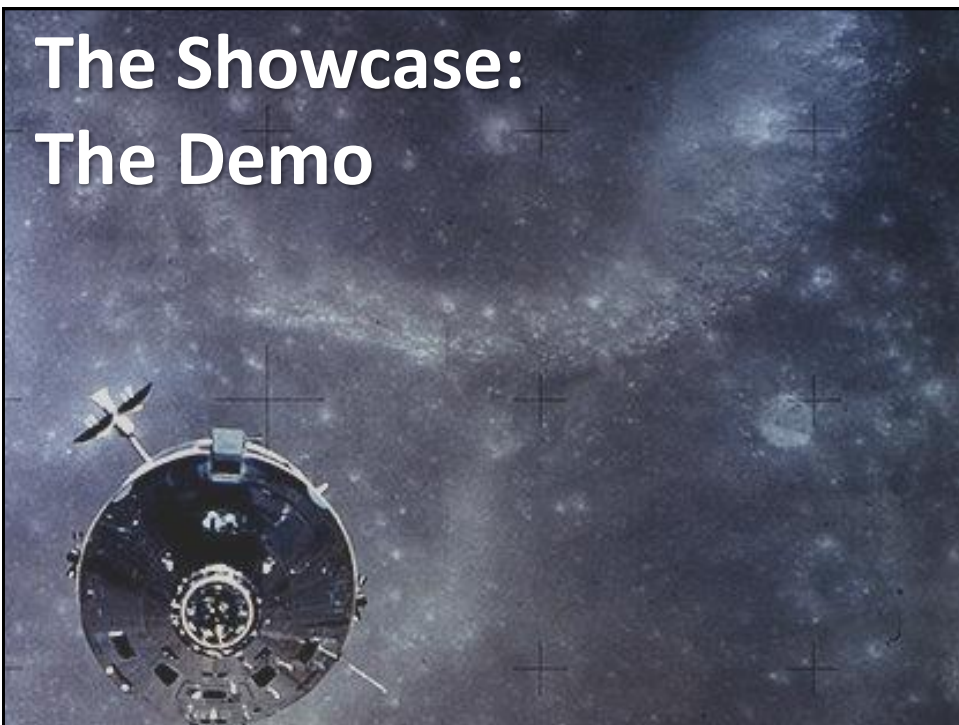
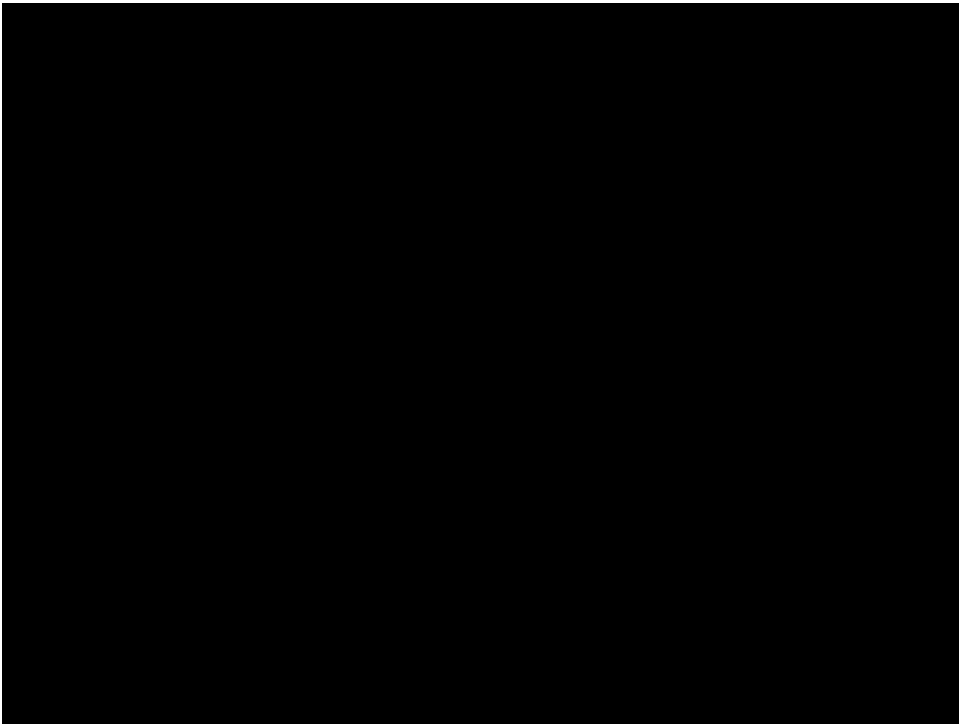
# Lejos-OSEK

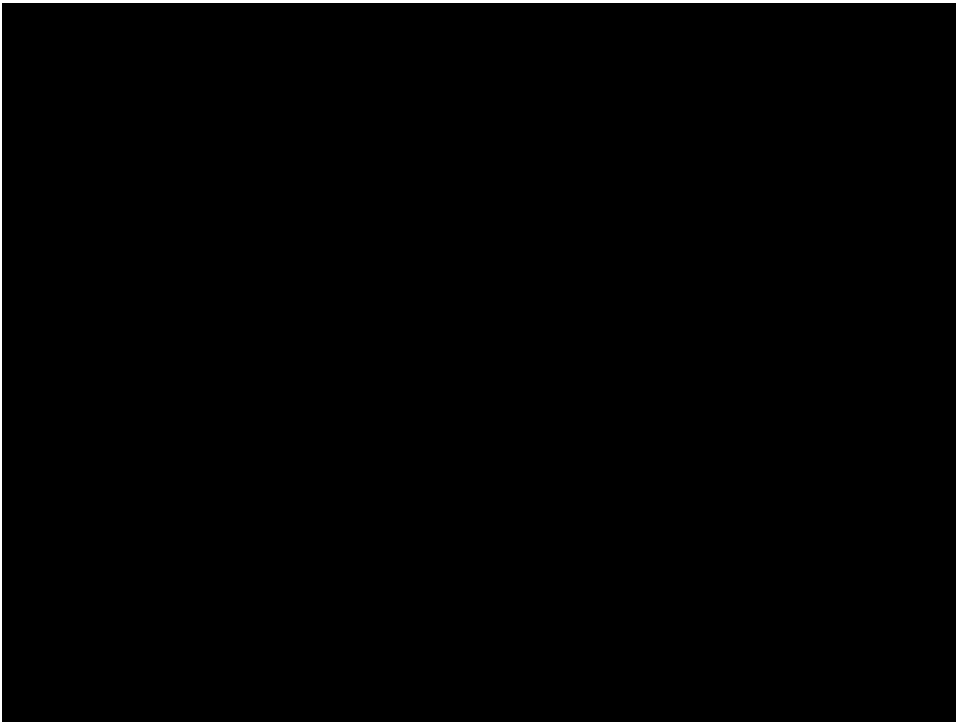
nxtOSEK: OSEK platform for Lego NXT

- realtime, fast execution, memory 10k
- device driver of [leJOS NXJ](http://lejos-nxj.sourceforge.net/) C/Assembly
- Features:
  - ANSI C/C++ programming env using GCC tool chain
  - C/C++ API for NXT Sensors, Motor, and other devices
  - TOPPERS/ATK/JSP real-time multi tasking features
- main devs: Takashi Chikamasa, Masaaki Mizuno

<http://lejos-osek.sourceforge.net/>







# The End.



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skype	schogglad	
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