# Automatic Generation of SDM Application Source Code from xTEDS

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# Introduction

- The Satellite Data Model
  - PnP for satellites
  - Self-discovery & auto-configuration
- eXtensible Electronic Data Sheet (xTEDS)
  - Contains information about the data products, service and commands for a device
- SDM Application
  - Searches, selects and consumes data
  - Provides data and services

# The Problem

- Developing an SDM App is a non-trivial task
  - SDM Messaging
  - SDM Registration
  - Query, select, and subscribe to data
  - Manage data subscriptions

- Creates extra steps in the development of the flight software

# Our Solution

- Write the code for the application developers
- Create a tool that will generate much of the code
- How much code can we automatically generate?

# xTEDS

- xTEDS contain lots of information
  - Data products
  - Timing constraints
  - Command message
  - Message formats

- Let's use this information and generate code from it

# Example xTEDS

```
<Interface name="ExampleInterface" id="1" description="An example" >
   <Variable name="celcius" kind="temperature" format="UINT16" />
   <Notification>
      <DataMsg name="GetTemperature" id="2" msgArrival="PERIODIC" msgRate="1.00">
         <VariableRef name="celcius" />
      </DataMsg>
   </Notification>
   <Command>
      <CommandMsg name="SetTemp" id="1" >
         <VariableRef name="celcius" />
      </CommandMsg>
   </Command>
   <Request>
      <CommandMsg name="GetTemp" description="" id="3" >
         <VariableRef name="celcius" />
      </CommandMsg>
      <DataReplyMsg name="TempData" id="4" >
         <VariableRef name="celcius" />
      </DataReplyMsg>
   </Request>
</Interface>
```

# SDM App Code Architecture

- Library code
  - Sending messages
  - SDM registration
  - Listen and queue incoming messages
- Automatically Generated Code
  - Dataflow
  - Subscription management and data production
  - Query, select and subscribe to data
- Regular Hand Written Code
  - Algorithm and data processing
  - Command handling

# Auto-generated Program Code

Dataflow & Subscription Management

- How do we get messages out of the queue and into the function that needs it?
- Using the message descriptions in the xTEDS, a switch statement is setup to move data to the intended destination.

```
if(messageManager.IsReady())
{
    switch(messageManager.GetMessage(buf))
    {
      case SDM_Subreqst:
          subReqstMsg.Unmarshal(buf);
          subManager.AddSubscription(subReqstMsg);
          break;
      case SDM_Deletesub:
          deleteSubMsg.Unmarshal(buf);
          subManager.RemoveSubscription(deleteSubMsg);
          break;
      case SDM_Command:
          printf("SDMCommand msg received\n");
          CommandHandler(buf);
          break;
      case SDM_RegInfo:
          RegInfoHandler(buf);
          break;
      case SDM_Data:
          DataHandler(buf);
          break;
```

# Auto-generated Program Code

Data Production

## xTEDS

```
<Notification>
   <DataMsg name="GetTemperature" id="2" msgArrival="PERIODIC" msgRate="1.00">
      <VariableRef name="celcius" />
   </DataMsg>
</Notification>
```

## Generated Code

```
curTime = GetCurTime();

if(curTime - GetTemperature_1_lastPubTime >= GetTemperature_1_msgDelay)
{
    char buf_1_2[2];
    unsigned short celcius = Getcelcius1();

    PUT_USHORT(&buf_1_2[0], celcius);
    if(subManager.Publish(GetTemperature_1, buf_1_2, 2))
    {
        GetTemperature_1_lastPubTime = curTime;
    }
}
```

# Auto-generated Program Code

Query, select, and subscribe to data

- SDM Application can get multiple responses to a query for data
  - i.e. a query for temperature
- Setting up the query and selecting the most appropriate result is non-trivial
  - Perhaps the hardest part
- Not enough time to go over it in 13 minutes.
  - Come to a tech demo at the SDL @ 6:30 PM
  - Check it out at https://pnpsoftware.sdl.usu.edu

# SDM AppWizard




Utah State University

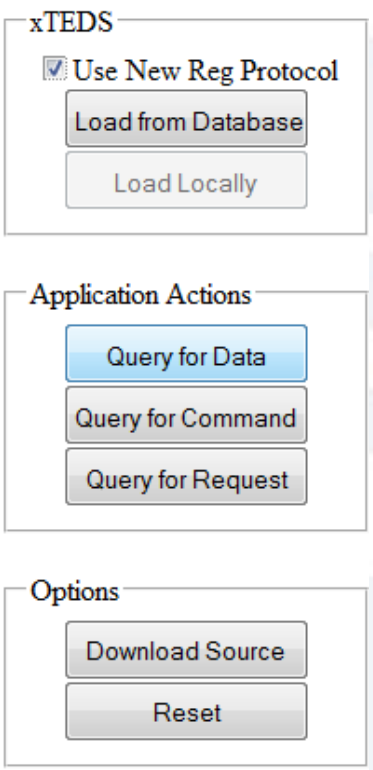
# SDM AppWizard

```
//*****************************SDM App Wizard Generated Code*************
//1. Complete any code marked with a //TODO: tag
//2. This file should be placed into your SDM/app/ directory
//3. Compile using the command g++ filename.cpp -o outputName -L../common
//              *The SDM library must be compiled first
//*************************************************************************

#include "../common/message/SDMxTEDS.h"
#include "../common/message/SDMMessage_ID.h"
#include "../common/message/SDMData.h"
#include "../common/message/SDMCancelxTEDS.h"
#include "../common/MessageManager/MessageManager.h"
#include "../common/MessageManipulator/MessageManipulator.h"
#include "../common/Time/SDMTime.h"
#include "../common/SubscriptionManager/SubscriptionManager.h"
#include "../common/message/SDMSubreqst.h"
#include "../common/message/SDMDeletesub.h"
#include "../common/message/SDMCommand.h"
#include "../common/message/SDMSerreqst.h"

#include <string.h>
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>
#include <signal.h>
#include <fstream>

using namespace std;
```



# Future Work and Conclusion

- SDM App Wizard does not use optional attributes
- Add more compiler / architecture options
- Upgrade the code to make it more robust

- Extra work in developing a SDM Application is reduced by generated most of the code.
- Automatic generation of SDM Application code saves time by decreasing the learning curve

# Tech Demo

- 6:30 PM
- SDL