Open STEM ware

cFS Basecamp
Hello Child Coding Lessons

Version 1.10

December 2023

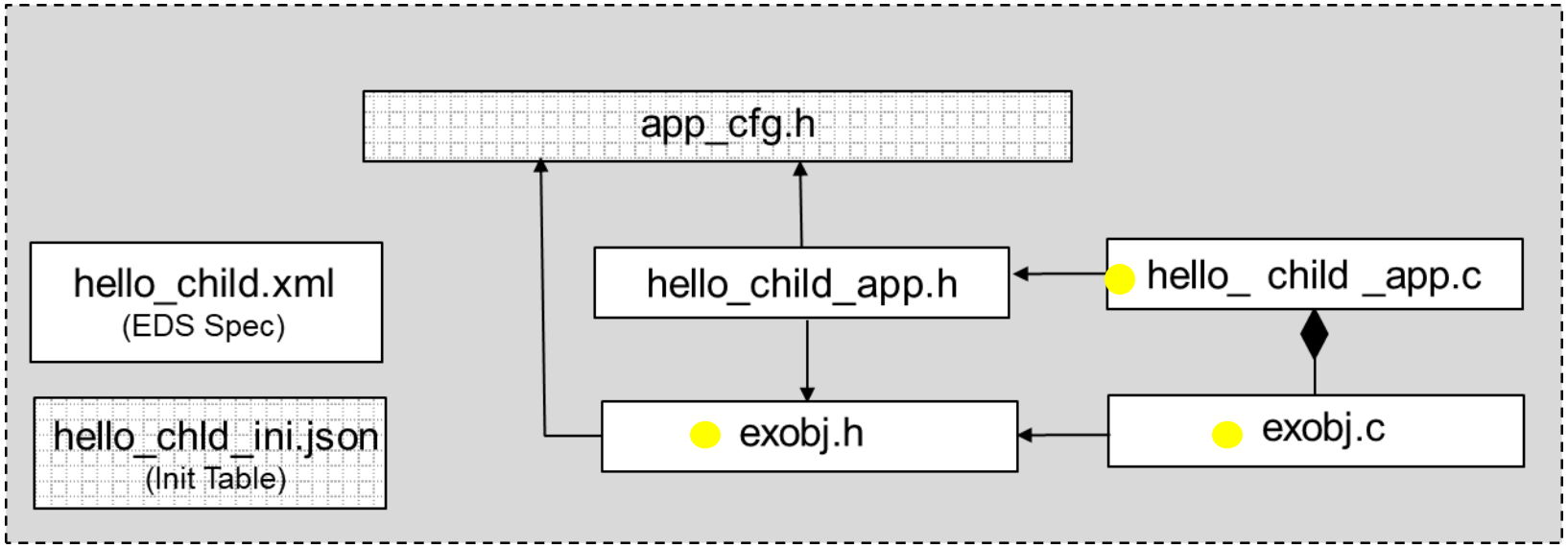
Tutorial Introduction

- **These slides provide guidance for doing the Hello Child coding tutorial exercises**
- **The "Hello App Designs" section in Basecamp's *Application Developer's Guide* provides design information for all of Hello App coding tutorials**
  - Having all of the design information in one place makes the developer's guide flow better
  - It should be used in conjunction with this guide
- **The Hello Child app template includes the Hello Object app and some of the lesson functionality**
  - The EDS-defined Counter Mode type is in the status telemetry message (retained from coding lesson)
  - The EXOBJ_Execute() event message is defined as an INFORMATION event and an event filter allows the first 16 events to be published (similar to hello object coding lesson)
  - The counter limits are defined in the JSON init file
  - The App reset command resets the event filter. EXOBJ does not have any reset behavior
  - A new command allows the child task execution delay to be modified
  - The coding exercises introduce developer's to mutex and counting semaphores
- **Prerequisites**
  - Completed Hello Object coding tutorial and met its prerequisites

Objectives

- Learn how to create and use a Mutex Semaphore to control access to a resource that is shared between two threads

- **The following files are modified in this lesson**



Lesson 1 – Mutex Semaphores (2 of 3)

exobj.h

- Add a new variable called ChildDataSemaphore to hold the Mutex Semaphore identifier

exobj.c

- The Mutex Semaphore is created in the constructor by calling *OS_MutSemCreate()*
- The stack data structure and global function *EXOBJ_StackPop()* already exists.
- This lesson adds
  - A new static *StackPush()* function that includes calls to *OS_MutSemTake()* and *OS_MutSemGive()*
  - Calls to *OS_MutSemTake()* and *OS_MutSemGive()* in *EXOBJ_StackPop()*
  - A call to *StackPush()* in *ManageCounter()*
- These changes cause the child task to push a new stack counter entry for each execution

hello_child_app.c

- Add a new static function *ProcessExObjStack()* that pops all data counter stack entries and sends an event message containing the contents of the entry
  - The event message is filtered
- Call the new *ProcessExObjStack()* function from *ProcessComamnds()* when the 1Hz message is received

Lesson 1 – Mutex Semaphores (3 of 3)

Verification

1. The default configuration should result in EXOBJ pushing counter entries and the main app task popping the entries
   - The events are filtered so you should see the first 16

```
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[21.76395]: INCREMENT counter mode: Value 1. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:03:21.76395]: 1
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[23.76467]: INCREMENT counter mode: Value 2. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:03:23.76467]: 2
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[25.76594]: INCREMENT counter mode: Value 3. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:03:25.76594]: 3
```

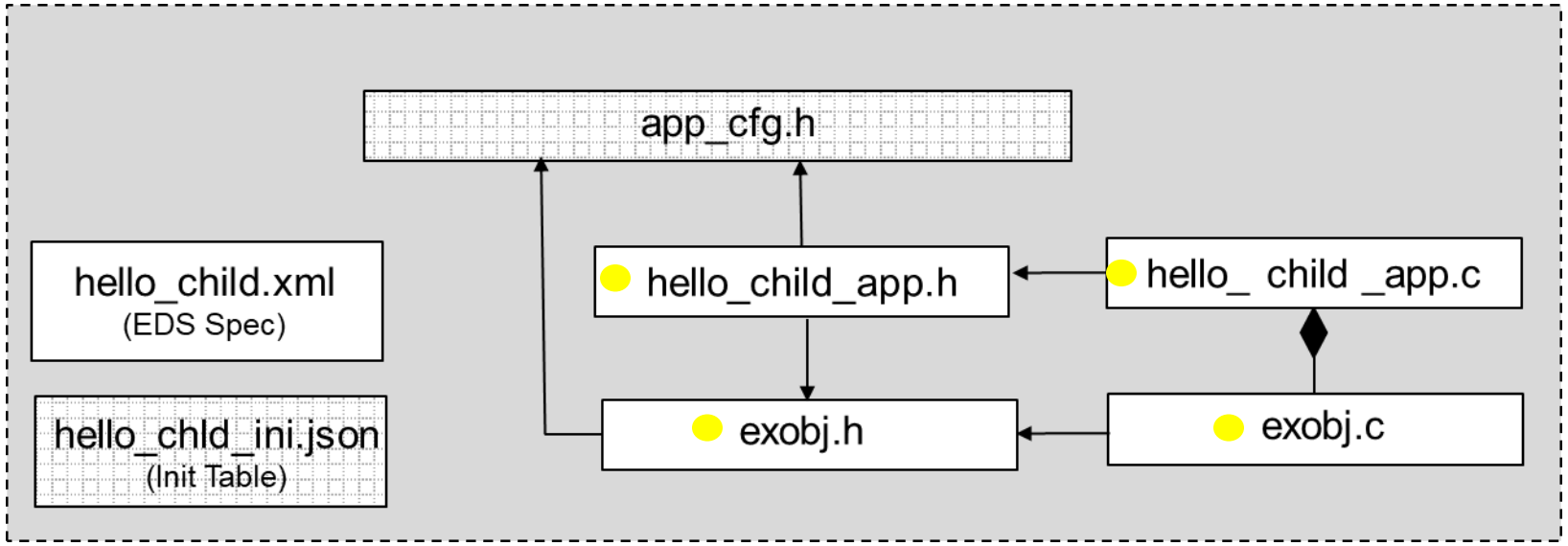
2. Use the HELLO_CHILD SetChildDelay command to experiment with different timing relationships between the two tasks
   - The child delay units are in milliseconds
   - Here's an example with a 200ms delay

```
EVS Port1 66/1/HELLO_CHILD 120: Child task loop delay changed from 1000 to 200
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[17.39351]: INCREMENT counter mode: Value 66. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[17.79395]: INCREMENT counter mode: Value 67. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:11:17.79395]: 67
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:11:17.39351]: 66
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[18.19416]: INCREMENT counter mode: Value 68. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[18.59461]: INCREMENT counter mode: Value 69. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[18.99503]: INCREMENT counter mode: Value 70. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:11:18.99503]: 70
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:11:18.59461]: 69
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:11:18.19416]: 68
```

Objectives

- Learn how to create and use a Counting Semaphore to control the execution of a child task

- **The following files are modified in this lesson**



Lesson 2 – Counting Semaphores (2 of 3)

exobj.h

- Add a new variable called ChildExecSemaphore to hold the Counting Semaphore identifier
- Since EXOBJ doesn't own the counting semaphore a new parameter is added to EXOBJ_Constructor() so the semaphore ID can be passed to EXOBJ

exobj.c

- The constructor is updated to save the counting semaphore ID
- In *EXOBJ_ChildTask()'s* the task delay statement is replaced with a call to *OS_CountSemTake()* because it will control when the child task executes

hello_child_app.h

- Add a new variable called ChildExecSemaphore to hold the Counting Semaphore identifier

hello_child_app.c

- In *InitApp()* create the Counting Semaphore by calling *OS_CountSemCreate()*
- In *ProcessCommands()*
  - In the 1Hz logic replace the call to *ProcessExObjStack()* with *OS_CountSemGive()* which will cause the child task to execute
  - A call to *ProcessExObjStack()* is added to the 4second logic
- This child task execution logic isn't very practical, its purpose is to illustrate counting semaphores

Verification

1. The default configuration should result in EXOBJ pushing counter entries at 1Hz and the main app task popping the entries every 2 seconds
   - The events are filtered so you should see the first 16
   - During startup the scheduler app timing may be erratic. You should see the events settle into the following pattern:

```
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[00.00594]: INCREMENT counter mode: Value 6. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[01.00680]: INCREMENT counter mode: Value 7. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[02.00760]: INCREMENT counter mode: Value 8. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[03.00757]: INCREMENT counter mode: Value 9. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:03.00757]: 9
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:02.00760]: 8
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:01.00680]: 7
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:00.00594]: 6
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[04.00854]: INCREMENT counter mode: Value 10. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[05.00906]: INCREMENT counter mode: Value 11. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[06.00915]: INCREMENT counter mode: Value 12. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 122: EXOBJ Manage Counter[07.00968]: INCREMENT counter mode: Value 13. Limits: Low=0, High=99
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:07.00968]: 13
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:06.00915]: 12
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:05.00906]: 11
EVS Port1 66/1/HELLO_CHILD 104: EXOBJ StackPop [1980-012-14:18:04.00854]: 10
```