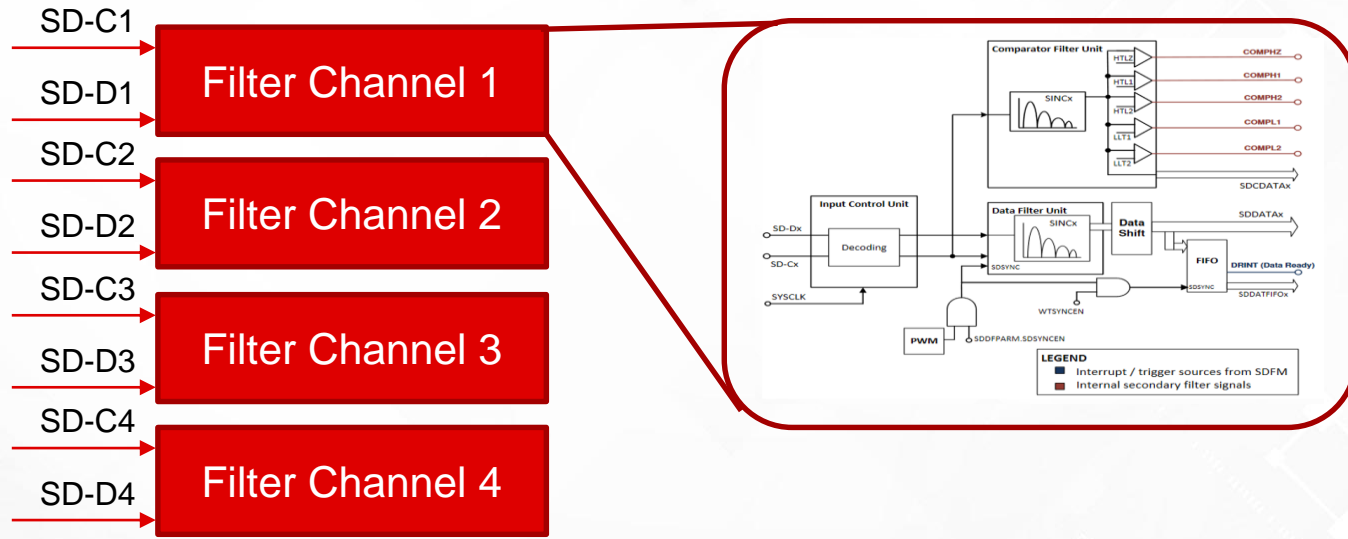


# SDFM – Type 2 Overview

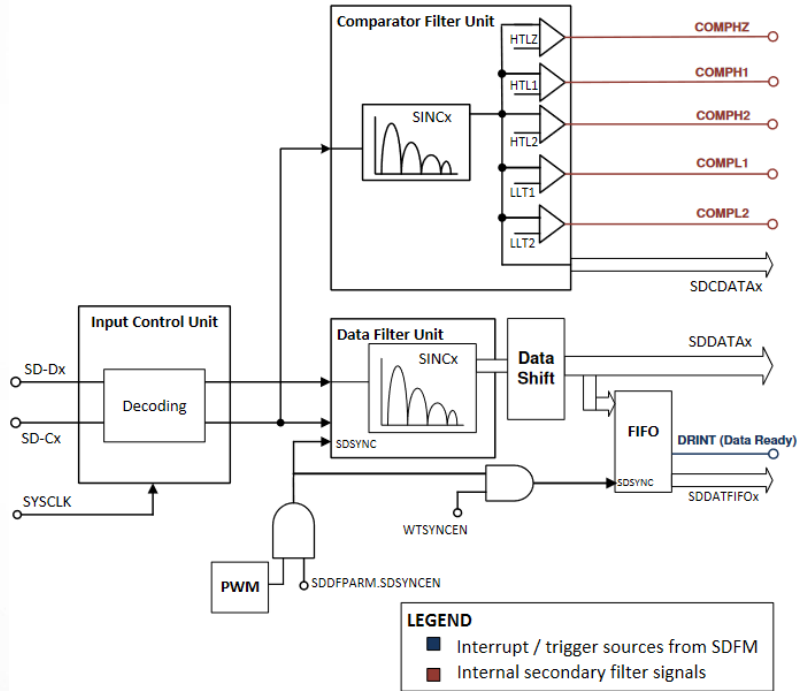
**C2000 Sigma Delta Filter Module (SDFM) Series**

# What is SDFM?

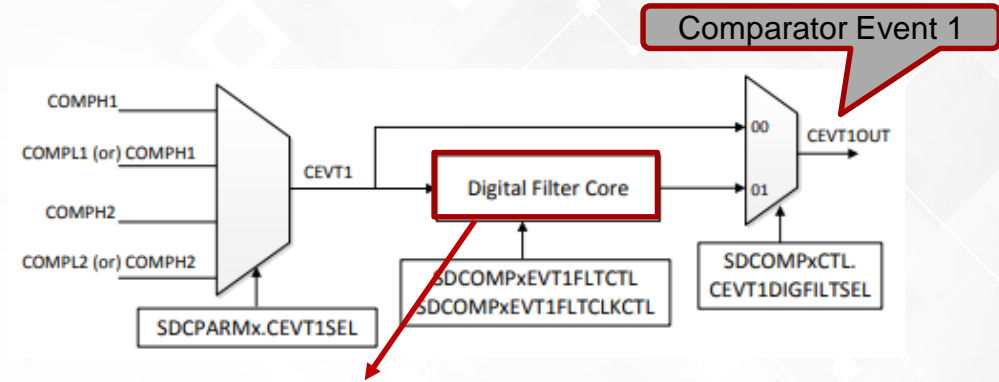
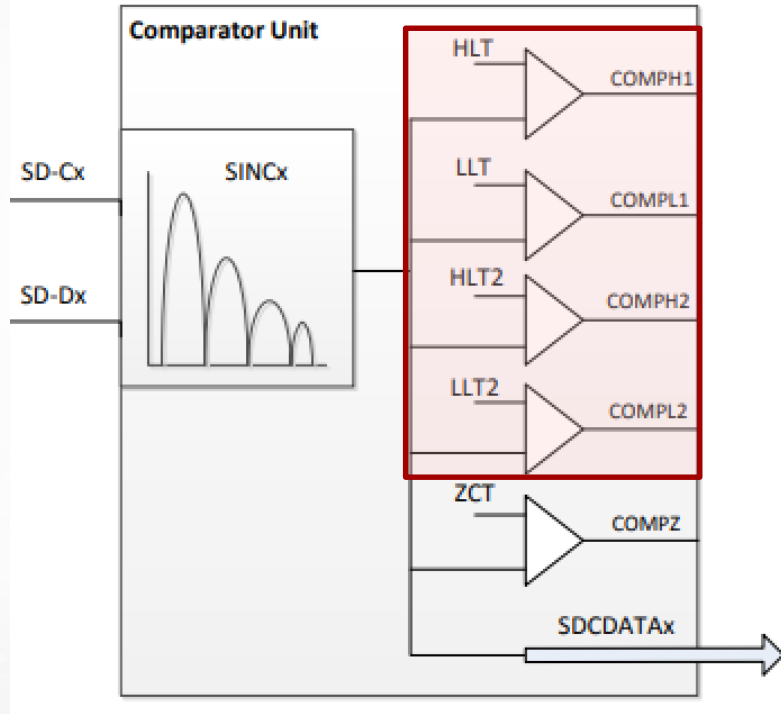
- Four-channel configurable Digital Low pass Filter based on Sinc filters
- Filter channels are identical and independently configurable
- Each filter channel has comparator filter and data filter which work on same bit stream



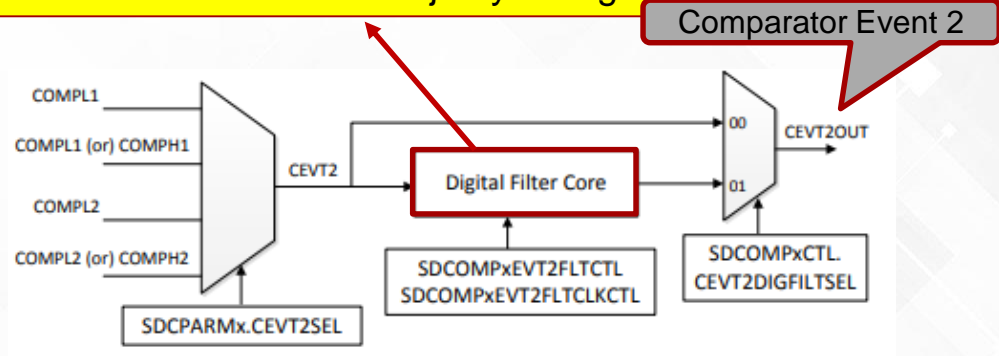
# Block Diagram of One Filter Module



# SDFM Comparator events



Digital filter core works on majority voting



# Data Filter FIFO Features

## Wait for Sync Feature

- FIFO doesn't store new filter data until SDSYNC signal is received

## Clear FIFO contents on SYNC event

- Flushes FIFO contents on SDSYNC event

## Programmable FIFO Threshold

- Ability to generate FIFO interrupt based on programmable number of data filter results

# PWM Sync (SDSYNC)

- Provide ability to use PWM to reset / synchronize data filter for exact phase adjustment
- Any PWM SOCA / SOCB events can trigger SDSYNC for any SDFM filter channel

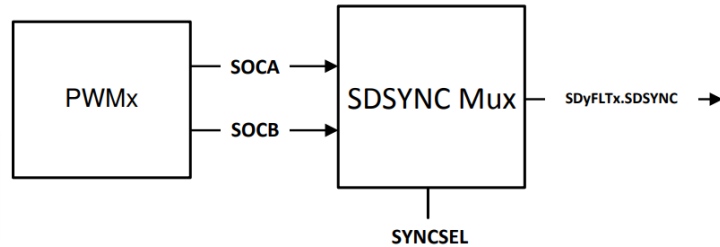


Figure 17-8. SDSYNC Event

- PWM11 and PWM12 CMPC / CMPD events can trigger SDSYNC to SDFM1 and SDFM2



# SDFM Noise immunity

**Layout Guidelines:** Best Practices for clock and data line routing and termination

## Application Report

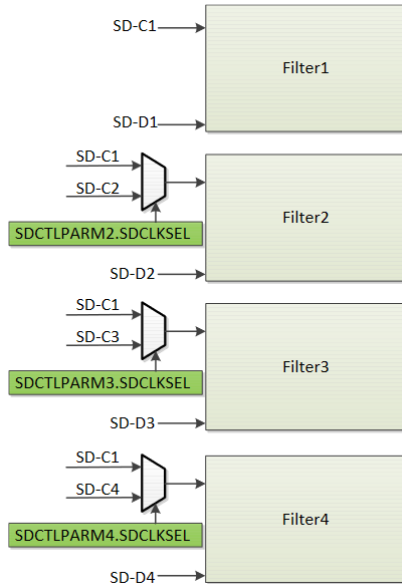
[Achieving Better Signal Integrity With Isolated Delta-Sigma Modulators in Motor Drives](#)

Improper routing schemes of clock and data signals on the PCB can create signal-integrity issues and sample and hold violations.

**Additional C2000 HW Protection:** SDFM Input Qualification feature provides protection against occasional random noise glitches

# SDFM Clock Control

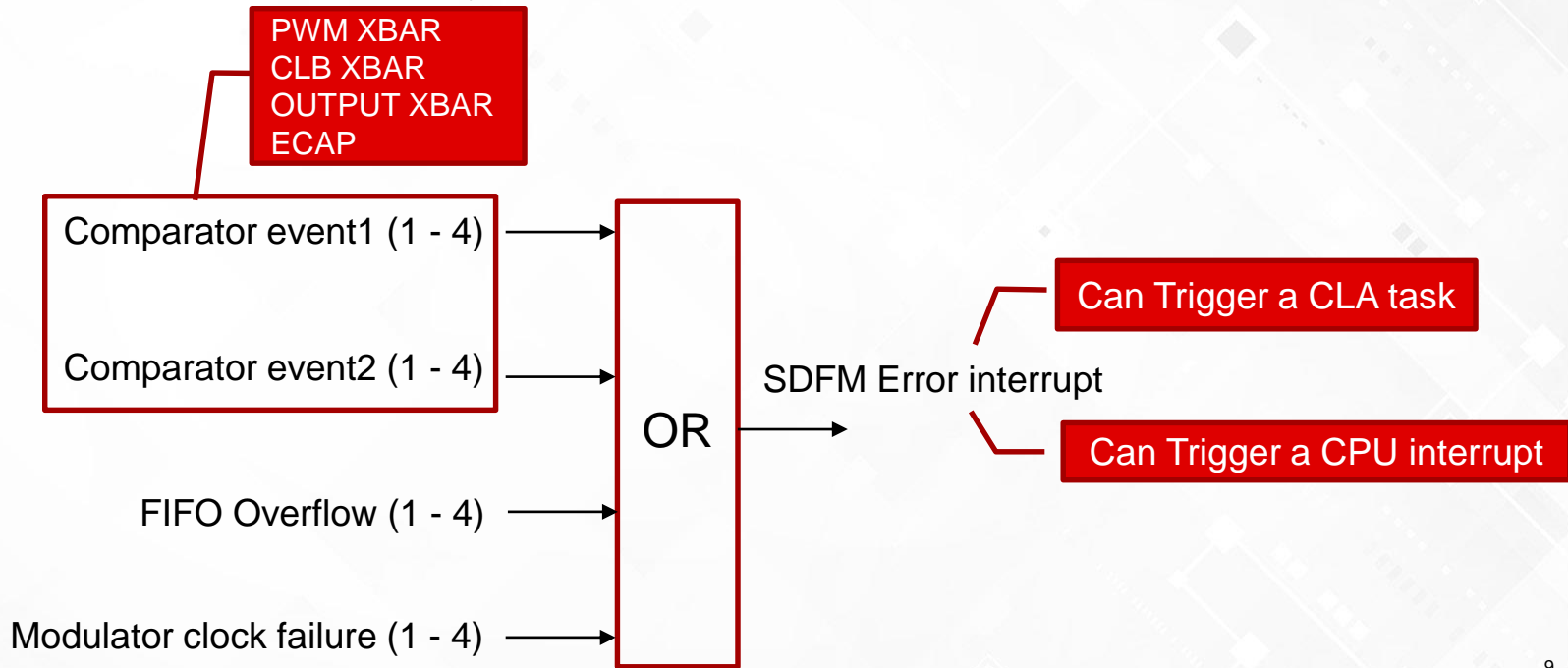
- Ability to internally route Filter Channel 1 Clock (SD-C1) to other filter channel clocks
- Provides option to save 3 GPIOs per SDFM
- Lesser Higher speed traces on PCB mitigates signal integrity issues



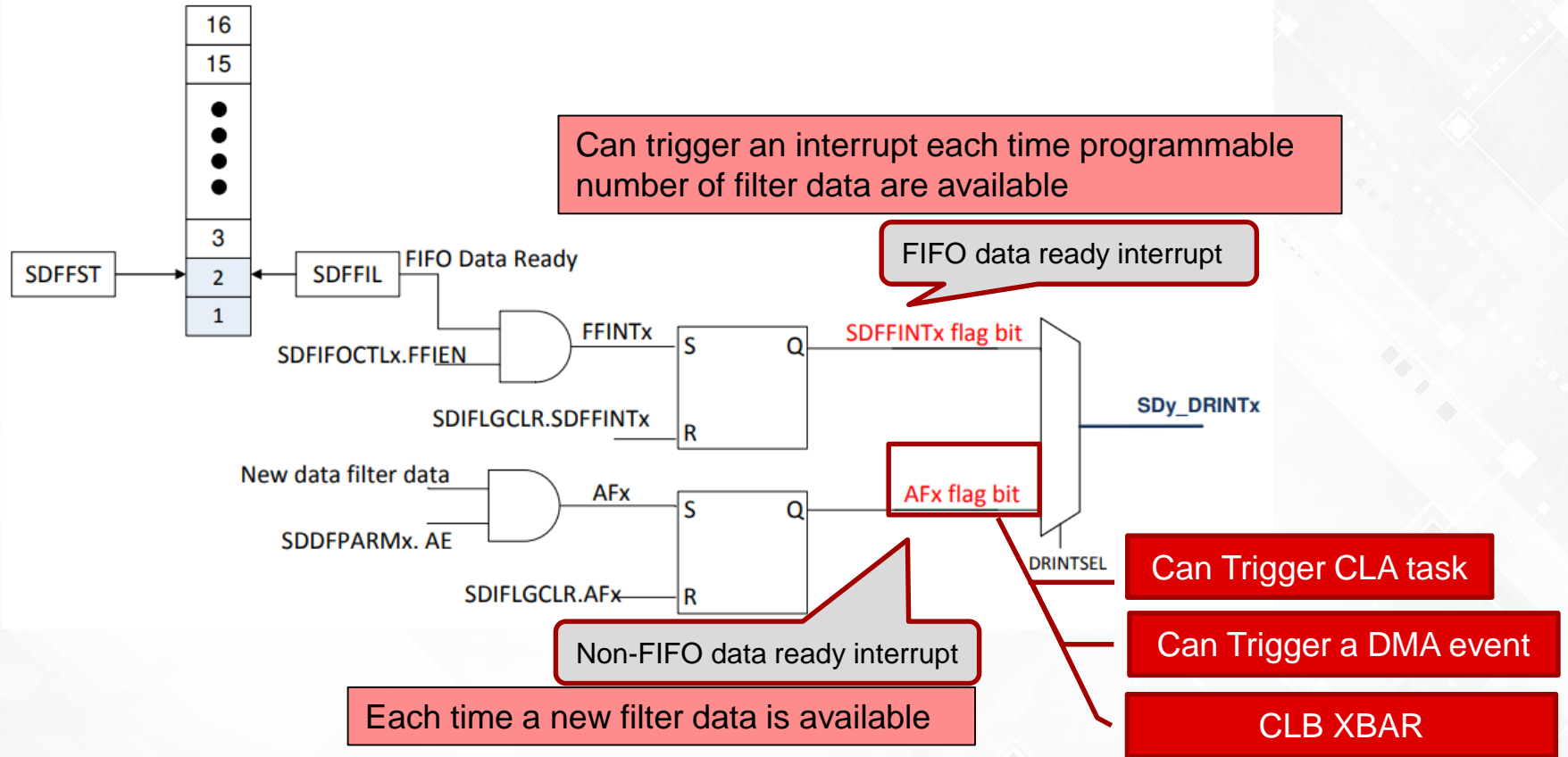


# SDFM Interrupts

- Each SDFM module can trigger upto 5 CPU interrupts
  - One SDFM Error interrupt
  - Four SDFM Data Ready interrupt



# SDFM Data Ready Interrupt



# SDFM Sysconfig support

SDFM (1 of 2 Added) + ADD REMOVE ALL

✓ mySDFM0 🗑️

Name	mySDFM0
Use Filter Channel 1	<input checked="" type="checkbox"/>
Use Filter Channel 2	<input checked="" type="checkbox"/>
Use Filter Channel 3	<input checked="" type="checkbox"/>
Use Filter Channel 4	<input checked="" type="checkbox"/>

SDCLK Source Configuration Select SDCLK for respective filter channels

Channel 1 SDCLK source	SD1 channel clock
Channel 2 SDCLK source	SD2 channel clock
Channel 3 SDCLK source	SD3 channel clock
Channel 4 SDCLK source	SD3 channel clock

FILTER Configurations

Filter1	Configure Filter1
Filter2	Configure Filter2
Filter3	Configure Filter3
Filter4	Configure Filter4

Interrupt Configurations

Use SDFM interrupts	<input type="checkbox"/>
Register Interrupts	None
PinMux Use Case	ALL
PinMux	Peripheral and Pin Configuration

Provides ability to select the filter channels to be used

SDFM Clock Control

Each filter channel has be independently configured

# SDFM Sysconfig support

FILTER Configurations

Filter1 Configure Filter1

SD Modulator mode (Mode0) Modulator clock is identical to the data rate

Enable Data Filter

Enable Comparator

ComparatorFilter Settings

FilterType Sinc3 structure

COSR 32

Data rate (us) 1.6

Latency (us) 4.8

High Level Threshold 1 32767

High Level Threshold 2 32767

Use High Threshold (Z)

High Level Threshold (Z) 32767

Low Level Threshold 1 0

Low Level Threshold 2 0

Comparator Event1 SourceSelect COMPH1 event

Use CEVT1 Digital Filter

CEVT1 Digital Filter settings

Initialize Digital Filter (CEVT1)

CEVT1 Prescale 0

CEVT1 Threshold 0

CEVT1 Sample Window 0

Comparator Event2 SourceSelect COMPL1 event

Use CEVT2 Digital Filter

CEVT2 Digital Filter settings

Initialize Digital Filter (CEVT2)

CEVT2 Prescale 0

CEVT2 Threshold 0

CEVT2 Sample Window 0

Configure Comparator filter

Data rate and Latency automatically calculated

Comparator Event 1 settings

Comparator Event 2 settings

# SDFM Sysconfig support

DataFilter Settings	
FilterType	Sinc3 structure
DOSR	256
Data rate (us)	12.8
Latency (us)	38.4
Min (Data filter output)	-16777216
Max (Data filter output)	16777216
Data Filter Output Representation	32 bits 2's complement format
Shift 32-bit filter output by x bits	10
Use PWM synchronization	<input checked="" type="checkbox"/>
SDSYNC feature Settings	
Source of SDSYNC event	PWM1 SOCA
Clear Wait for Sync flag manually?	<input type="checkbox"/>
Use FIFO	<input checked="" type="checkbox"/>
FIFO Settings	
SDFIFO interrupt level (SDFFIL)	FIFO_EMPTY
Clear FIFO on SDSYNC event?	<input type="checkbox"/>
SD_modulator_Settings	
SD Modulator Frequency (MHz)	20
Differential clipping voltage (V)	0.32
DC input to SD-modulator (V)	0
Bitstream 1's density	0.5
Theoretical Data filter Output	0
Theoretical Comparator filter Output	16384

Configure Data filter settings

Data rate and Latency automatically calculated

SDModulator settings

# SDFM Sysconfig support

Interrupt Configurations

Use SDFM interrupts

SDFM interrupt Configure SDFM interrupt

Modulator Clock failure None

Low Threshold interrupt  FILTER 1

High Threshold interrupt  FILTER 2

FIFO Overflow error  FILTER 3

FILTER 4

SDFM data ready interrupt Configure SDFM data ready interrupt

Data Acknowledge None

SDFM FIFO Interrupt  FILTER 1

FILTER 2

FILTER 3

FILTER 4

Register Interrupts

PinMux Peripheral and Pin Configuration

Sigma-Delta Peripheral	Any(SD1)
SD_C1	Any(GPIO17)
SD_D1	Any(GPIO16)
SD_C2	Any(GPIO27)
SD_D2	Any(GPIO18_X2)
SD_C3	Any(GPIO29)
SD_D3	Any(GPIO28)
SD_C4	Any(GPIO31)
SD_D4	Any(GPIO22_VFBSW)

SDFM Error interrupt

SDFM Data Ready interrupt

Configure SDFM pins

# Additional SDFM Resources

## Foundational Materials

- [How delta-sigma ADCs work, Part 1](#)
- [How delta-sigma ADCs work, Part 2](#)
- [Nuts and Bolts of the Delta-Sigma Converter](#) (video)
- [C2000 Academy](#) with Hands-on Labs

## Expert Materials

- [Achieving Better Signal Integrity With Isolated Delta-Sigma Modulators in Motor Drives](#)
- [C2000 DesignDRIVE Development Kit for Industrial Motor Control](#)
- [Isolated Current Shunt and Voltage Measurement Kit](#)
- [Three Phase Power Factor Correction Reference Design Using C2000 MCU](#)

Check Video Description for Additional Resources