ACPI for CoreSight™ 1.3

Platform Design Document

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This is an engineering draft of the specification. It is meant to obtain feedback from Arm partners and internally within Arm. It is subject to change based on this feedback.

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Release information

Date	Version	Changes
2023/Dec/10	1.3	• Remove misleading references to Compatible ID (_CID) • Introduce Scatter-Gather (SG) property for Coresight SoC 400 TMC ETR • Editorial fixes
2023/May/23	1.2	• Use of inclusive language • Fixed issues with references and added missing references • Updated graph example to match ACPI _DSD guide • Added _HID definition for Embedded Trace Extension (ETE) • Clarify in Section 2.3 that MMIO interface is mandatory only when the device is not accessible via system instructions
2019/Jul/12	1.1	• External release
2019/May/20	1.0	• Added CoreSight static funnel

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About this document

Terms and abbreviations

Term	Meaning
ACPI	The Advanced Configuration and Power Interface specification. This defines a standard for device configuration and power management by an OS
CoreSight	The CoreSight architecture provides a system-wide solution for real-time debug and collecting trace information

References

This section lists publications by Arm and by third parties.

See Arm Developer (http://developer.arm.com) for access to Arm documentation.

[1] *ARM CoreSight Architecture Specification v3.0*. See https://developer.arm.com/documentation/ihi0029/latest

[2] *_DSD Implementation Guide. UEFI Forum*. See https://github.com/UEFI/DSD-Guide

[3] *Arm® Architecture Reference Manual for A-profile architecture*. See https://developer.arm.com/documentation/ddi0487/latest

[4] *ARM CoreSight Trace Memory Controller Revision r0p1 Technical Reference Manual*. See https://developer.arm.com/documentation/ddi0461/b/

[5] *Arm CoreSight System-on-Chip SoC-600 Technical Reference Manual*. See https://developer.arm.com/documentation/100806/0200

[6] *Advanced Configuration and Power Interface Specification. UEFI Forum*. See http://uefi.org/specifications

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1 ACPI description for CoreSight trace components

This specification describes how to support CoreSight [1] trace components with the Advanced Configuaration and Power Interface (ACPI). This specification is based on the ACPI _DSD graph specification [2], which provides support for representing system components that are arranged as a set of connected devices. This is the case with CoreSight, where components might be:

- trace sources, such as a CPU ETM trace unit or an STM
- trace sinks, such as an ETB
- both, such as funnels or replicators

The following sections describe:

- The CoreSight graph structure
- Hardware identifiers (_HID) for CoreSight components
- How to represent resources for CoreSight components
- Power management and CoreSight components
- Reference example

1.1 CoreSight graph structure

Each CoreSight component is described in the namespace using a device. The component type is described by a _HID. The ID allocation for Arm IPs is described in Section 1.2.

A CoreSight device node must be declared as a child of the device that owns it. For CPUs, the CoreSight device nodes would typically be for ETM trace elements for that CPU. For devices other than CPUs, the device that is producing the trace data must also be declared in the namespace DSDT. CoreSight devices that are system-level, such as funnels or replicators, must be declared under the scope of the device that describes the system.

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The ACPI _DSD device graph format [2] must be used to describe the graph topology of the CoreSight trace system.

ACPI _DSD graphs use a UUID to indicate the specification that governs the behavior of the graph. The specification UUID for CoreSight graphs is:

- *3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd*

In addition to the rules for graphs that are imposed in [2], the following rules must be observed:

1. Link descriptors must include an additional field, called Direction, to indicate whether the originator of the link is a producer or a consumer. The format of this data is an integer. A value of 1 indicates producer, and a value of 0 indicates consumer. This property reflects the direction of data flow, and applies to the source port of a link. The source port is either an output port, in the producer case, or an input port, in the consumer case:

```
Package() { Source Port, Destination Port, Destination Device, Direction }
// Direction indicates whether source port is an output port on producer
// or input port on consumer
```

2. All output port numbers for a particular component must be unique.
3. All input port numbers for a given component must be unique.
4. A given source port cannot be used by more than one link. The port is identified by its number and by whether it is an output or input port. Thus, output port 0 and input port 0 on the same component are different ports.
5. Links must be declared in both components that are connected by that link. In the component that produces the data, the link declaration must have the direction field set to 1. This link is called the

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forward link. In the component that sinks the data, the link declaration must have the direction field set to 0. This link is called the backward link.

For example:

In the producer component, a forward link that targets the consumer component is described:

```
Device (PROD) { // Producer device
...
  Package() { 0, 1, CSMR, 1 } // Forward link declaration
  // Output port 0 is connected to
  // Input port 1 of the consumer device
  // Direction = 1 indicates that this link originates in the producer
}
```

In the consumer component, a backward link that terminates in the consumer is described:

```
Device (CSMR) { // Consumer device
...
  Package() { 1, 0, PROD, 0 } // Backward link declaration
  // Input port 1 is connected to
  // Output port 0 of the producer device
  // Direction = 0 indicates that this link terminates in the consumer
}
```

1.2 Device identifier

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Table 3 shows the hardware identifiers that are associated with architected CoreSight components.

Table 3: Hardware IDs for architected CoreSight components

Component	Identifier
Coresight ETE [3] and CoreSight-ETMv4.x [4]	ARMH C500
CoreSight-ETR [4]	ARMH C501
CoreSight-STM [4]	ARMH C502
CoreSight-Debug	ARMH C503
CoreSight-Replicator-Static(*) [4]	ARMH C985
CoreSight-Funnel-Static(*) [4]	ARMH C9FE

(*) The term static denotes lack of an MMIO interface.

Table 4 shows the IDs that are associated with Arm's CoreSight IP implementations.

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Table 4: Hardware IDs for Arm's CoreSight IP implementations

Component	Identifier	Description
CoreSight-TMC [4]	ARMH C97C	This ID describes: • SoC 400 ETB • Coresight TMC configured as ETF, ETR or ETB when integrated with Coresight SoC 400 products • CoreSight SoC 600 TMC configured as ETF, ETB or ETS **Note**: CoreSight SoC 600 TMC ETR is covered by the ETR hardware ID described in Table 3.
CoreSight-Funnel [4]	ARMH C9FF	This ID covers all CoreSight funnels except for the static funnels that are described in Table 3.
CoreSight-TPIU [4]	ARMH C979	This ID covers CoreSight TPIU products.
CoreSight-Replicator [4]	ARMH C98D	This ID covers all CoreSight replicators except for the static replicators that are described in Table 3.
CoreSight-CATU [5]	ARMH C9CA	

1.3 Resources

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Each CoreSight component must declare the resources that it owns using the _CRS method. The resources declared must include:

- The **base address** and **span** of the MMIO interface of the device, if the device cannot be accessed using system instructions. If the device can be accessed using system instructions, then providing the base address and span is optional. **Note**: For STM, two base addresses and spans must be presented, which must be provided in order. The first is the configuration base address and span, and the second is the the base address and span of the external stimuli memory region.
- Interrupts, if any, associated with the device.

1.4 Scatter-gather (SG) property for SoC-400 TMC ETR devices

Coresight SoC 400 TMC when configured as an ETR (_HID ARMHC97C) cannot work in scatter-gather (SG) mode in some systems due to hardware design constraints. Any Coresight SoC 400 TMC ETR device must indicate its support for SG mode using the Device Properties UUID for the Device Specific Data (_DSD) ACPI configuration object as specified in [2].

The Device Properties UUID as defined in [2] is: **daffd814-6eba-4d8c-8a91-bc9bbf4aa301**

The Key for the property must be **arm-armhc97c-sg-enable**, and its value can either be **0** (SG-mode disabled) or **1** (SG-mode enabled). It is illegal to use any other value.

If this device property is not specified, then OSPM can assume that SG-mode cannot be reliably enabled in this platform.

An example which indicates that SG mode can be enabled is shown below:

```
Device (ETR0) {
  Name (_HID, "ARMHC97C")   // SoC 400 TMR ETR
  ...
  Name (_DSD, Package () {
```


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```
      ToUUID("daffd814-6eba-4d8c-8a91-bc9bbf4aa301"),
      Package (2) {"arm-armhc97c-sg-enable", 1}       // Enable SG-mode
    })
  ...
}
```

Note

Coresight SoC 600 TMC ETRs are not affected by this issue, and must not use this property.

1.5 Power

Where necessary, devices declared in the namespace to describe CoreSight components can use standard power methods (_PSx, _PRx). If _PR0 is implemented for a given device, the OSPM must ensure that the power resources it lists are in the ON state before the associated CoreSight component is used. Presenting a _PR0 also allows an OSPM to prevent entry into Lower Power Idle states that might turn off the resources associated with the CoreSight component, if the DSDT supplies _LPI and _RDI methods for those resources. Equivalently, if _PS0 is implemented, the OSPM must invoke the method before the associated CoreSight component is used.

1.6 Example

Consider the example system shown in the following figure:

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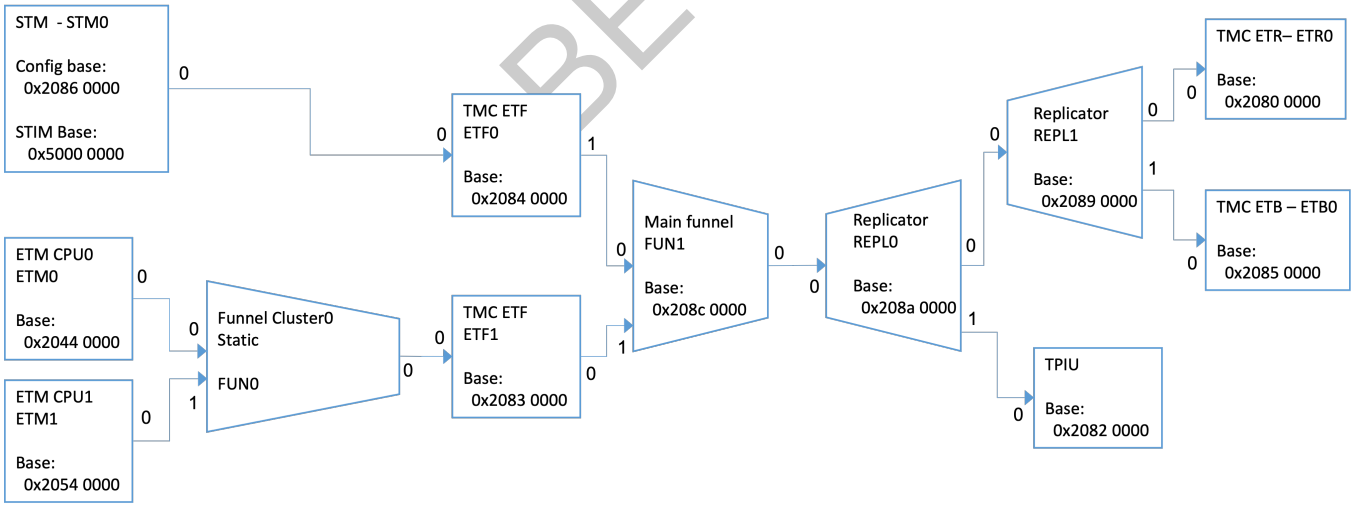

Figure 1: Example system

This example system can be described by the following ASL code:

```
Scope(\_SB) {

  Device (CLU0) { // Cluster0 state
    Name(_HID, "ACPI0010")
    ...
    Device (CPU0) { // CPU0
      Name(_HID, "ACPI0007")
```


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```
  ...
  Device (ETM0) { // ETM on CPU0
    Name (_HID, "ARMHC500")
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x20440000, 0x1000)
    })

    Name (_DSD, Package () {
      ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
      Package () {
        0,    // Revision
        1,    // Number of graphs
        Package () {
          1, // GraphID // CoreSight graph UUID
          ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
          1, // Number of links

          // Forward link between ETM0 and FUN0
          Package() {0, 0,       // output port 0 to connected
              \_SB.CLU0.FUN0, 1}  // to input port 0 on FUN0

      }
    })
...
}

Device (CPU1) { // CPU1
  Name(_HID, "ACPI0007")
  ...
  Device (ETM1) { // ETM on CPU0
    Name (_HID, "ARMHC500")
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x20540000, 0x1000)
    })

    Name (_DSD, Package () {
      ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
      Package () {
        0,    // Revision
        1,    // Number of graphs
        Package () {
          1, // GraphID // CoreSight graph UUID
          ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
          1, // Number of links

          // Forward link between ETM1 and FUN0
          Package() {0, 1,        // output port 0 to connected
              \_SB.CLU0.FUN0, 1}   // to input port 1 on FUN0
      }
    })
  }
...
} // End of CPU1

Device (FUN0) { // Funnel 0 described in cluster 0 scope
  Name (_HID, "ARMHC9FF")

  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
```


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```
            0,    // Revision
            1,    // Number of graphs
            Package () {
               1, // GraphID // CoreSight graphs UUID
               ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
               3, // Number of links

               // Backward link between FUN0 and ETM0
               Package() {0, 0,              // input port 0 connected
                    \_SB.CLU0.CPU0.ETM0, 0}, // to output port 0 on ETM0

               // Backward link between FUN0 and ETM1
               Package() {1, 0,              // input port 1 to connected
                    \_SB.CLU0.CPU1.ETM1, 0}, // to output  port 0 on ETM1

              // Forward link between FUN0 and ETF1
               Package() {0, 0,             // output port 0 connected
                    \_SB.ETF1, 1}           // to input port 0 on ETF1
            }
         })
    }

...
}  // end of cluster0


Device (ETF1) { // ETF at 0x20830000 described \SB scope
    Name (_HID, "ARMHC97C")
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x20830000, 0x1000)
    })

    Name (_DSD, Package () {
      ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
      Package () {
        0,    // Revision
        1,    // Number of graphs
        Package () {
           1, // GraphID // CoreSight graphs UUID
           ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
           2, // Number of links

           // Forward link between ETF1 and FUN1
           Package() {0, 1,        // output port 0 connected
                \_SB.FUN1, 1},     // to input port 1 on FUN1.

          // Backward link between ETF1 and FUN0
           Package() {0, 0,         // input port 0 connected
                \_SB.CLU0.FUN0, 0}  // to output port 0 on FUN0.
          }
      }
    })
}



Device (STM0) { // STM0
    Name (_HID, "ARMHC502")  // STM
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x20860000, 0x1000)
```


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```
    Memory32Fixed(ReadWrite, 0x50000000, 0x1800000) // stimulus
  })

  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
      0,    // Revision
      1,    // Number of graphs
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         1, // Number of links

         // Forward link between STM0 and ETF0
         Package() {0, 0,    // output port 0 connected
              \_SB.ETF0, 1}  // to output port 0 on ETF0.
       }
    }
  })
}


Device (ETF0) { // ETF at 0x20840000 described \SB scope
  Name (_HID, "ARMHC97C")
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x20840000, 0x1000)
  })

  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
      0,    // Revision
      1,    // Number of graphs
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         2, // Number of links

         // Forward link between ETF0 and FUN1
         Package() {0, 0,    // output port 0 connected
              \_SB.FUN1, 1}, // to input port 0 on FUN1.

         // Backward link between ETF0 and STM0
         Package() {0, 0,    // input port 0 connected
              \_SB.STM0, 0}  // to output port 0 on STM0.
       }
    }
  })
}


Device (FUN1) { // Funnel 1 described in \SB scope
  Name (_HID, "ARMHC9FF")
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x208c0000, 0x1000)
  })

  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
```


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```
        0,    // Revision
        1,    // Number of graphs
        Package () {
           1, // GraphID // CoreSight graphs UUID
           ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
           3, // Number of links

           // Forward link between FUN1 and RPL0
           Package() {0, 0,    // output port 0 connected
                \_SB.RPL0, 1}, // to input port 0 on RPL0.

           // Forward link between FUN1 and ETF0
           Package() {0, 0,    // input port 0 connected
                \_SB.ETF0, 0}, // to output port 0 on ETF0.

           // Backward link between FUN1 and ETF1
           Package() {1, 0,    // input port 1 connected
                \_SB.ETF1, 0}  // to output port 0 on ETF1.
         }
      }
    })
  }

  Device (RPL0) { // Replicator 0 described in \SB scope
    Name (_HID, "ARMHC98D")
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x208a0000, 0x1000)
    })

    Name (_DSD, Package () {
      ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
      Package () {
        0,    // Revision
        1,    // Number of graphs
        Package () {
           1, // GraphID // CoreSight graphs UUID
           ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
           3, // Number of links

           // Forward link between RPL0 and RPL1
           Package() {0, 0,    // output port 0 connected
                \_SB.RPL1, 1}, // to input to port 0 on RPL1.

           // Forward link between RPL0 and TPIU
           Package() {1, 0,    // output port 1 connected
                \_SB.TPIU, 1}, // to input port 0 on TPIU.

           // Backward link between RPL0 and FUN1
           Package() {0, 0,    // input port 0 connected to
                \_SB.FUN1, 0}  // to output port 0 on FUN1.
         }
      }
    })

  }

  Device (TPIU) { // TPIU described in \SB scope
    Name (_HID, "ARMHC979")
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x20820000, 0x1000)
```


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```
  })


  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
      0,    // Revision
      1,    // Number of graphs
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         1, // Number of links

         // Forward link between TPIU and RPL0
         Package() {0, 1,    // input port 0 connected
              \_SB.RPL0, 0}  // to output  port 1 on RPL0.
       }
    }
  })
}

Device (RPL1) { // Replicator 1 described in \SB scope
  Name (_HID, "ARMHC98D")
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x20890000, 0x1000)
  })

  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
      0,    // Revision
      1,    // Number of graphs
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         3, // Number of links

         // Forward link between RPL1 and ETR0
         Package() {0, 0,    // output port 0 connected
              \_SB.ETR0, 1}, // to input port 0 on ETR0.

         // Forward link between RPL1 and ETB0
         Package() {1, 0,    // output port 1 connected
              \_SB.ETB0, 1}, // to input port 0 on ETB0.

         // Backward link between RPL1 and RPL0
         Package() {0, 0,    // input port 0 connected
              \_SB.RPL0, 0}  // to output port 0 on RPL0.
       }
    }
  })
}

Device (ETR0) { // ETR0 described in \SB scope
  Name (_HID, "ARMHC501")
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x208000000, 0x1000)
  })

  Name (_DSD, Package () {
```


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```
      ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
      Package () {
        0,    // Revision
        1,    // Number of graphs
        Package () {
           1, // GraphID // CoreSight graphs UUID
           ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
           1, // Number of links

           // Backward link between ETR0 and RPL1
           Package() {0, 0,    // input port 0 connected
                \_SB.RPL1, 0}  // to output port 0 on RPL1.
         }
      }
    })
  }

  Device (ETB0) { // ETB0 described in \SB scope
    Name (_HID, "ARMHC97C")
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x20850000, 0x1000)
    })

    Name (_DSD, Package () {
      ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
      Package () {
        0,    // Revision
        1,    // Number of graphs
        Package () {
           1, // GraphID // CoreSight graphs UUID
           ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
           1, // Number of links

           // Backward link between ETB0 and RPL1
           Package() {0, 1,    // input port 0 connected
                \_SB.RPL1, 0}  // to output port 1 on RPL1.
         }
      }
  }
...
}
```


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