ACPI for CoreSight[™] 1.1

Platform Design Document Non-confidential



Contents

	Rele	ase information	3
Ar	m No	n-Confidential Document Licence ("Licence")	4
1	Abo	ut this document	6
	1.1	Terms and abbreviations	6
	1.2	References	6
	1.3	Feedback	6
2	ACP	I description for CoreSight trace components	7
	2.1	CoreSight graph structure	7
	2.2	Device identifier	8
	2.3	Resources	8
	2.4	Power	9
	2.5	Example	9

Copyright © 2019 Arm Limited. All rights reserved.

Release information

Date	Version	Changes
2019/Jul/12	1.1	External release
2019/May/20	1.0	Added CoreSight static funnel
2019/Feb/15	1.0	EAC release

Arm Non-Confidential Document Licence ("Licence")

This Licence is a legal agreement between you and Arm Limited ("**Arm**") for the use of the document accompanying this Licence ("**Document**"). Arm is only willing to license the Document to you on condition that you agree to the terms of this Licence. By using or copying the Document you indicate that you agree to be bound by the terms of this Licence. If you do not agree to the terms of this Licence, Arm is unwilling to license this Document to you and you may not use or copy the Document.

"**Subsidiary**" means any company the majority of whose voting shares is now or hereafter owner or controlled, directly or indirectly, by you. A company shall be a Subsidiary only for the period during which such control exists.

This Document is **NON-CONFIDENTIAL** and any use by you and your Subsidiaries ("Licensee") is subject to the terms of this Licence between you and Arm.

Subject to the terms and conditions of this Licence, Arm hereby grants to Licensee under the intellectual property in the Document owned or controlled by Arm, a non-exclusive, non-transferable, non-sub-licensable, royalty-free, worldwide licence to:

- (i) use and copy the Document for the purpose of designing and having designed products that comply with the Document;
- (ii) manufacture and have manufactured products which have been created under the licence granted in (i) above; and
- (iii) sell, supply and distribute products which have been created under the licence granted in (i) above.

Licensee hereby agrees that the licences granted above shall not extend to any portion or function of a product that is not itself compliant with part of the Document.

Except as expressly licensed above, Licensee acquires no right, title or interest in any Arm technology or any intellectual property embodied therein.

THE DOCUMENT IS PROVIDED "AS IS". ARM PROVIDES NO REPRESENTATIONS AND NO WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY, SATISFACTORY QUALITY, NON-INFRINGEMENT OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE DOCUMENT. Arm may make changes to the Document at any time and without notice. For the avoidance of doubt, Arm makes no representation with respect to, and has undertaken no analysis to identify or understand the scope and content of, third party patents, copyrights, trade secrets, or other rights.

NOTWITHSTANING ANYTHING TO THE CONTRARY CONTAINED IN THIS LICENCE, TO THE FULLEST EXTENT PETMITTED BY LAW, IN NO EVENT WILL ARM BE LIABLE FOR ANY DAMAGES, IN CONTRACT, TORT OR OTHERWISE, IN CONNECTION WITH THE SUBJECT MATTER OF THIS LICENCE (INCLUDING WITHOUT LIMITATION) (I) LICENSEE'S USE OF THE DOCUMENT; AND (II) THE IMPLEMENTATION OF THE DOCUMENT IN ANY PRODUCT CREATED BY LICENSEE UNDER THIS LICENCE). THE EXISTENCE OF MORE THAN ONE CLAIM OR SUIT WILL NOT ENLARGE OR EXTEND THE LIMIT. LICENSEE RELEASES ARM FROM ALL OBLIGATIONS, LIABILITY, CLAIMS OR DEMANDS IN EXCESS OF THIS LIMITATION.

This Licence shall remain in force until terminated by Licensee or by Arm. Without prejudice to any of its other rights, if Licensee is in breach of any of the terms and conditions of this Licence then Arm may terminate this Licence immediately upon giving written notice to Licensee. Licensee may terminate this Licence at any time. Upon termination of this Licence by Licensee or by Arm, Licensee shall stop using the Document and destroy all copies of the Document in its possession. Upon termination of this Licence, all terms shall survive except for the licence grants.

Any breach of this Licence by a Subsidiary shall entitle Arm to terminate this Licence as if you were the party in breach. Any termination of this Licence shall be effective in respect of all Subsidiaries. Any rights granted to any Subsidiary hereunder shall automatically terminate upon such Subsidiary ceasing to be a Subsidiary.

The Document consists solely of commercial items. Licensee shall be responsible for ensuring that any use, duplication or disclosure of the Document complies fully with any relevant export laws and regulations to assure that the Document or any portion thereof is not exported, directly or indirectly, in violation of such export laws.

If any of the provisions contained in this Licence conflict with any of the provisions of any click-through or signed written agreement with Arm relating to the Document, then the click-through or signed written agreement prevails over and supersedes the conflicting provisions of this Licence. This Licence may be translated into other languages for convenience, and Licensee agrees that if there is any conflict between the English version of this Licence and any translation, the terms of the English version of this Licence shall prevail.

The Arm corporate logo and words marked with ® or ™ are registered trademarks or trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere. All rights reserved. Other brands and names mentioned in this document may be the trademarks of their respective owners. No licence, express, implied or otherwise, is granted to Licensee under this Licence, to use the Arm trade marks in connection with the Document or any products based thereon. Visit Arm's website at http://www.arm.com/company/policies/ trademarks for more information about Arm's trademarks.

The validity, construction and performance of this Licence shall be governed by English Law.

Copyright © 2019 Arm Limited (or its affiliates). All rights reserved.

Arm Limited. Company 02557590 registered in England.

110 Fulbourn Road, Cambridge, England CB1 9NJ.

Arm document reference: LES-PRE-21585

1 About this document

1.1 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

1.2 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://static.docs.arm.com/ihi0029/e/coresight_v3_ 0_architecture_specification_IHI0029E.pdf

[2] Device Graphs. Using _DSD to represent arbitrary graphs DSD based graphs. UEFI Forum. See https://uefi.org/acpi

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

1.3 Feedback

Arm welcomes feedback on its documentation.

If you have comments on the content of this manual, send an e-mail to errata@arm.com. Give:

- The title (ACPI for CoreSight).
- The document ID and version (DEN0067 1.1).
- The page numbers to which your comments apply.
- A concise explanation of your comments.

Arm also welcomes general suggestions for additions and improvements.

2 ACPI description for CoreSight trace components

This specification describes how to support CoreSight [1] trace components with the Advanced Configuration 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:

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

The following sections describe:

- The CoreSight graph structure
- Device identifiers, _CID and _HID, for CoreSight components
- · How to represent resources for CoreSight components
- Power management and CoreSight components
- Reference example

2.1 CoreSight graph structure

Each CoreSight component is described in the namespace using a device. The component type is described by a _CID, and individual implementations can use a _HID. The ID allocation is described in Section 2.2.

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, are declared under the system bus scope (\SB).

To describe the graph topology of the CoreSight trace system, the _DSD device graph format must be used [2]. 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. Links must include an additional piece of data to indicate whether the originator of the link is a master or a slave. The format of this data is an integer. A value of 1 indicates master, and a value of 0 indicates slave. This property reflects the direction of data flow, and applies to the source port of a link. The port is either an output port, in the master case, or an input port, in the slave case.
- 2. All master port numbers for a particular component must be unique.
- 3. All slave 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 master or slave. Thus, master port 0 and slave port 0 are different ports.
- 5. Links must be declared in both of the components that are connected. In the component that produces the data, the link is declared as a master. In the component that sinks the data, the link is declared as a slave. For example:

In the producer component, there will be a master link described that targets the consumer component:

Package() { 0, 1, SINK , 1} // output port 0 connected to // input port 1 of SINK

In the consumer component, the link is a slave that goes in the reverse direction:

```
Package() { 1, 0, ETM0 , 0} // input port 1 to connected to 
// output port 0 of ETM0
```

2.2 Device identifier

Table 3 shows the compatible IDs that are associated with CoreSight architectures.

Table 3:	Compatible	IDs for	CoreSight	components
----------	------------	---------	-----------	------------

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

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

Table 4: Hardware IDs for CoreSight Arm implementations

Component	Identifier	Description	
CoreSight-TMC	ARMH C97C	This ID covers ETF, ETR, and ETB for CoreSight TMC 400 products, and CoreSight ETF, ETB for CoreSight TMC 600 products. CoreSight TMC 600 ETR is covered but the ETR compatible ID described in Table 3.	
CoreSight-Funnel	ARMH C9FF	This ID covers all CoreSight funnels except for the static funnels that are described in Table 3.	
CoreSight-TPIU	ARMH C979	This ID covers CoreSight TPIU products.	
CoreSight-Replicator	ARMH C98D	This ID covers all CoreSight replicators except for the static replicators that are described in Table 3.	
CoreSight-CATU	ARMH C9CA		

2.3 Resources

Each CoreSight component must declare the resources that it owns using the _CRS method. The method must include the base address and span of the MMIO interface of the device. Also, those components that can raise interrupts must describe the interrupts they consume.

For STM, two base addresses must be presented, which must be provided in order. The first is the configuration base address, and the second is the the base address the external stimuli memory region.

2.4 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.

2.5 Example



Consider the example system shown in the following figure:

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 (CPUO) { // CPUO
      Name(_HID, "ACPI0010")
      . . .
      Device (ETMO) { // ETM on CPUO
        Name (_HID, "ARMHC500")
        Name(_CRS, ResourceTemplate () {
          Memory32Fixed(ReadWrite, 0x20440000, 0x1000)
        })
        Name (_DSD, Package () {
          ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
          Package () {
            Ο,
                  // Revision
```

```
// Number of graphs
       1,
       Package () {
         1, // GraphID // CoreSight graph UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         1, // Number of links
         Package() {0, 0,
                                // output port 0 to connected
             \_SB.CLUO.FUNO,1} // to input port 0 on FUNO
     }
   })
. . .
}
Device (CPU1) { // CPU1
 Name(_HID, "ACPI0010")
  . . .
 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
             // Number of graphs
       1,
       Package () {
         1, // GraphID // CoreSight graph UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         1, // Number of links
         Package() {0, 1,
                                 // output port 0 to connected
             \_SB.CLU0.FUN0,1} // to input port 1 on FUN0
     }
   })
 }
} // End of CPU1
Device (FUNO) { // Funnel 0 described in cluster 0 scope
 Name (_HID, "ARMHC9FF")
 Name (_CID, "ARMHC500")
  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
     Ο,
           // Revision
     1,
           // Number of graphs
     Package () {
        1, // GraphID // CoreSight graphs UUID
        ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
        3, // Number of links
        Package() {0, 0,
                                    // input port 0 connected
              SB.CLU0.CPU0.ETM0,0},// to output port 0 on ETMO
        Package() {1, 0,
                                    // input port 1 to connected
             Package() {0, 0,
                                    // to input port 0 on ETM1
             \ SB.ETF1,1
     }
   })
}
```

```
} // end of cluster0
Device (ETF1) { // ETF at 0x20830000 described \SB scope
  Name (_HID, "ARMHC97C")
Name (_CID, "ARMHC500")
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x20830000, 0x1000)
  })
  Name (_DSD, Package () {
    ToUUID ("ab02a46b -74c7 -45a2 -bd68 -f7d344ef2153"),
    Package () {
            // Revision
      Ο,
            // Number of graphs
      1,
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         2, // Number of links
         Package() {0, 1,
                                 // output port 0 connected
              \ SB.FUN1,1\},
                                 // to input port 1 on FUN1.
         Package() {0, 0,
                                 // input port 0 connected
              \_SB.CLUO.FUNO,0} // to output port 0 on FUNO.
        }
    }
 })
}
Device (STMO) { // STMO
  Name (_CID, "ARMHC502") // STM
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x20860000, 0x1000)
    Memory32Fixed(ReadWrite, 0x50000000, 0x1800000) // stimulus
  })
  Name (_DSD, Package () {
    ToUUID ("ab02a46b -74c7-45a2-bd68-f7d344ef2153"),
    Package () {
         // Revision
      Ο,
            // Number of graphs
      1,
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         1, // Number of links
         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 (_CID, "ARMHC500")
  Name(_CRS, ResourceTemplate () {
```

```
Memory32Fixed(ReadWrite, 0x20840000, 0x1000)
  })
  Name (_DSD, Package () {
    ToUUID ("ab02a46b -74c7 -45a2 -bd68 -f7d344ef2153"),
    Package () {
      Ο,
            // Revision
            // Number of graphs
      1,
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         2, // Number of links
         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 (_CID, "ARMHC500")
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x208c0000, 0x1000)
  })
  Name (_DSD, Package () {
    ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
    Package () {
      0,
         // Revision
            // Number of graphs
      1,
      Package () {
         1, // GraphID // CoreSight graphs UUID
         ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
         3, // Number of links
         Package() {0, 0, // output port 0 connected
              \_SB.RPL0,1}, // to input port 0 on RPL0.
         Package() {0, 0, // input port 0 connected
              \_SB.ETF0,0}, // to output port 0 on ETF0.
         Package() {1, 0, // input port 1 connected
              \_SB.ETF1,0} // to output port 0 on ETF1.
        }
    }
 })
}
Device (RPLO) { // Replicator O described in \SB scope
  Name (_HID, "ARMHC98D")
Name (_CID, "ARMHC502")
  Name(_CRS, ResourceTemplate () {
    Memory32Fixed(ReadWrite, 0x208a0000, 0x1000)
  })
  Name (_DSD, Package () {
    ToUUID ("ab02a46b -74c7 -45a2 -bd68 -f7d344ef2153"),
    Package () {
           // Revision
      Ο,
```

```
// Number of graphs
     1.
     Package () {
        1, // GraphID // CoreSight graphs UUID
        ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
        3, // Number of links
        Package() {0, 0,
                         // output port 0 connected
             \_SB.RPL1,1}, // to input to port 0 on RPL1.
        }
   }
 })
}
Device (TPIU) { // TPIU described in \SB scope
 Name (_HID, "ARMHC979")
 Name (_CID, "ARMHC501")
 Name(_CRS, ResourceTemplate () {
   Memory32Fixed(ReadWrite, 0x20820000, 0x1000)
 })
 Name (_DSD, Package () {
   ToUUID ("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
   Package () {
     Ο,
          // Revision
     1,
          // Number of graphs
     Package () {
        1, // GraphID // CoreSight graphs UUID
        ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
        1, // Number of links
        Package() {0, 1, // input port 0 connected
             \_SB.RPL0,0} // to output port 1 on FUN1.
       }
   }
 })
}
Device (RPL1) { // Replicator 1 described in \SB scope
 Name (_HID, "ARMHC98D")
 Name (_CID, "ARMHC502")
 Name(_CRS, ResourceTemplate () {
   Memory32Fixed(ReadWrite, 0x20890000, 0x1000)
 })
 Name (_DSD, Package () {
   ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
   Package () {
     Ο,
          // Revision
          // Number of graphs
     1,
     Package () {
        1, // GraphID // CoreSight graphs UUID
        ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
        3, // Number of links
        Package() {1, 0, // output port 1 connected
```

```
\_SB.ETB0,1}, // to input port 0 on ETB0.
           Package() {0, 0, // input port 0 connected
                 \_SB.RPL0,0} // to output port 0 on RPL0.
          }
      }
   })
 }
  Device (ETRO) { // ETRO described in \SB scope
    Name (_CID, "ARMHC501")
    Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x208000000, 0x1000)
    })
    Name (_DSD, Package () {
      ToUUID ("ab02a46b -74c7 -45a2 -bd68 -f7d344ef2153"),
      Package () {
              // Revision
        Ο,
              // Number of graphs
        1,
        Package () {
           1, // GraphID // CoreSight graphs UUID
           ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
           1, // Number of links
           Package() {0, 0, // input port 0 connected
                 \_SB.RPL1,0} // to output port 0 on RPL1.
          }
      }
    })
 }
  Device (ETBO) { // ETBO described in \SB scope
    Name (_HID, "ARMHC97C")
Name (_CID, "ARMHC500")
Name(_CRS, ResourceTemplate () {
      Memory32Fixed(ReadWrite, 0x20850000, 0x1000)
    })
    Name (_DSD, Package () {
      ToUUID("ab02a46b-74c7-45a2-bd68-f7d344ef2153"),
      Package () {
        Ο,
              // Revision
              // Number of graphs
        1,
        Package () {
           1, // GraphID // CoreSight graphs UUID
           ToUUID("3ecbc8b6-1d0e-4fb3-8107-e627f805c6cd"),
           1, // Number of links
           Package() {0, 1, // input port 0 connected
                 \_SB.RPL1,0} // to output port 1 on RPL1.
          }
      }
 }
. . .
}
```