



January 24 - 26, 2023
DoubleTree by Hilton San Jose
ChipletSummit.com

Using a Markup Language in Chiplet-Based Design

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James Wong, CTO, Palo Alto Electron
David Ratchkov, CTO, Anemoi Software
Anthony Mastroianni, Director, Siemens
Jawad Nasrullah, CEO, Palo Alto Electron



Chiplet Design Needs a Standard

- Important of chipletization:
 - Single chip designs are hitting a limit
 - Enables the continuity of Moore's Law
 - Improve yield
 - Reusable IP - same chiplet can be reused in many different designs
 - Heterogeneous integration - putting chiplets with different processes nodes together
 - KGD - chiplets can be tested before assembly
- Design of a chiplet-based system needs standard chiplet data specification to address the following challenges:
 - Integration of multi-chips with different IPs, nodes and technologies
 - Die-to-Die (D2D) interfaces integrations such as BOW, UCIe, OpenHBI, AIB
 - Power distribution to the chiplets
 - Thermal dissipation at the system level simulation and verification
 - Built-in self-test (BiST) in Chiplets to be usable in the system
 - Operation conditions of the chiplets
 - Handling of sensitivity/robustness of the chiplets such as ESD

Open Standard Proposal

- Chiplet Data eXchange Markup Language (CDXML) open standard is being developed at Chiplet Design Exchange (CDX) Workstream of Open Domain-Specific Architecture (ODSA) within the Open Compute Project (OCP) in collaboration with Industry Leaders
- It is adopted the zGlue Chiplet Info Exchange Format (ZEF) open source model.
- Chiplets data are defined in a standardized XML format with a **schema**
- The XML data contains the following information of a chiplet:
 - Mechanical information
 - IO information
 - Electrical information
 - Assembly information
 - D2D interfaces information
 - Power and thermal information

OCP-JEDEC Collaboration

- Collaboration between OCP and JEDEC for integrating the CDXML and JEDEC/JEP30, with representatives from JEDEC such as Michael Durkan (Director, Siemens), and other JEDEC members:
 - Integrate CDXML as part of the JEDEC/JEP30 Part Model
 - All CDXML fields are mapping into the JEP30
 - Target release later this year
 - An XSLT program will be created to transform between Integrated JEP 30-CDXML and CDXML
- CDXML chiplet-specific format is being developed within the CDX/CDXML workstream of OCP/ODSA group
- The workstream holds biweekly meetings on Thursdays and all interested parties are welcome to join

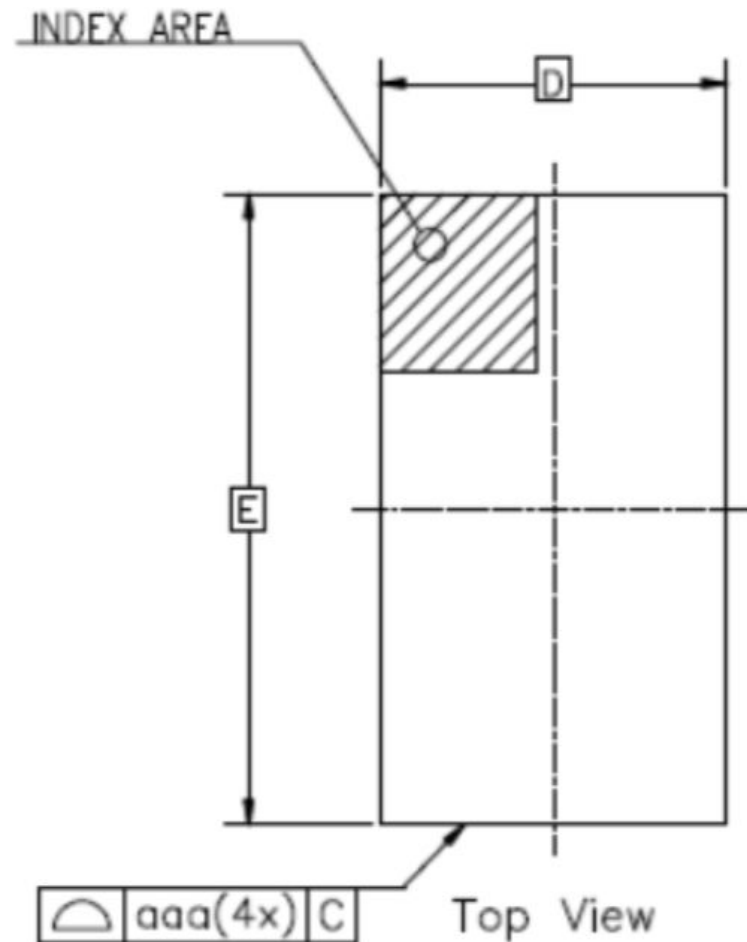
Format Structure

- The schema.xsd XSD file defines the schema. The filename will follow the format of Manufacturer's Part Number <MPN>.xml, example: ZGL12345FC.xml.
- CDXML contains the data file, XML and the schema, XSD.
- The CDXML.xsd defines the schema for the XML file for each chiplet.
- The filename will follow the format of <MPN>.xml. MPN stands for Manufacturer's Part Number which is a unique product identifier, example: ZGL12345FC.xml.
- The consists of general chiplet information and three main sections such as mechanical, electrical and IO. Most of this information can be found in the datasheets.
- The general information are:
 - MPN
 - OPN
 - Version
 - Authors
 - Type
 - Manufacturer
 - smt_compatible

Mechanical

Mechanical describes all chiplet sizes, soldering type, material properties and etc. such as:

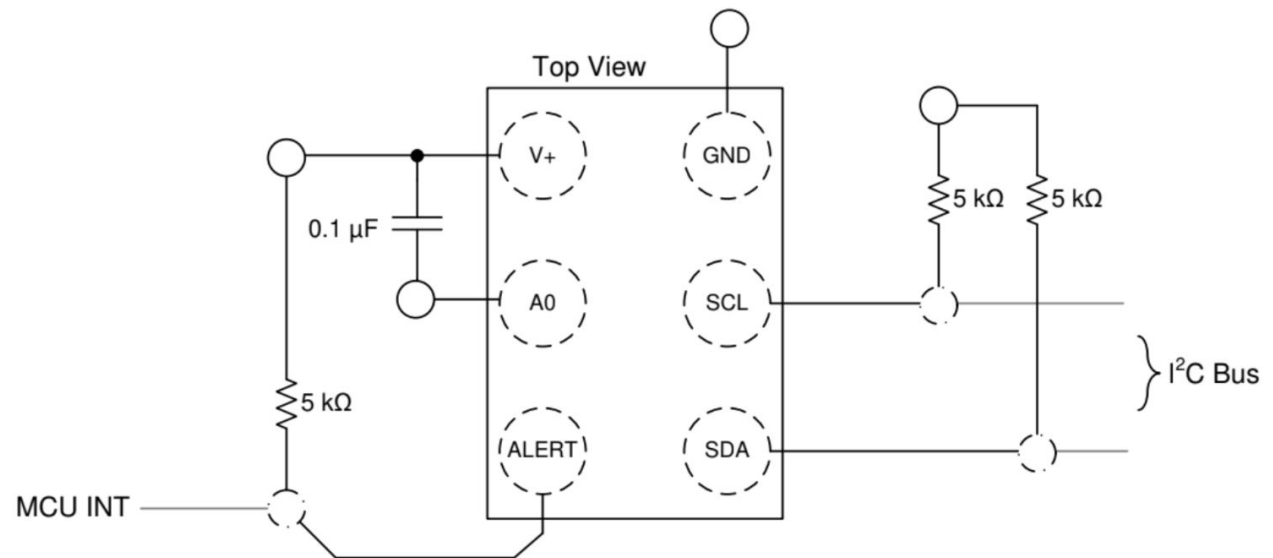
- Dimensions
 - width
 - length
 - thickness
- Orientation
- Bump
 - pitch
 - diameter
 - shape
 - count
 - unpop_count
 - formula



Electrical

Electrical contains the overall electrical characteristics information such as

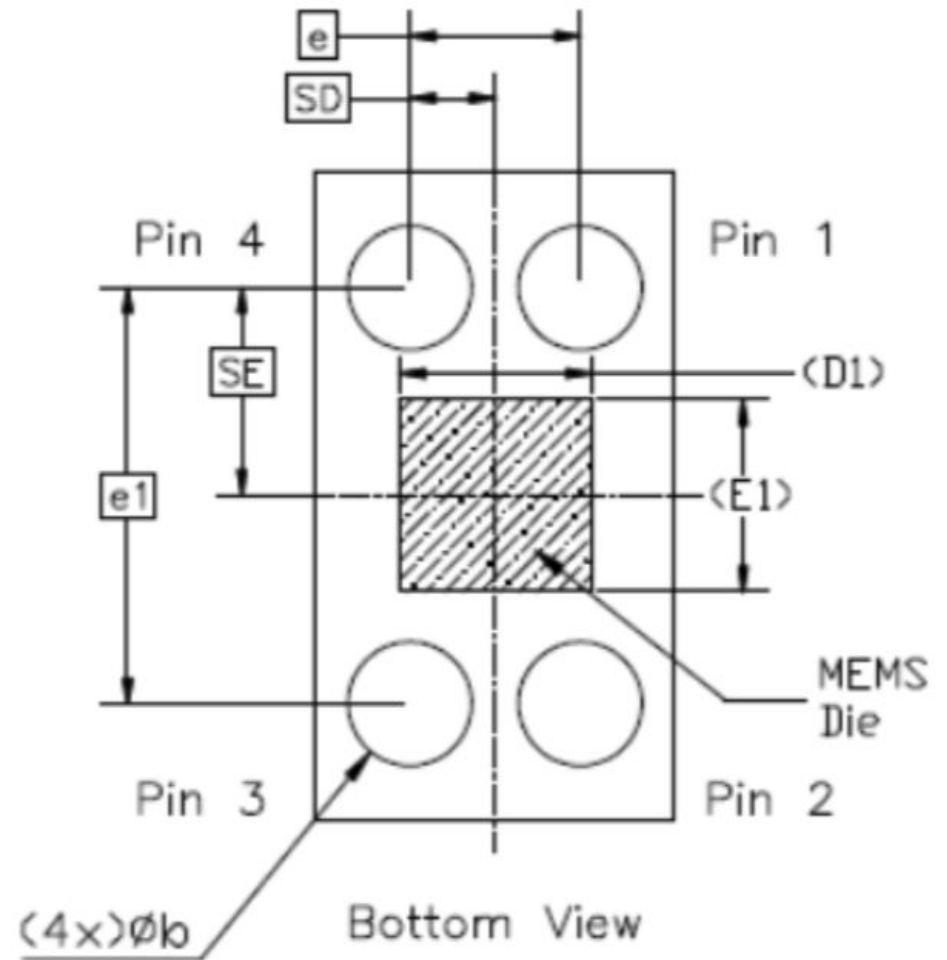
- operation_modes
 - Voltage
 - Current
- Absolute Maximum Ratings
- Recommended Operating Conditions
- ESD
- Interfaces - BoW, UCle, OpenHBI, AIB



IO

IO describes each pin information such as:

- pnum
- pname
- direction
- position
- netlist_name
- pin_mode
- signal_group
- IO_temperature
- Vdd_pin
- Gnd_pin
- mechanical
 - mechanical_type
- Electrical
 - frequency
 - ESD
 - Capacitance_load
 - V_max
 - Controlled_Impedance



Schema and XML

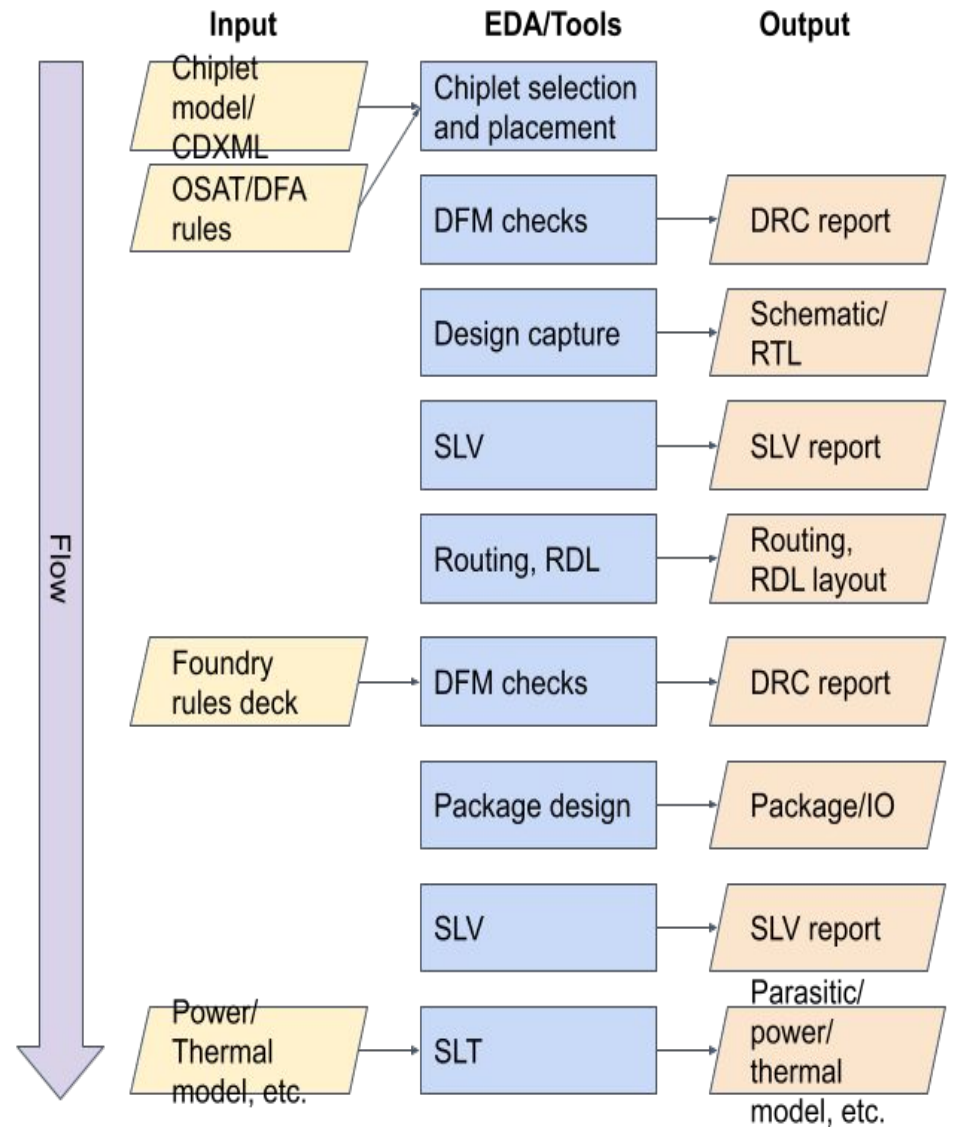
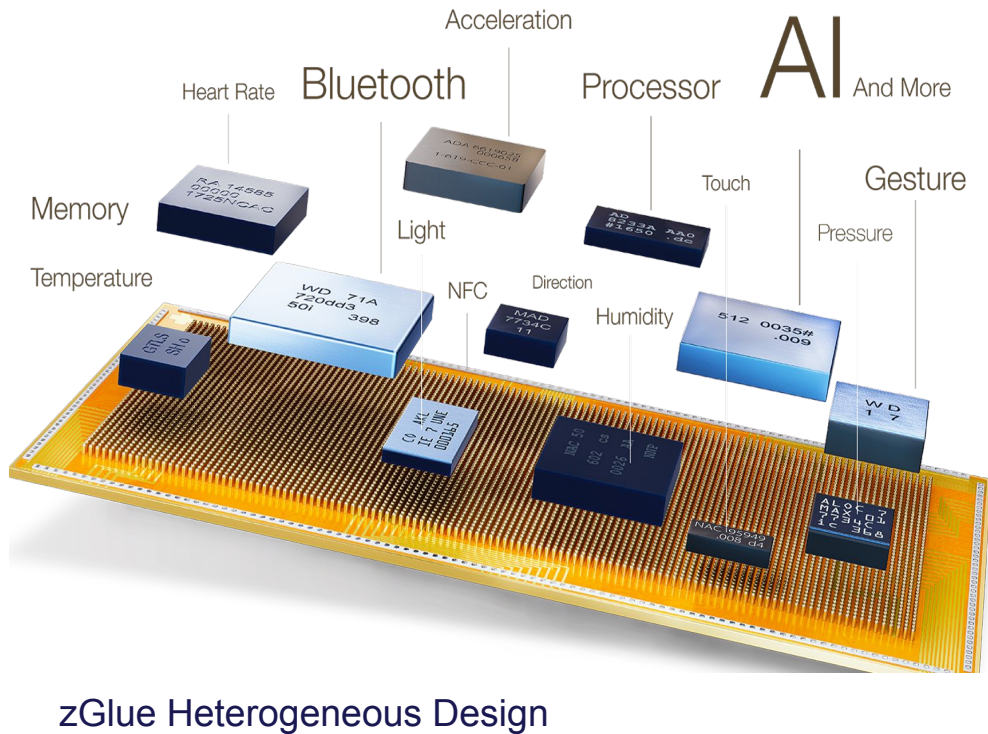
```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
<xs:element name="cdxml">
  <xs:complexType>
    <xs:all>
      <xs:element name="id" type="xs:string"/>
      <xs:element name="mpn" type="xs:string"/>
      <xs:element name="opn" type="xs:string"/>
      <xs:element name="version" type="xs:string"/>
      <xs:element name="created_date" type="xs:date"/>
      <xs:element name="updated_date" type="xs:date"/>
      <xs:element name="type" type="xs:string" minOccurs="0"/>
      <xs:element name="description" type="xs:string" minOccurs="0"/>
      <xs:element name="authors">
        <xs:complexType>
          <xs:choice>
            <xs:element name="person" minOccurs="1" maxOccurs="unbounded">
              <xs:complexType>
                <xs:all>
                  <xs:element name="name" type="xs:string"/>
                  <xs:element name="email" type="xs:string" minOccurs="0"/>
                  <xs:element name="company" type="xs:string" minOccurs="0"/>
                </xs:all>
              </xs:complexType>
            </xs:element>
          </xs:choice>
        </xs:complexType>
      </xs:element>
    </xs:all>
  </xs:complexType>
</xs:element>
<xs:element name="mech">
  <xs:complexType>
    <xs:all>
      <xs:element name="smt_compatible" type="xs:string" minOccurs="0"/>
      <xs:element name="orientation_ccw" type="xs:integer" minOccurs="0"/>
      <xs:element name="mold_material" type="xs:string" minOccurs="0"/>
      <xs:element name="reflow_prof" type="xs:string" minOccurs="0"/>
      <xs:element name="width">
        <xs:complexType>
          <xs:all>
            <xs:element name="min" type="xs:integer" minOccurs="0"/>

```

```
<?xml version="1.0"?>
<cdxml>
  <id>U100540</id>
  <mpn>BQ27426</mpn>
  <opn>BQ27426YZFT</opn>
  <version>1.0</version>
  <created_date>2022-10-16</created_date>
  <updated_date>2022-10-16</updated_date>
  <authors>
    <person>
      <name>James Wong</name>
    </person>
  </authors>
  <mech>
    <smt_compatible>true</smt_compatible>
    <orientation_ccw>0</orientation_ccw>
    <width>
      <min>1550</min>
      <typ>1580</typ>
      <max>1610</max>
    </width>
    <length>
      <min>1590</min>
      <typ>1620</typ>
      <max>1651</max>
    </length>
    <thickness>
      <typ>625</typ>
      <max>625</max>
    </thickness>
    <io>
      <pitch>
        <typ>500</typ>

```

Example Design Flow with Standard Format Data



Summary

- The XML standard helps chiplet development in the followings:
 - Standardization of the data from various Chiplet Vendors
 - New die-to-die interface definitions
 - SLV of the heterogenous chiplets
 - BIST of the chiplets for KGD
 - DFT of the systems
 - Simulation and modeling for power and thermal
 - Handling of the chiplet with different operation conditions
 - Data exchange in open chiplet marketplaces
 - Data exchange between the EDA tools
 - DFM and assembly rules check at different manufacturers
 - Performance optimization in HPC use cases such as AI/ML, AV
 - Partitioning of chipletization
- CDXML is released under the Common Creative (CC) license on the OCP Github
 - <https://github.com/opencomputeproject/ODSA-CDXML>
- CDXML is being integrated into JEP30 per JEDEC-OCP MoU





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Q & A





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Thank you

