An Industry-led Platform for Interoperability

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I. Introduction:

Design challenges that are expected in the 90nm technology node and which are predicted by technology pundits to worsen in the 65nm node remind us of the need for:

1. Tightly integrated design flows with interoperating design and analysis tools, and
2. "Plug-and-play" platforms, which are essential to create best-in-class tool flows, where tools from multiple sources may be integrated.

The above challenges can best be resolved through an open, industry-supported platform – which includes a well-defined and documented API and information model, and an implementation of the API – on which EDA tools from various sources can interoperate.

An increasingly popular option to achieve the above is OpenAccess, the infrastructure standard (with a rich, supportive and evolving reference implementation) that enables "plug-and-play" interoperability of EDA tools. It allows the end-user to reach the long-cherished goal of creating design flows that integrate best-in-class, OpenAccess-based design tools from vendors or internal CAD groups without the severe penalties historically associated with creating and maintaining data translators between steps in the design flow. In fact, OpenAccess expands the definition of interoperability by providing an infrastructure that allows interoperability between organizations.

OpenAccess has been available for just over a year. In this short period, many EDA vendors and end-users have ported their tools and flows to this platform, and more are arriving every day. In this paper, we will cover briefly the process by which OpenAccess is developed, its current state, and short-term and long-term plans to show where it is headed in the future. We will present details of all the collateral that is available for current users as well as potential adopters who may be considering implementing their tools and flows on this platform. Real-life examples of interoperability will be presented to demonstrate the impact it has had in simplifying their flow, improving design cycle time and in enabling efficient plug-and-play.

II. OpenAccess Development Process:

The OpenAccess Roadmap, representing both short and long-term direction, is managed by Si2's OpenAccess Coalition. The latter consists of representatives from both the end-user, semiconductor and EDA industries and currently has 22 members. They elect the members of the Change Team from among the coalition companies. The Change Team defines and approves both near-term and long-term goals that are embodied in the Roadmap document that is available to all through the Si2 web-sites. From time to time, a working group may be sponsored specifically targeted to evaluate a particular problem and recommend a solution for future implementation. For example, the solution for Embedded Module Hierarchy (EMH), a technique to efficiently represent logical, physical and occurrence-level hierarchies and their interrelationships, was developed by the EMH Working Group.

One of the most significant aspects of OpenAccess is its openness, starting with quarterly face-to-face meetings, access to details of the roadmap, and best of all, the actual delivery of essential enabling materials (documentation, source code and multiple binary representations) through Si2. This openness, and in particular, access to source code, serves as a compelling catalyst for many companies to adopt it as their EDA platform of choice. Thus, an ecosystem is rapidly growing with multiple companies providing their tools and sub-flows on this open platform, which, while it does not assure interoperability, certainly satisfies the first prerequisite of compliance with a common syntax. The other prerequisites, of course, are that interoperating tools must have semantic agreement on the data they mutually affect, and that the user has established the control mechanisms by which tools communicate with each other over a shared run-time model.

III. OpenAccess: Current State and Plans

The latest release of OpenAccess is version 2.1.1, available from Si2, which provides key capabilities such as EMH, mentioned above, and multi-threading. The Change Team is now focused on consolidating plans for requested enhancements for version 2.2, which is scheduled for delivery later in 2004, and goals for subsequent releases. Documentation for both of these will be openly available as part of an updated roadmap in the near future. Some of the many enhancements being evaluated for this next version include:

- **Major release API compatibility** to ensure interoperability between future, adjacent major releases of OpenAccess
- **Version-independent on-disk storage** to allow one version of the database to be able to read and save the databases from adjacent, major releases in the future
- **Wafer database** to handle wafer manufacturing data that describes the layout of chips on reticles and how to map those reticles across a silicon wafer
- **Milkyway-to-OpenAccess translator** to map from the Milkyway database to the OpenAccess database enabling OpenAccess-based applications to utilize data stored in Milkyway.

OpenAccess is mostly focused on the back-end of the design process at this time. But future goals are aimed at expanding its scope both up and down in the design process, moving both into the RTL design and manufacturing domains. As will be discussed in the subsequent section, some of the enhancements listed above directly affect interoperability of tools in a multi-vendor environment.

To propagate this platform throughout the end-user and EDA industry, Si2 offers a host of training materials. These include face-to-face classroom instructions and on-line training modules. There are hard-copy books and CD’s, and an Accelerator Kit that contains a collection of sample code, sample designs, and add-on functions and code to accelerate the newly-initiated onto a faster learning curve on adoption.

IV. Interoperability with OpenAccess

The most common interpretation of interoperability refers to the operation of multiple tools from different sources cooperating on top of a common data model to eliminate, or minimize, the cost of inter-tool translators. Cost to an end-user company covers not just the expenditure to create and maintain the translators but the performance penalty and semantic misalignments associated with processing data from the output of one tool to the format of a subsequent tool, often including additional steps to store the output of a tool to disk and then retrieve it for translation. While the above may be the most common definition to consider, the other dimension of interoperability, described later in this section, postulates the idea of interoperability between two or more organizations based on OpenAccess as the platform for sharing data to provide a more holistic solution for all involved.

OpenAccess provides the platform to achieve tool-to-tool interoperability, with the goal of providing semantic alignment on shared data between the interoperating tools. An example of such alignment could be between a router and a routing editor relating to the selection of a common representation for a wire segment from among the choices offered by OpenAccess. Once this is achieved, the gains can be substantial. The cost of implementation and maintenance of a translator, commonly estimated to run between 2x to 5x that of the tool itself, can now be eliminated.

The performance penalty of a translator can be equally daunting. In an experiment run at LSI [1], there was a two-order magnitude improvement in the performance of a particular analysis step when comparing one sequential process using a series of translators to get in and out of the analysis tool versus a process which accessed the tool through an API to create a more interactive environment. While not all translations offer this significant an opportunity for improvement, the advantages that accrue from elimination of translators are unmistakable. In another experiment at Infineon [2], where the pivotal tool in their Circuit

Re-simulation flow was integrated onto OpenAccess, thus removing several translators, a 3x improvement in overall performance in the flow was observed.

A practical aspect of tool-to-tool interoperability lies in the fact that if tools are integrated from multiple sources, then the evolution of the underlying platform, even when it is nascent, must grow in a compatible manner so all tools are not required to move lock-step with every advance of the platform. Rather, they can evolve in a disjointed fashion, based primarily on their business interests. In other words, tools operating on one release of OpenAccess must be able to interoperate with tools using the next major release. The first two enhancements listed in Section III above are aimed at facilitating this cross-version interoperability in future releases of OpenAccess.

A year into the life of OpenAccess, real-life examples of interoperability have already begun to appear [1, 2]. The architecture of the evolving future CAD system at HP [3], based on OpenAccess, points in the same direction. Among EDA companies, one of the first examples comes from In2Fab [4] whose design-retargeting and migration tools interoperate with those from Cadence [5], such as, SoC Encounter. The greatest benefit from the elimination of translators accrues to flow simplification [6] and resultant improvement in throughput for the designer, an example of which is shown in Figures 1 and 2 below. Much, if not all, of the data translations in the original flow are eliminated leading to multiple tools operating directly off the OpenAccess API which, once appropriate linking and control mechanisms are specified, may now operate concurrently based on designer needs.

There is an entirely different view of interoperability that is quite often missed – it is interoperability between organizations, such as between an IP provider and an IP user in a SoC design. If both are using compatible versions of OpenAccess and have agreement on the semantic definition of the data to be exchanged, based on a standard, well-documented API, then the data defining the IP can be readily provided to the IP user directly through OpenAccess, rather than through other standard formats that will require time-consuming conversions. This paradigm may also be applied to resolve the conundrum where academic

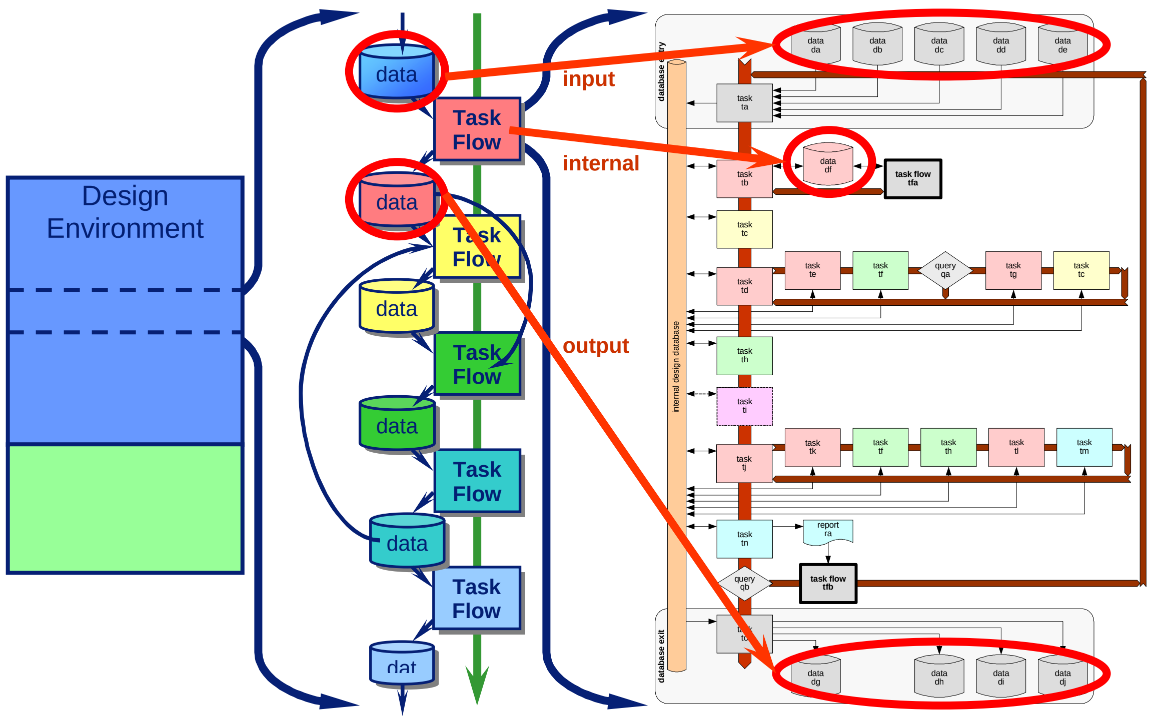

Fig. 1: Existing Philips Flow

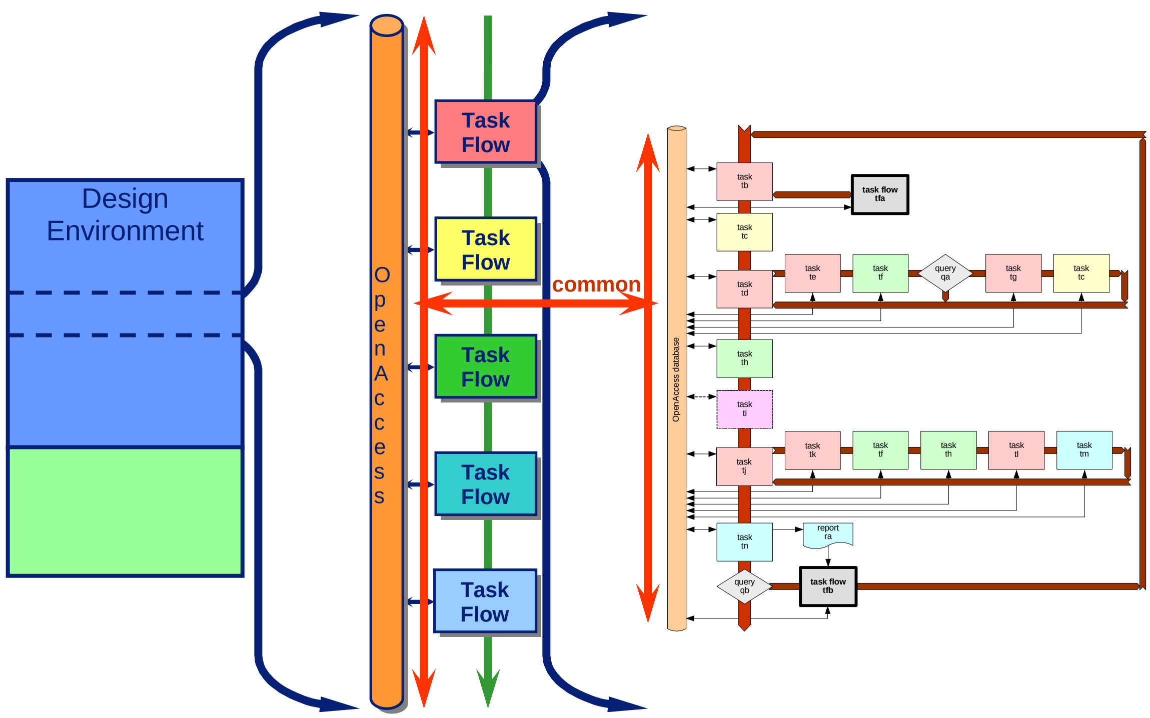

Fig. 2: Philips Flow on OpenAccess

researchers need advanced test cases to benchmark the results of their research to solve cutting-edge challenges from industry, yet the leading companies are loathe to allow their latest designs to leave their internal, secure environments. However, if OpenAccess is the ubiquitous platform between an academic institution and a set of end-user companies, then the benchmarks may be run on the research algorithms, installed within the corporate environments where their design IP is secure, after which the normalized results of the benchmarking can be released externally, thus serving the end-goals of the researcher and the security concerns of the companies involved.

V. Conclusions

OpenAccess, at age one year, is a nascent technology, yet it is already delivering on the promise of an open platform that has been developed in close cooperation between end-user companies and EDA vendors. The rewards of openness and interoperability promised by OpenAccess will accrue to all who share in this effort. The end-user wins through freer access to and integration of best-in-class tools from multiple sources. The large EDA vendors gain from lower integration costs among their own tool-sets, or of their own tools into customers' flows, or with tools from value-added partners and newly-acquired companies who have already adopted OpenAccess. Smaller EDA companies, particularly start-ups, which adopt this platform could see significant savings in infrastructure investment [4], and by capitalizing on plug-and-play interoperability, could achieve quicker access to a larger set of customers.

References:

[1] "OpenAccess Deployment and Adoption": Scott A. Peterson, LSI Logic, presented at OpenAccess Deployment and Adoption Panel, DesignCon, February 2, 2004

[2] “Deploying OpenAccess in Infineon's Analog/Mixed Signal Design Flow (”Freeway”)”: Thomas Heiter, Infineon, presented at OpenAccess Interoperability Workshop, DATE, February 16, 2004

[3] “OpenAccess Adoption and Early Deployment in a Production Flow”: James Wilmore, HP, presented at OpenAccess Deployment and Adoption panel, DesignCon, February 2, 2004

[4] “OpenAccess: That Was Then, This Is Now”: Rob Baker, In2Fab, presented at OpenAccess Interoperability Workshop, DATE, February 16, 2004

[5] “Cadence’s Interoperability Vision and Commitment to OA”: Michael Sanie, Cadence, presented at OpenAccess Interoperability Workshop, DATE, February 16, 2004

[6] “OpenAccess Migration: Design Environment Integration”: Timothy Ehrler, Philips, presented at OpenAccess Interoperability Workshop, DATE, February 16, 2004