

# WaferBoard™ Rapid Prototyping

(Draft - for discussion purposes only)

**WaferBoard™ Rapid Prototyping for Electronic Systems enhances creativity and invention and slashes prototyping costs, risks and time to market by allowing hardware from simple electronics to high-density electronics, micro-nano systems or system-on-chip ASICs to be prototyped in minutes.**

A WaferBoard™ is a “waffle iron” for prototyping electronic systems. Simply place packaged components (“dough”) on the WaferBoard™ and close the cover. The WaferBoard™ then senses the component contacts and recognizes the components and intelligently interconnects them (“cooks them”). The prototype (“waffle”) is now ready to be brought up and run. WaferBoard™ prototyping can save the electronic systems development process weeks or months of time to market and tens to hundreds of thousands of dollars (or more).

In developing new technologies for micro-nano systems, displays, sensors, telecommunication devices, multimedia and computing systems; diverse components ranging from processors and memories, ASICs and FPGAs, analog and RF, photonics and sensors, and MEMs and microfluidics are interconnected to form complex systems. Whether these electronics are the new technology or whether they merely support the new technology, WaferBoard™ makes prototyping such systems simple by providing what these diverse components all need: power, ground and communications with each other and with the external world.

Compared to traditional development, the WaferBoard™ approach is simple:

1. Select components that are packaged in ball grid array, QFP, TSOP, etc.
2. Place the packaged components - FPGAs, ASICs, processors, memories, etc. – on WaferBoard™, components that will be connected together are placed near each other.
3. Close the WaferBoard™ cover to press the components in place.
4. The WaferBoard™ maps the components and their contacts, and imports the map into the WaferConnect™ configuration software.
5. The WaferBoard™ map is then displayed for component identities to be confirmed and the interconnections to be specified by mouse or by importing a netlist.
6. The WaferConnect™ configuration software then programs the WaferBoard™ to set the specified interconnections. The prototype hardware is now ready to run.

WaferBoard™ establishes the specified control and data connections between components, and supplies power to specified component contacts at controlled voltages. WaferBoard™ built-in PCI-express and USB provide links to the external world. User-specific connections can also be added; non-digital connections, such as analog sensors, antennae and micro-fluidics, are not programmable but can be made directly to components if needed.

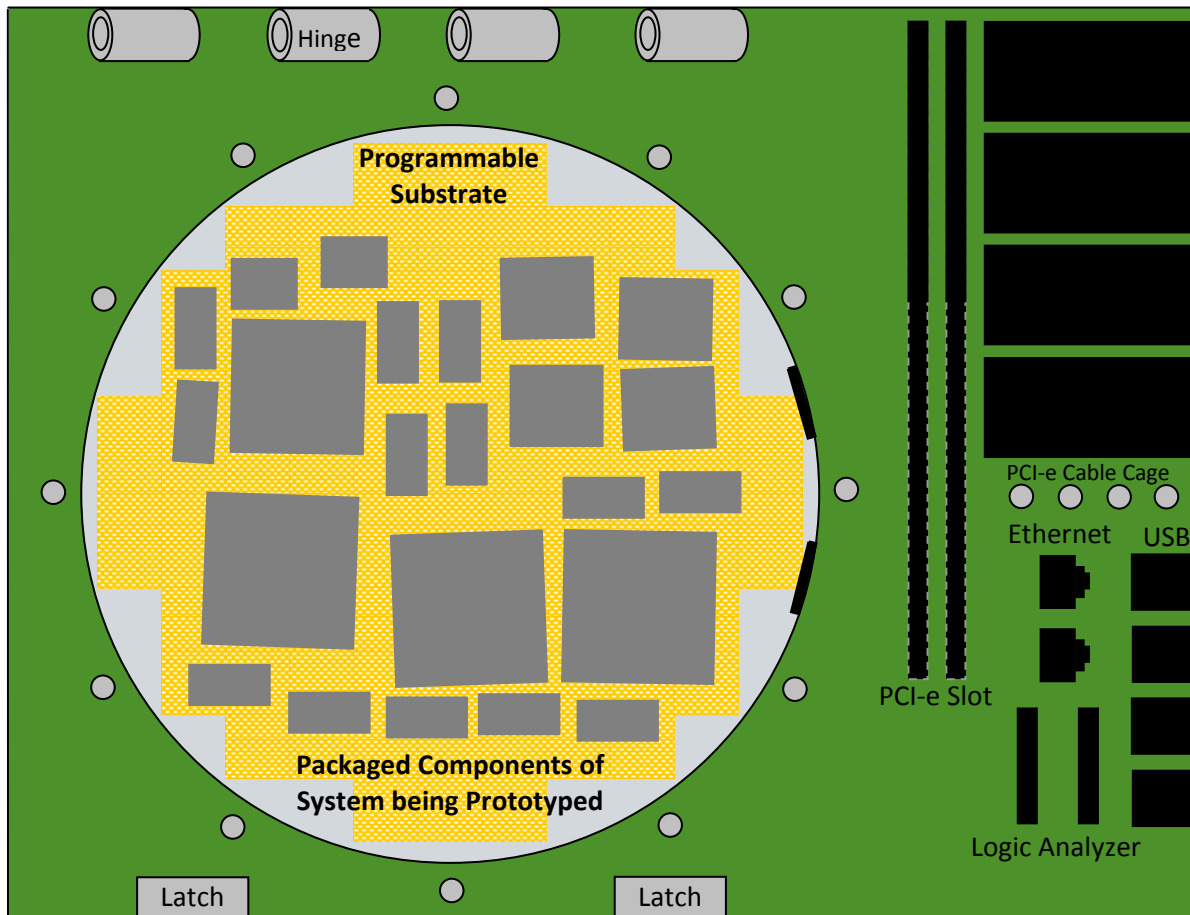
Hardware bring-up begins immediately. Debugging is simplified – any signals can be cloned at any point, and copies routed to software or to WaferBoard™ scope or logic analyzer connectors at any time. Software integration starts early, and with a system that uses the actual components rather than emulation<sup>1</sup>.

[www.DreamWafer.com](http://www.DreamWafer.com)

<sup>1</sup> For SoC, where emulation is desired, partitioning is simplified by every FPGA connection being available where it is most useful. Complex hard IP (e.g. processors) can be used in component form when available to further speed prototype performance and peripherals can be added to replicate the SoC's environment. Thus software testing can proceed on a complete near-real-time prototype, allowing increased coverage while speeding time-to-market.

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## WaferBoard™ (cover not shown)

WaferBoard™ enhances creativity by removing obstacles to experimental and iterative development. Hand-placement of packaged components is sufficient because the WaferBoard™ detects and adapts to component position, connections can be made or removed at any time without worrying about signal integrity, and components can be added, moved or replaced as needed.

### Technical Information

Programmable Area: 8" (200 mm) wafer

Connectors:

- Four USB, two logic analyzer, two 10/100/GigE
- Six PCI-e x16 (PCI-e cable cage links WaferBoards™)

WaferIC NanoPad™ density: 5000/cm<sup>2</sup>

Minimum Component Contact pitch: 0.5 mm

Minimum Component Contact diameter: 0.2 mm

Embedded repeater spacing: 2 mm

- Prevents cross-talk and attenuation

Maximum Signal Rate (SDR): 300 MHz (TBC)

Maximum Signal Rate (DDR): 500 Mb/s/contact (TBC)

Maximum Signal Rate (Differential): TBD

Signal Latency: 0.2 nanoseconds/mm

Maximum current per contact: 100 mA

- Use adapter if more current needed

Maximum voltage supplied: 3.3V

- Higher-voltage feeds can be added if needed

Maximum Total Power: 250W (TBC)

Intrinsic Decoupling Capacitance: TBD  $\mu\text{F}/\text{cm}^2$

- An adapter can add more decoupling if needed

Maximum Pressure Applied: 100 PSI (700 Kilopascals)

Maximum Ambient Temperature: TBD

Maximum Ambient Humidity: TBD

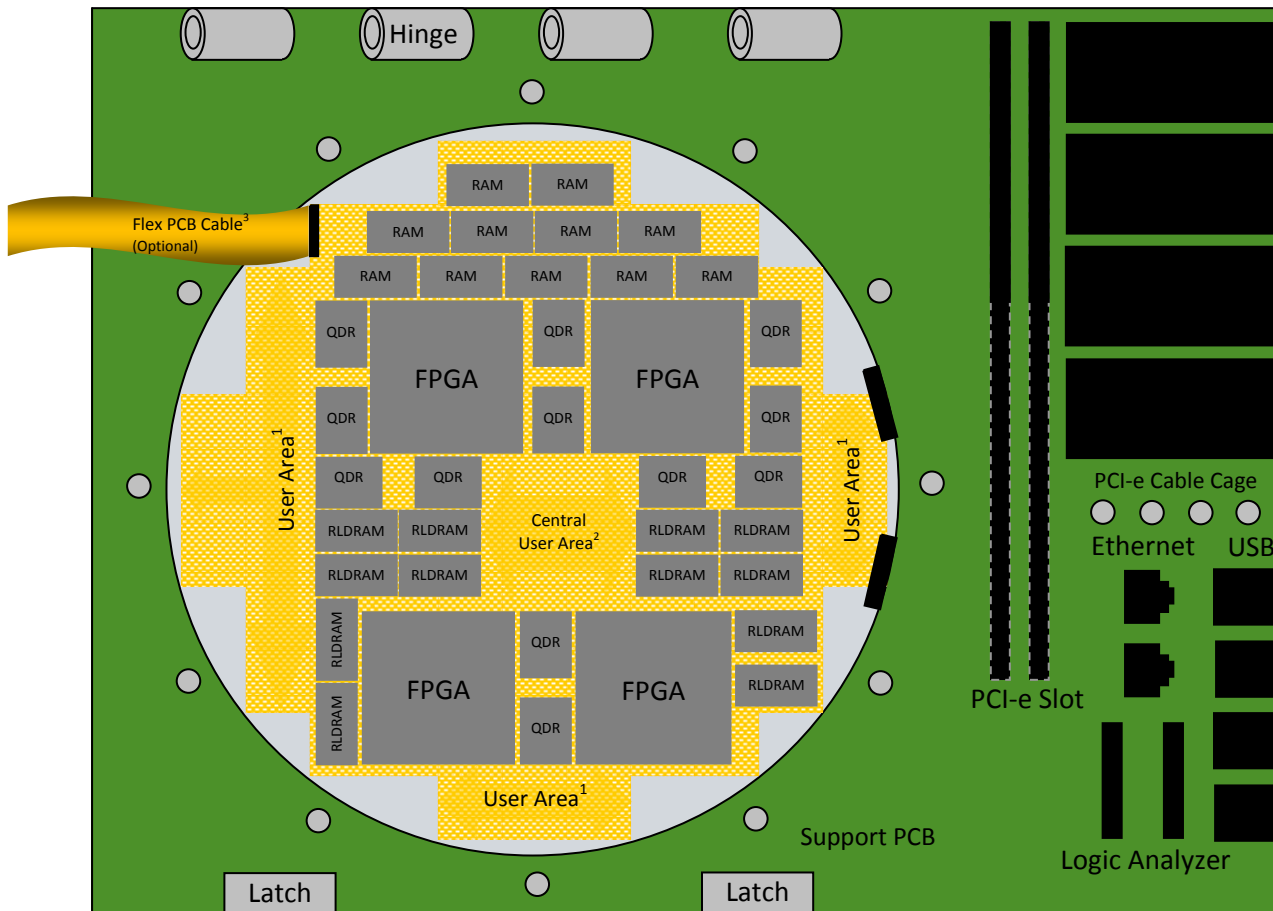
Maximum Acceleration: 5G (TBC)

Platform size: 314 mm x 250 mm x 60 mm (TBC)

Platform Weight (full wafer): 40 Nt (9 lbs) (TBC)

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## WaferBoard™ FPGA Platform (cover not shown)

- 1. User Area** is for packaged components of system being prototyped
  - The larger user areas are on the sides for easy access and support complex custom packaged chip sets and peripherals for the system being prototyped.
- 2. Central User Area** is for packaged components needing the fastest access to FPGAs e.g. custom ASICs
  - If the prototype needs specialized chips, the central user area is ideal for a high-performance user ASIC, being close to all the large FPGAs and a variety of fast memories (with bulk RAM available further away).
- 3. Flex PCB Cable** (optional) is greater than 100 connections per cm<sup>2</sup>
  - ADC/DAC, custom I/O, optics, etc.
- 4. Support PCB Underside** includes Control CPU, PCI-e Switch, Flash memory and DIMMS

Any chip can be reprogrammably connected to any other chips; this flexibility makes the FPGAs and memories by themselves sufficient for prototyping many systems.

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## WaferBoard™ FPGA Platform

### 1. Why it's essential for research

WaferBoard™ is essential for experimentation because it lets “what if” questions be answered quickly. Whether the system being prototyped *is* the research or whether it *supports* the research, the ability to rapidly and reprogrammably customize it to research needs speeds up the research process.

- The FPGAs can be reprogrammed.
- Custom ASICs can be added and integrated.
- Commercial ASICs can be added and integrated.
- All interconnections between FPGAs, memories, commercial and custom ASICs are completely reprogrammable at any time.

### 2. What do I the researcher do with it?

Many systems simply require selecting the right FPGA-to-memory and FPGA-to-FPGA connections for the ‘hardware’, compiling C code to FPGA firmware, and the system is ready to run. Right out of the box WaferBoard™ is an FPGA-based development platform on steroids!

- Select components that are packaged in ball grid array, QFP, TSOP, etc.
- Programmable FPGA-to-memory connectivity allows custom algorithms to be prototyped.
- Custom FPGA accelerators can give super-computer performance on a desk-top platform.

Other research systems are centered on custom ASICs, but need supporting logic and memories.

- The WaferBoard™ Central User Area allows high-pin-count customer or commercial to be densely inter-connected with the supplied FPGAs and memories.
- WaferBoard™ User Areas allow custom PACKAGED chip sets to be added and reprogrammably interconnected to each other and to the supplied FPGAs and memories.

Testing of experimental systems is enhanced, too; WaferBoard™ provides the ability to clone any signals at any point and display them using its virtual logic analyzer software.

### 3. What tools do I need?

Only a desk-top or lap-top computer and your research goals!

- WaferBoard™ WaferConnect™ software lets all system interconnections be specified through its intuitive graphical interface, supplied libraries provide the basic memory controllers and customizable FPGA-to-FPGA connections, the CMC-supplied FPGA tools allow compiling RTL, Verilog, VHDL or C algorithms to FPGA firmware.
- If you already have system design tools, WaferConnect™ will import netlist files from PCB tools, configuration bit-streams from FPGA tools, ASIC descriptions from parts libraries, and will export cloned signals to logic analyzer connectors.

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