OpenFPGA:
"Defining Reconfigurable Supercomputing"

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Computing Challenges Today:
Space and Power Limits

- Large systems need space…
  - A hypothetical 50 node 1U system requires est. 20 square feet of floor space for air flow
  - One rack (dual core) delivers 100 CPU units
  - Speedup potential only 50 for 99% parallel application

- …for cooling systems
  - Need for ambient air cooling increases with CPU power
  - Multiple cores still means more cooling per node

- Bottom line: Building-size refrigerators (data centers) expensive to build, expand or retrofit
  - To build: $67M to build data center consuming 15 MW power
  - To operate: $12M+ per year at 40% capacity

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Computing Challenges Today:
In Face of Increased Demands

- Increasing amounts of data generated
  - By research simulations and instruments
  - By surveillance sensors, cameras, RFID

- Longer secure records retention
  - Government regulations (SOX, privacy, HIPAA)
  - Protecting and leveraging R/D intellectual property

- Data volumes are soaring
  - Genbank volume doubles every 18 months
  - Walmart preparing to add TBs regularly for RFID

- With increased application complexity and demand for even lower times to solution

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A Solution In Reconfigurable Computing

- FPGA computing is well established
    - MAPLD, RECON, ACM/IEEE, etc.
    - FCCM around for 14 years

- Diverse tools employed by logic designers in lieu of an ASIC approach
    - Generalizable platform
    - Reconfigurable – an option to change without physical replacement
    - Fast instructionless computing

- Well developed embedded markets
    - Vehicle control systems
    - Defense systems (radars, missiles, aircraft)
    - Medical systems
    - Communication/networking hardware

- Transitioning to HPC/enterprise applications as Moore's law wanes

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Why OpenFPGA?

- To Solve Fragmentation
  - Many efforts working in isolation without cross-communication

- To Address Common Challenges and Needs
  - Expensive tools and long development times
  - No portability across vendors and across product versions
  - A Challenging market to enter

- To Improve Common Practices
  - Current situation similar to early days of message-passing and SMP
  - Vendor specific but common functionality
  - Technology emerging into general applications market

- To Influence Priorities for Future Architectures
  - Hardware interface designs and standards
  - Inter-component and inter-system designs and standards

- To Lower the Risk of Adoption so Market Can Expand!

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OpenFPGA Vision

Create a future where:

- Advances in reconfigurable computing technology will be easily and eagerly adopted, incorporated across critical high-performance computing and enterprise applications.

- OpenFPGA will be a catalyst for innovation and a vehicle for establishing standards for portability, performance and interoperability in the heterogeneous supercomputing community.

- OpenFPGA will advance contexts for reconfigurable computing research and channels for moving innovations into production use.

OpenFPGA Mission

"The mission of OpenFPGA is to promote the use of Field Programmable Gate Arrays in high level and enterprise applications by collaboratively defining, developing and sharing critical information, technologies and best practices."
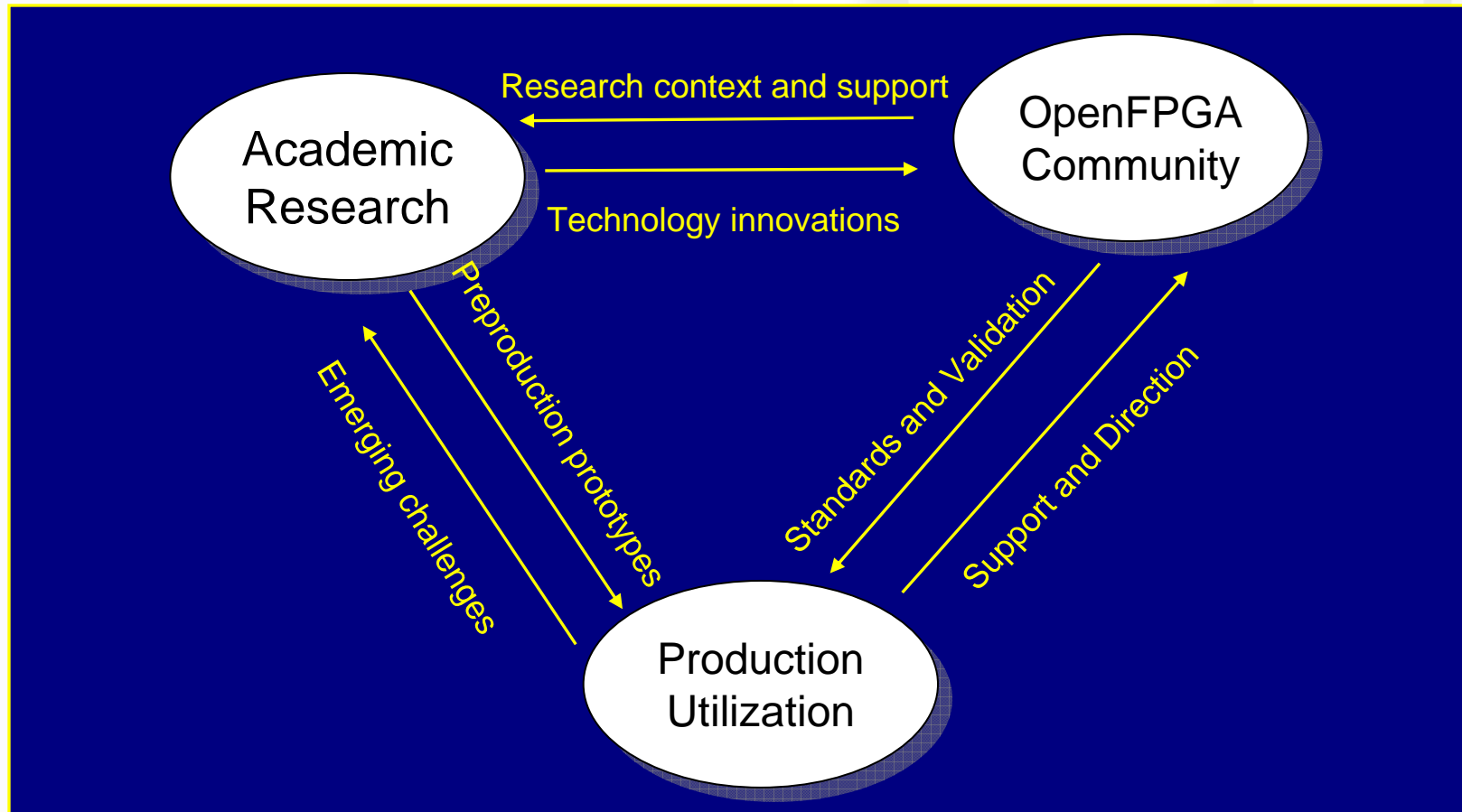
The mission is realized through pursuit of the following objective areas

- **Innovation and Evaluation** – sharing tools and best practices
- **Standardization** – collectively defining common implementations
- **Education** – developing skilled professionals
- **Promotion** – advancing successful application uses of FPGAs
- **Communication and Collaboration** – fostering communication
- **Participation** – expanding involvement

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OpenFPGA: Objective Area Updates

- Promotion – market building
  - Website, success stories, benchmarks

- Participation – community building
  - Over 300 participants worldwide
  - Over 30 countries

- Communication & Collaboration – sharing of ideas
  - Email lists, Wiki, RC application/development examples

- Education – expertise building
  - A starting point to bootstrap individual FPGA application development

- Innovation and Evaluation - assessments and new developments
  - Working groups and collaborations

- **Standardization – common practices for portability and supportability**
  - Rapidly developing

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OpenFPGA: Taking Research to Practice

Research context and support

Academic Research

OpenFPGA Community

Technology innovations

Preproduction prototypes

Emerging challenges

Standards and Validation

Support and Direction

Production Utilization

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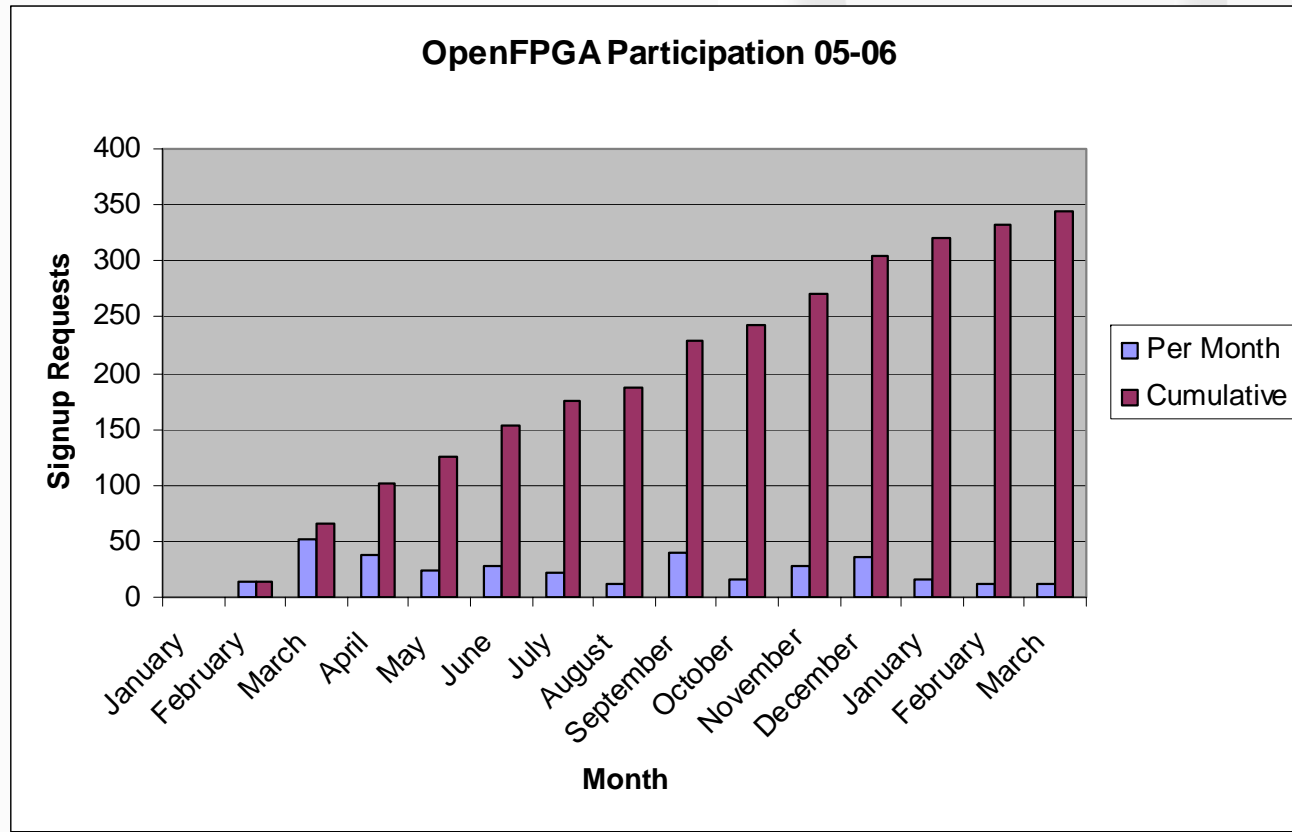# OpenFPGA Community Origins

- OSC commenced the initiative in late 2004 to form OpenFPGA following
  - Demonstrated FPGA capabilities with TimeLogic
  - Hearing common challenges across all sectors
  - Hosting a successful FPGA workshop (October 2004)

- Effort officially commenced in February 2005
  - Formed exploratory OpenFPGA Steering Group
  - 16 initial respondents (presently 19 represented organizations)
  - Cross-cut: international, academic, commercial, government, hardware, software

- Announced at Manchester Reconfigurable Computing workshop (late Februrary 2005)

- Co-host for RSSI held at NCSA (July 2005, and now in 2006)

- First open standards working group discussion @ MAPLD (September 2005)

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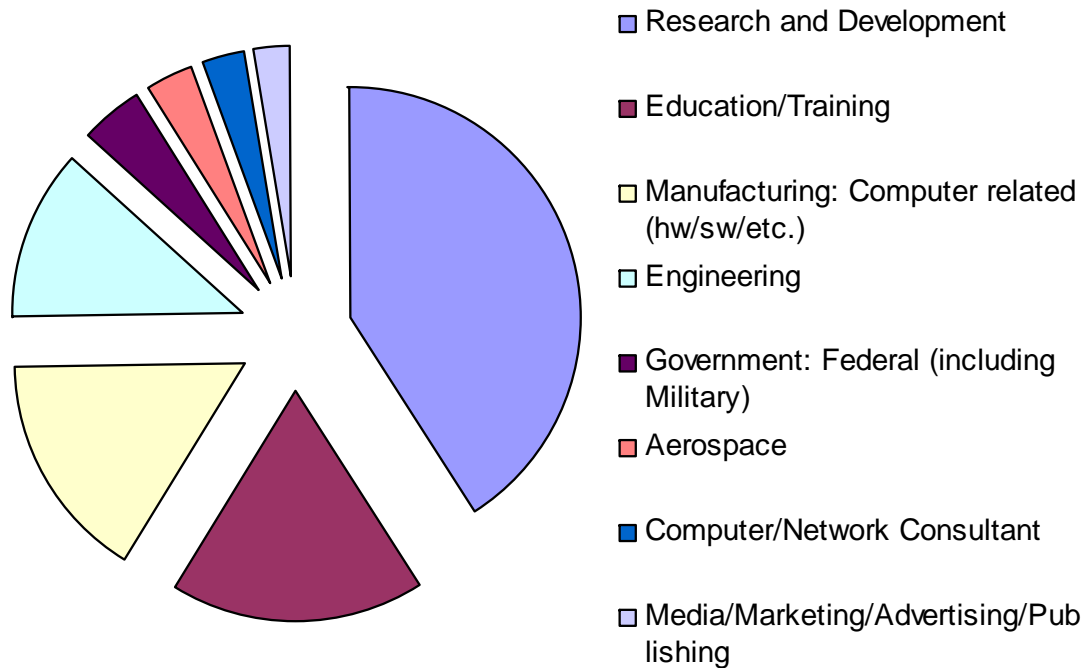
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OpenFPGA Steering Group

- Cray, Inc.
- George Washington University
- GE Global Research
- Koan Corporation
- Mitrionics, Inc.
- Nallatech, Inc.
- NCI-ABCC
- NCSA
- NIST
- Oak Ridge National Lab
- OSC

- Riken
- Sandia National Lab
- SGI, Inc.
- SRC Computers, Inc.
- Starbridge Systems, Inc.
- University of Cincinnati
- University of Manchester
- University of South Carolina
- University of Toledo
- Zuse Institute Berlin

OpenFPGA Growth
(since inception)

OpenFPGA Participation 05-06

OpenFPGA Company Profiles

OpenFPGA Company Areas
(top 270 participant areas)

■ Research and Development

■ Education/Training

□ Manufacturing: Computer related (hw/sw/etc.)

□ Engineering

■ Government: Federal (including Military)

■ Aerospace

■ Computer/Network Consultant

□ Media/Marketing/Advertising/Publishing

Additional Key Areas

Financial: Commercial Banking

Financial: Brokerage

Energy

Agriculture

Pharmaceutical

Local/State Government

Retail / Wholesale

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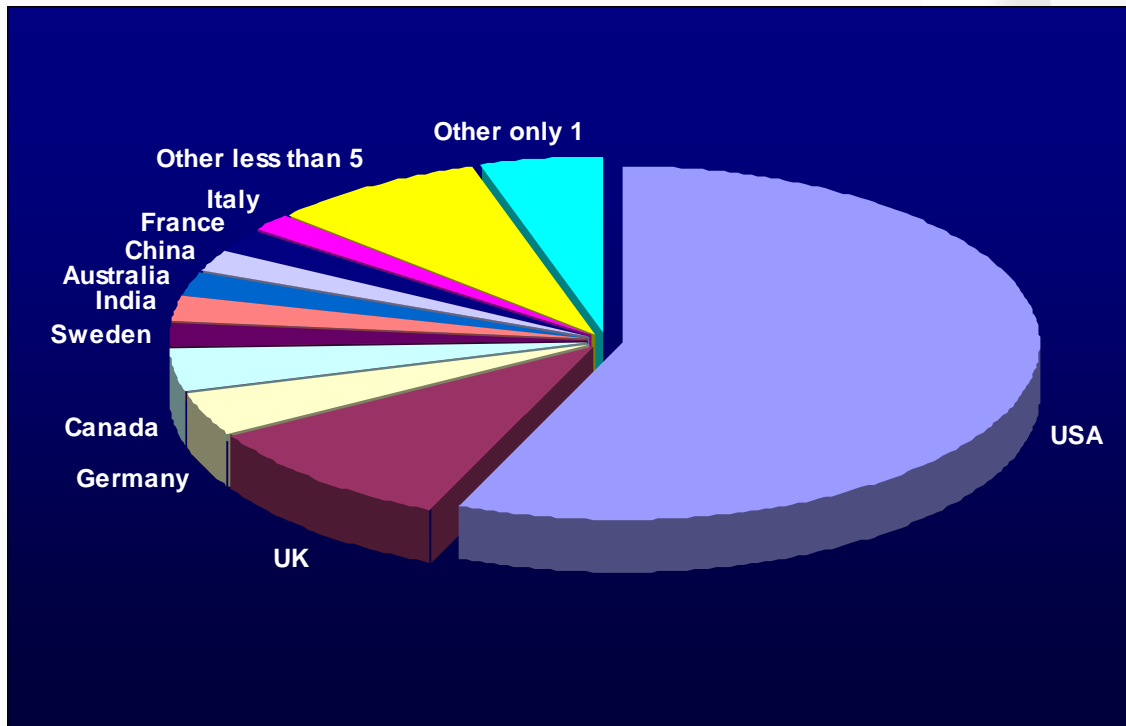
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Member Interest Areas

- Xilinx, Altera
- Wireless Communications
- Supercomputing
- Software tools
- Signal Processing and cryptography
- SoC
- Algorithms and Applications
- Benchmarks
- Numerical simulation
- Low-power design
- Data Mining
- Cellular Automata
- Biological modeling
- Bioinformatics
- Automotive
- Clusters of FPGAs

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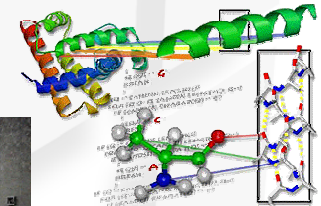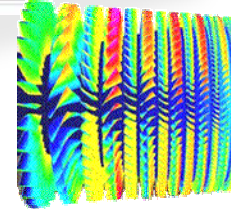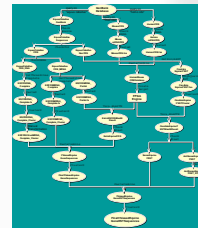
OpenFPGA Worldwide

Other (< 5)
Japan – 4
Taiwan – 4
Belgium – 4
Spain – 4
Thailand – 3
Puerto Rico – 2
Netherlands – 2
Portugal – 2

Other (single)
Finland
Croatia
Brazil
Greece
Iraq
Israel
Malaysia
Netherlands
Norway
Pakistan
Saudi Arabia
Singapore
Turkey
Latvia

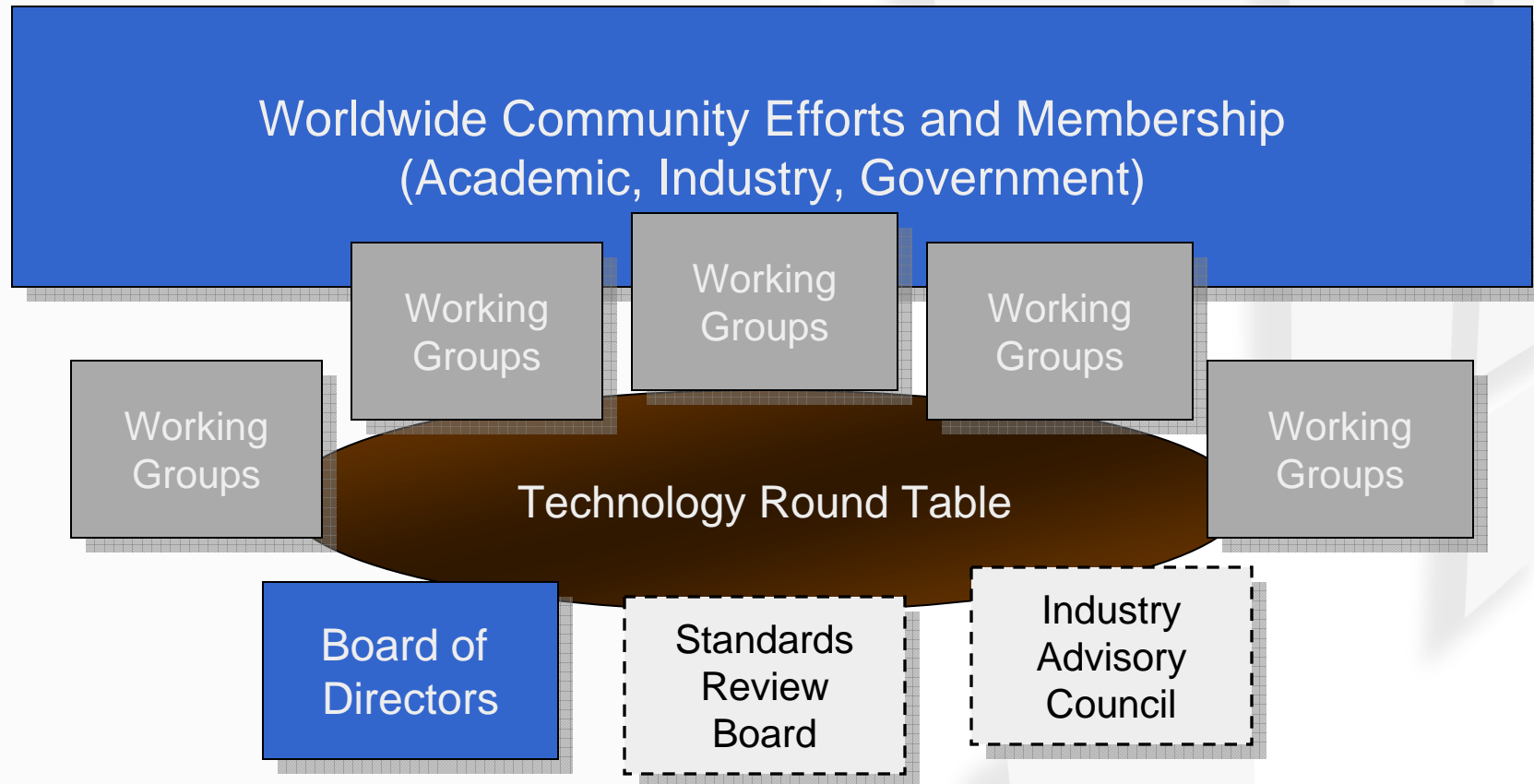## Over 30 countries participating

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OpenFPGA: Making a Difference

- Education
  - Resource for preparing a knowledgeable workforce
  - Informing the market of application capabilities

- Unifying Efforts
  - Working groups on specific needs
  - Sharing insight, research and results
  - Debating new ideas and approaches

- Technical Impact
  - Baseline standards for communication and interoperability
  - Benchmark measurement standards
  - Open-source area for applications
  - Open-source tools

OpenFPGA Stakeholders

- #1 - Worldwide community and members
  - the most important stakeholder by far

- Cross-interest working groups
  - where real progress is made

- Industry Advisory Council
  - guidance for production use interests

- Standards Review Board
  - where commitments to standards are made

- OpenFPGA Board of Directors
  - responsible for overall organization

OpenFPGA Organization

Worldwide Community Efforts and Membership
(Academic, Industry, Government)

Working Groups

Working Groups

Working Groups

Working Groups

Working Groups

Technology Round Table

Board of Directors

Standards Review Board

Industry Advisory Council

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OpenFPGA Technology Round Table

- Connecting working group activities with stakeholders

- Bi-weekly conference calls

- Updates, information and opinions on a regular basis

- Most enduring feature

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OpenFPGA Working Groups

- Where real progress is made

- Comprised of OpenFPGA members

- Cross-disciplinary teams leveraging worldwide investment
  - CHREC, FHPCA, Industry, Government

- Communication supported through OpenFPGA
  - Working group email lists
  - Wiki for shared input
  - Technology roundtable for ongoing updates

- Organizing lead to get things rolling

OpenFPGA Application Working Groups

- ## Applications Requirements (U-APPREQ)
  - Organizing lead: Eric Stahlberg (OSC)
  - Goal: Characterize application needs present and future

- ## Benchmarking (T-BENCH)
  - Organizing lead: Dean McCoullough (NCI-ABCC)
  - Goal: Provide performance metrics for comparison

- ## Applications Libraries (T-APPLIB)
  - Organizing lead: Thomas Steinke (ZIB)
  - Goal: Delivery of usable FPGA-enhanced application libraries

OpenFPGA Technology Working Groups

- High-level Languages (T-HLLANG)

  - Organizing lead: Aussie Schnore (GE RD)

  - Goal: Address efficient algorithm specification for FPGAs

- General API (T-GENLIB)

  - Organizing lead: Stefan Mohl (Mitrionics)

  - Goal: Define portable generalized FPGA API

- Core Interoperability (T-CORELIB)

  - Organizing lead: Dan Poznanovic (SRC)

  - Goal: Define interoperability among RC cores

OpenFPGA Member Network

- Nearly 400 participants on email list

- Connecting through informal email discussions

- List members only traffic – no spam

- Simple sign-up at the OpenFPGA site

Expertise

Opportunities

Opinions

Breaking news

Assistance

Approaches

Collaborations

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OpenFPGA: Moving the Industry Forward

- Membership and Communication
  - Open communication, insight and progress

- Development Improvements
  - Improved portability, reduced development time, preserved investment

- Open Standards
  - Interoperability, cross-platform, inter-component, inter-system

- Shape the Future
  - Hybrid computing, dual-paradigm, low-power, massive scale

Stake a Claim in the Future of OpenFPGA

- Individual membership open to all

- Low cost membership
  - Very affordable and accessible
  - Supports working group activities
  - Looking to subsidize

- Easy sign up at the OpenFPGA site

  Get involved. Visit www.openfpga.org today!

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