

---

# *CS598LRS: Improving Your Research Skills*

Lecture 1  
January 17th, 2007

# *Announcement*

---

- Class Website: <https://agora.cs.uiuc.edu/display/cs598lrs/Home>
- You can login with your Active Directory password.
  
- Assignment #1: Self-Introduction. Due 1/19/2007
  - say a few words about yourself
  - what's your goal in your research
  - what do you expect from this class
  - Summarize it and e-mail it to the professor at [lrs@uiuc.edu](mailto:lrs@uiuc.edu), so that he can structure this class to best serve your interest.
  - If you are registered for the course, place your self-introduction on the course website, to make sure you can access the wiki.

# *Course Objective*

---

**Course Objective:** This is a course designed to help improve your research skills in the following areas.

- How to keep up with research trends and identify critical issues,
- How to estimate the value of potential research topics,
- How to give presentations and write papers,
- How to establish a personalized creative process,
- How to create a well structured research agenda,

in the context of creating the scientific foundation for Cyber-Physical Systems: the convergence of computing, communication and control.

# Course Outline

---

- Lecture 1: Introduction
- Lecture 2: Each student introduces herself/himself
  - Each student give 5 min of presentation on your gift, your interest and the R&D trend that will help you to succeed
- Lecture 3: Elements of Research
- Lecture 4: Student team's presentation on their take on NSF Research Planning Workshop on Cyber Physical Systems (Search it on the Web)
  - Read and evaluate NSF Research planning workshop reports on cyber physical system research initiative.
  - Summarize and present your views, and tell us how you can contribute by identifying potential intersection between your current research interests and the NSF Initiative
- The rest of the classes
  - Guest lectures and special topics (to be announced, will adapt to students progress and unique situations)
  - Student teams' practice on key research skills
    - Iteratively present improved research plans and ideas on improving research skills
    - Give constructive feedback to other teams, help them to improve.

# *How The Final Evaluation is Done*

---

- Each of you will serve as program “committee member”. I will serve as the “program chair”
- Each one will be scheduled to present for each major stages
- Each of the others will **email** me the review form (see next slides). I will summarize the reviews and pass on the suggestions.
- You get the feedback but don’t know who is the reviewer

# *A Sample Electronic Review Forms*

---

- Name of presenter/author\_\_\_\_, Title\_\_\_\_, Date\_\_\_\_
- (1) Originality of the ideas (1 - 10)
- (2) Problem(s) is (are) well defined (1 - 10):
- (3) Assumptions are described and realistic (1 - 10):
- (4) Solutions/Approaches are clearly described (1 - 10):
- (5) Data or examples are clearly shown (1 - 10):
- (6) Mathematics are essential, complete, correct (1 - 10):
- (7) Paper is technically sound (1 - 10):
- (8) Applicability of the ideas/result (1 - 10)
- (9) Presentation style (1 - 10)
- Overall score and **constructive** suggestion to the presenter/author.

# *Evaluation*

---

- You will have 2 chances for each presentation
  - Your group will present your finding
  - The peers will give you critics
  - Your group will present it again in light of the feedback
  - Your second presentation will be posted in the class website for to let your peers to review it.
- The following are 2 sample presentations from a recent shorten 6 week course at National Taiwan University during my sabbatical at Taiwan in fall 2005.

---

*Play without Plug (PWP)*  
*A New Product Line*

Jen-Wei Hsieh & Yu-Kai Huang (NTU Students)

With Contribution by Neil, Johnson, and Kuan-Ling

Advised by Professor Lui Sha

26 October 2005

# *Outline*

---

- The Emerging Trends
- Play without Plug\*
- Killer Applications
- Evaluation
- The Challenges
- Conclusions
- Key Related Works
- The Candidate Conferences / Workshops

\* This fantastic name is created by Neil Perng.  
Improving your research skills, 2007

# *The Emerging Trends*

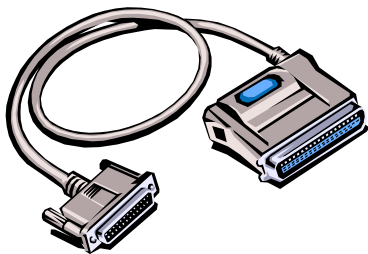
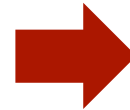
---

- **New Trends**
  - Wired Devices vs. Wireless Devices
  - User-Friendly Interfaces (Auto-Configuration)
- **New Enabling Technologies**
  - Ultra Wideband (UWB, IEEE 802.15.3)
- **Observation & Existing Limitations**
  - Storage Redundancy
  - Synchronization Problem



# *Evolution of Infrastructure*

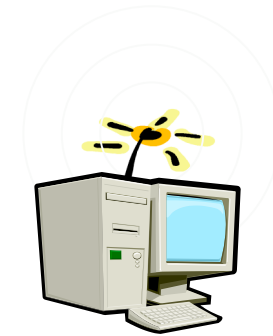
---



Dedicated Devices



Plug and Play



Play without Plug

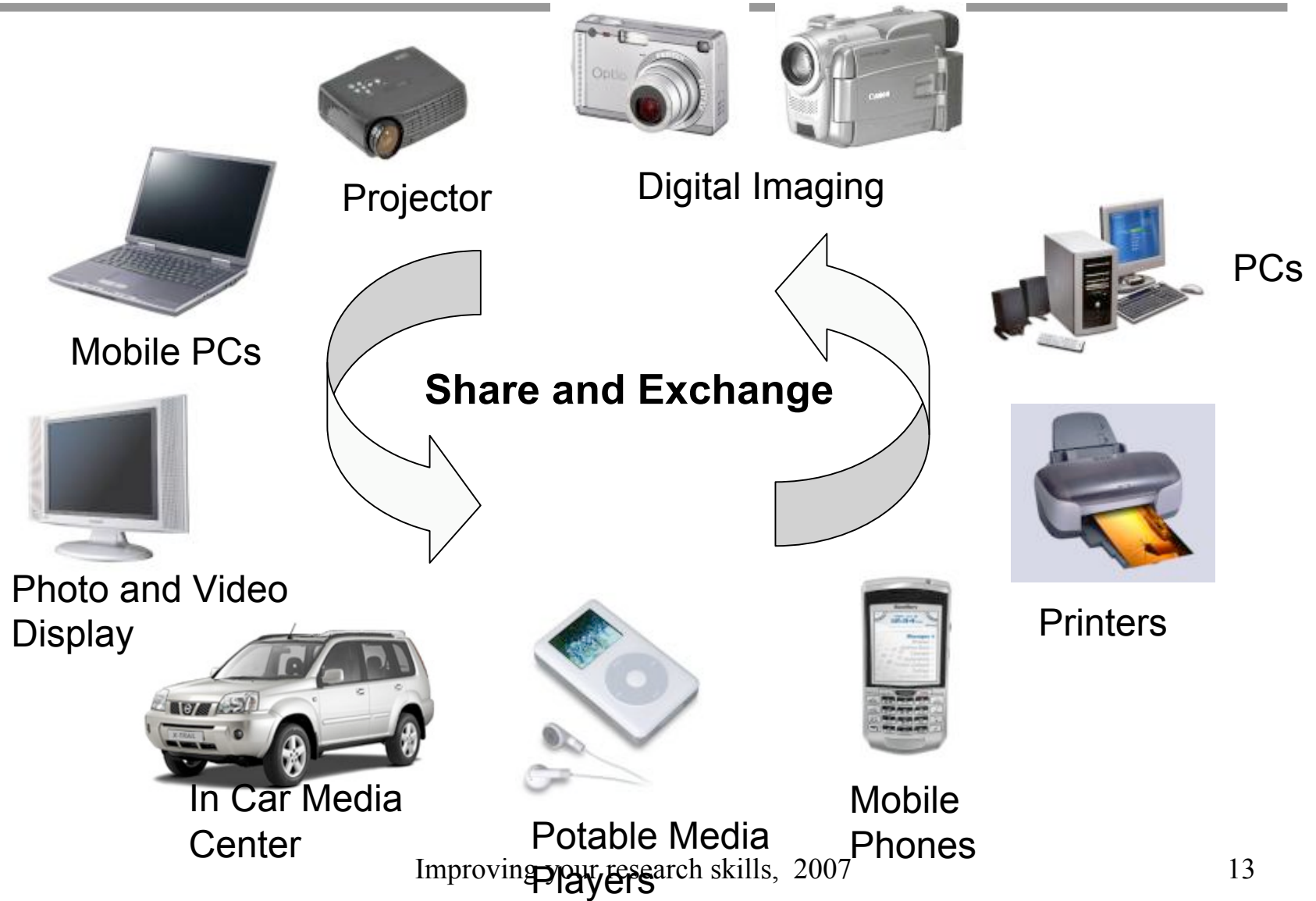
# *Killer Applications (1 / 3)*

---

- \*Personal / Home Storage® (Home)
  - People can carry about their personal data.
  - The storage can be accessed by numbers of intrinsically different devices, e.g., ear phone, display, projector, printer, etc.
    - Object could be “touched” from different dimensions
    - Coupled with a brand-new file system
  - Storage-less peripheral would emerge.

\* The original idea of this product is proposed by Johnson Chang.

# The Concept



# *Killer Applications (2/3)*

---

- \*Instant Notes® (Work)
  - The download process could be done easily and simultaneously.
  - Applications
    - In Class: Students can get the latest lecture slides immediately.
    - In Conference: The protected data can only be distributed to the attendances.
    - In Company: The confidential data can only be accessed in company.

\*This product is named by Professor Lui Sha.

Improving your research skills, 2007

# *Killer Applications (3/3)*

---

- Personal Tourist Guide® (Vacation)
  - Provide tourists abundant suggestions and directions.
    - \*Co-operate with search engine, e.g., google.
    - Overall roadmap can be downloaded from tourist office.
    - Detailed information can be updated wirelessly while approaching the spot.
    - Rich multimedia contents are provided.
  - \*\*Interest-Oriented Information Sharing, not File-Oriented Sharing.

\* Suggested by Johnson.

\*\*Suggested by Professor Lui Sha & Kuan Lin

Improving your research skills, 2007

# *Similar Products*

---

- Bluetooth Products
  - No Similar Product
  - Limited Bandwidth
  - Lack of Many-to-Many Transmission Function
- PaPaGO! (GPS)
  - Location Inaccuracy
  - Relying on Existing Content in Devices
  - Lack of Flexibility, Updating Inconveniency

# *Evaluation (1 / 3)*

---

- Attractive Features
  - **Play without Plug**
    - Devices can be used without complex setup
    - Content can be accessed by intrinsically different devices.
  - **Economy** – Dramatically reduction in total-weight in system, power consumption, and size
  - **Many-to-Many Transmission** – Information can be spread out quickly.

# *Evaluation (2/3)*

---

- **Instant Update** – Suitable and the latest information can be retrieved naturally.
- **Interest-Oriented Information Sharing** – Desired information can be easily extracted.
- **Secure Enhancement** – Confidential information can only be accessed in the company.

# *Evaluation (3/3)*

---

- Quality Attributes
  - **Transparency** – user/host is not aware of the difference while adopting this new product.
  - **Reliability** – data is available and correct anytime and anywhere.
  - **Inter-Operability** – the new product can be used over different platform.
  - **Performance** – the new product should be good enough, compared to the similar products.

# *System Description Table (SDT): Design, Trade-off*

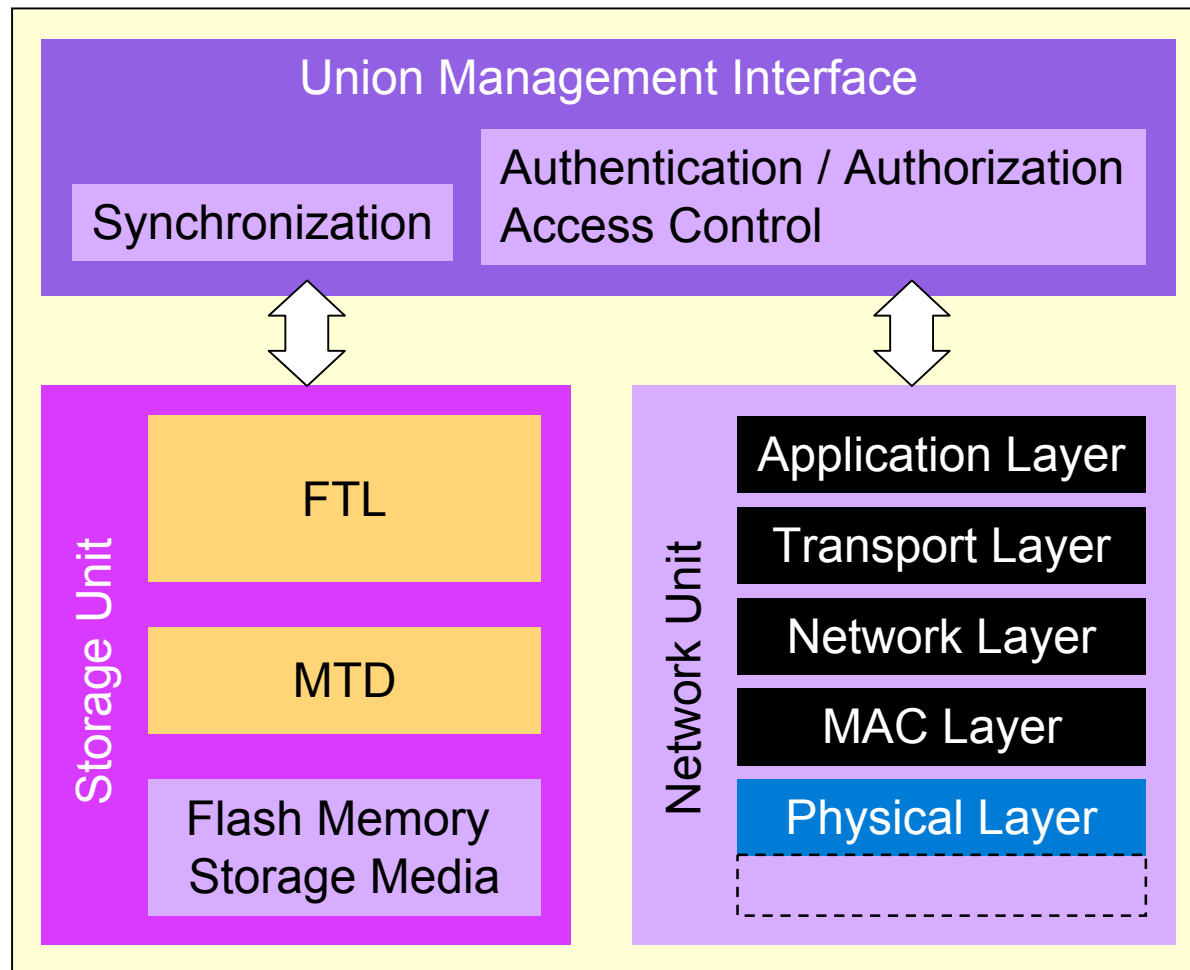
---

	Transparency	Reliability	Inter-Operability	Performance
Play without Plug	Adapter (L)	UWB (H)	FTL (M)	UWB (H)
Many-to-Many Transmission	Multicast / Broadcast (M)	UWB (H)	Layered Design (H)	P2P (H)
Instant Update	Daemon (H)	Synchronization (M)	Porting (H)	Hand-Off (M)
Secure Enhancement	Encryption / Decryption (H)	Authentication / Authorization (H)	Layered Design (M)	Hardware Circuits (H)

\*Efforts: H: High, M: Medium, L: Low

# Block Diagram for SDT

---



# The Challenges (1 / 2)

---

	Play without Plug	Many-to-Many Transmission	Instant Update	Secure Enhancement
MTD	(D)	(D)	(D)	(R) Encrypt / Decrypt
FTL	(R) Rapid Booting	(R) Simultaneous Read / Write	(D)	(D)
UMI	(R) Transparency	(R) P2P Networking	(R) Version Control	(R) AAA Control
PHY	(D)	(D)	(D)	(D)
MAC	(D)	(R) QoS between Peers	(D)	(D)

\*R: Research, D: Develop

# *The Challenges (2/2)*

---

- Power Consumption

- Power Sources\* – Fuel Cells, Solar Cells, Heat, Vibration, Fusion
- “How to save energy” is also a hot research topic, for example:

[1] Chin-Hsien Wu, Tei-Wei Kuo, and Chia-Lin Yang, 2004, "Energy-efficient flash-memory storage systems with an interrupt-emulation mechanism," IEEE/ACM/IFIP International Conference on Hardware/Software Codesign and System Synthesis, Stockholm, Sweden, September, 2004.

[2] Li-Pin Chang, Tei-Wei Kuo, and Shi-Wu Lo, "A Dynamic-Voltage-Adjustment Mechanism in Reducing the Power Consumption of Flash Memory for Portable Devices," IEEE International Conference on Consumer Electronics, Los Angeles, USA, June 2001.

\* [http://www.trnmag.com/Stories/2005/061505/HiW\\_Power\\_sources\\_--\\_fuel\\_cells\\_solar\\_cells\\_heat\\_vibration\\_and\\_fusion\\_061505.html](http://www.trnmag.com/Stories/2005/061505/HiW_Power_sources_--_fuel_cells_solar_cells_heat_vibration_and_fusion_061505.html)

# *Rank the Proposed Topics*

---

- Integration
- Power Consumption
- Quality of Service (QoS)
- Security

# *Conclusions*

---

- A New Product line to improve quality of life.
- A well-organized, exciting set of research topics are proposed.

# *Key Related Works (1 / 3)*

---

- Wireless Flash Memory
- [1] <http://www.intel.com/design/flash/wireless.htm>
- Play without Plug
- [2] <http://www.ieee802.org/11/DocFiles/05/11-05-0788-00-000s-mna-5min-statement-to-tgs.ppt>
- QoS for USB
- [3] Chih-Yuan Huang, Tei-Wei Kuo, and Ai-Chun Pang, "QoS Support for USB 2.0 Periodic and Sporadic Device Requests," *the 25<sup>th</sup> IEEE Real-Time Systems Symposium (RTSS)*, Lisbon, Portugal, December 2004.
- [4] Chih-Yuan Huang, Li-Pin Chang, and Tei-Wei Kuo, "A Cyclic-Executive-Based QoS Guarantee over USB," *IEEE 9<sup>th</sup> Real-Time and Embedded Technology and Applications Symposium (RTAS)*, Toronto, Canada, June 2003.

# *Key Related Works (2/3)*

---

- Ultra-Wideband
- [5] Xin Wang, Yong Ren, Jun Zhao, Zihua Guo, and R. Yao, "Comparison of IEEE 802.11e and IEEE 802.15.3 MAC," *Proceedings of the IEEE 6<sup>th</sup> Circuits and Systems Symposium*, 2004.
- [6] Yu Cai, Zihua Guo, and R. Yao, "A novel design of IEEE 802.15.3 MAC over UWB," *Vehicular Technology Conference*, 2004.
- [7] S. Datta, I. Seskar, M. Demirhan, Siun-Chuon Mau, and D. Raychaudhuri, "Ad-Hoc Extensions to the 802.15.3 MAC Protocol," *World of Wireless Mobile and Multimedia Networks*, 2005.
- [8] <http://www.uwb.org/>
- [9] IEEE standard for information technology - telecommunications and information exchange between systems - local and metropolitan area networks - specific requirements part 15.3: wireless medium access control (MAC) and physical layer (PHY) specifications for high rate wireless personal area networks (WPANs), IEEE Std 802.15.3-2003

## *Key Related Works (3/3)*

---

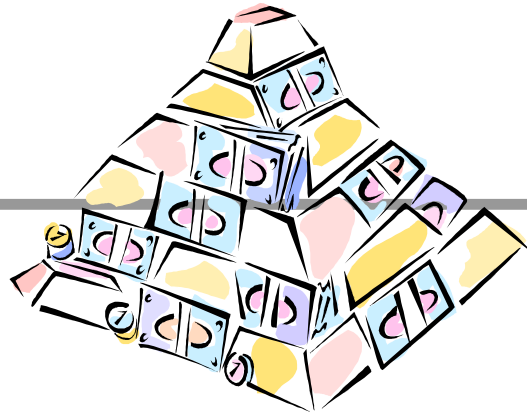
- [10] S. Roy, J. R. Foerster, V. S. Somayazulu, and D. G. Leeper, "Ultra-wideband radio design: the promise of high-speed, short-range wireless connectivity," *Proceedings of the IEEE*, Volume 92, Issue 2, Feb 2004.
  - Power Sources
- [11] [http://www.trnmag.com/Stories/2005/061505/HIW\\_Power\\_sources\\_--\\_fuel\\_cells\\_solar\\_cells\\_heat\\_vibration\\_and\\_fusion\\_061505.html](http://www.trnmag.com/Stories/2005/061505/HIW_Power_sources_--_fuel_cells_solar_cells_heat_vibration_and_fusion_061505.html)
  - Power Consumption for Flash Memory
- [12] Chin-Hsien Wu, Tei-Wei Kuo, and Chia-Lin Yang, 2004, "Energy-efficient flash-memory storage systems with an interrupt-emulation mechanism," IEEE/ACM/IFIP International Conference on Hardware/Software Codesign and System Synthesis, Stockholm, Sweden, September, 2004.
- [13] Li-Pin Chang, Tei-Wei Kuo, and Shi-Wu Lo, "A Dynamic-Voltage- Adjustment Mechanism in Reducing the Power Consumption of Flash Memory for Portable Devices," IEEE International Conference on Consumer Electronics, Los Angeles, USA, June 2001.

# *The Candidate*

## *Conferences / Workshops*

---

- RTAS 2006  
The 12<sup>th</sup> IEEE Real-Time and Embedded Technology and Applications Symposium
- SAC 2006  
The 21<sup>st</sup> Annual ACM Symposium on Applied Computing - Special Tracks on Embedded Systems
- AINA 2006  
The IEEE 20<sup>th</sup> International Conference on Advanced Information Networking and Applications
- NSDI 06  
The 3<sup>rd</sup> Symposium on Networked Systems Design and Implementation
- AuS Wireless 2006  
The 1<sup>st</sup> IEEE International Conference on Wireless Broadband and Ultra Wideband Communications
- ASWN 2006  
The 6<sup>th</sup> IEEE International Workshop on Applications and Services in Wireless Networks



# *Summary: Creativity Process - structured and learnable*

Kuan-Ling Chen (NTU Student)

Lui Sha



# *Creativity Process*

---

- **Identify potential research topics**
  - Position the research focus on the intersection of your **gifts**, your **interests**, and **societal needs**.
  - All the ideas and contributions should be recognized and acknowledged explicitly. This is key to successful collaboration..
- **Examine the Trends**
  - Examine the candidate topics' relation to the current research trends
  - Identify the contributions and limitations of related works
  - Spot opportunities that may create new trends
- **Look deeper into the Challenges**
  - What can be solved by current technology?
  - What needs to be invented?
  - What is the estimated effort?
  - What is the **key factor** that makes a result significant?

# *Creativity Process*

---

- **Estimate the Impacts**
  - What are the categories of research and their risks/impacts?
    - new directions, unification/integration, broad applicability, incremental improvements.
- **Look ahead into the Future**
  - What are the new and exciting application scenarios that established technologies stop working?
  - What will the future technology enable?
  - What is impossible, and what can be formulated into a similar and solvable problem?
    - understand the true nature of constraints and separate the hard constraints from the soft ones.

# *Creativity Process*

---

- **Expand to a Family of solutions**
  - A group of solutions where each member is complemented and reinforced with each other .
    - What are their ***intrinsic characteristics***?
    - What are their strength and limitations?
- **Layout an elegant Architecture**
  - Optimally use the advantages of each member.
- **Implementation**
  - Publish papers and file patents.
  - Create new architectures, protocols,...
  - Prototype demonstration and identify industrial partners.

# *End Products*

---

- From incremental improvements along the line of existing ideas
- To the creation of a new direction
  - Structurally different from the existing ones
  - Enabled by emerging technologies
  - Enable new and exciting applications that were not possible before