Tags

- Tags will be passive. They will be everywhere. This includes embedded in the physical infrastructures, such as building walls, and public spaces. They will also be in everyday objects. They will be affixed at time of object production. Or they can be affixed later. The point is that there is a richness of how tags will appear in our lives. We cannot constrain ourselves to one idea of tag distribution.
- Because of the richness, some tags will be mobile, some will be fixed in location.
- Some tags will fail quickly. Some will be more robust.
- Some tags will have little storage. Some will have a lot. We believe we can leverage their storage beyond their original use.

Readers (Interrogators)

- Readers will also be pervasive, and again in a rich sense. Some will be in fixed infrastructure (like many already are for warehouse and supply chain management). But others will be in personal devices.

Sensors

- We believe in cheap and embedded sensors. But these will likely happen after the explosion of passive tags. That is, sensors need power, and so we expect these ideas and innovations to occur after passive tags become truly pervasive.

Distributed Computation, Storage, and Communication

- Tags and readers truly pervasively available allows for powerful distributed computation paradigms.
- We believe there is more than just an extension of the Internet architecture here. There is more than just connecting everything online. Yes, this will be significant. But current research (and industry trends) have shown there is an online and physical locality gap.
- We believe RFID will play a big role in bridging the online and locality gap. Online (cloud) paradigm has many benefits. Availability. Fault tolerance. Virtualization. Scalability. Locality paradigm has many benefits too. Immediate relevance of space-time situation. No connectivity issues. Privacy and security (system assurance) through locality.
- How to synchronize local and online? What does it mean to synchronize? Simple application examples include collaborative whiteboarding (two-way communication) and information dissemination (one-way communication). These have traditionally been available both offline and online, in a variety of settings and technologies. RFID has the opportunity to bring these together. That is, RFID allows for offline computation. But active devices interact frequently RFID, allowing for online functionality.
- Machine learning. Tag population can learn together. As readers move and scan tags, learning can be achieved in a space-time context.
- Research in wireless networks and its manifestations, like DTNs, ad-hoc networks, etc. teaches us many lessons about communication and computation in a distributed fashion. But these systems are premised on active nodes. Even if the networks contain different types of nodes and capabilities, the passive components are rarely part of the big picture. In our vision, these passive devices play a significant role. One can view this as a further generalization of DTNs. But that would still restrict the model. We want to investigate how this richness of devices (both tags and readers) contributes to many novel ideas.
- Example of storing information in a building. In previous work, people store data in tags, in a building. We generalize further. These tags are not known ahead of time. They may be in the walls. They may be in movable objects. They may come in and out of the building. We take information, chop it up, encoding it for reliability and assurance. Then, we distribute it over the building. This can manifest itself in a variety of ways. Active devices trading information peer-to-peer. Information being distributed over an active network. But finally, information is stored in tags. Now, how can we retrieve that information back later, if its constituent parts are all over the building? The tags are everywhere and possibly even moving. Readers also are highly varying.

There is so much randomness in this model. But we believe this richness gives us a very powerful model of computation, storage, and communication.
- We desire some low level model to give us design pointers when we build difficult systems. What are the scaling laws? For example, if my building has a density of pho tags per unit area. What is the ballpark figure for computation power or reliable storage? Given some engineering resources, we want models that tell us what makes sense. This will help us in building large-scale systems.