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Emerging Technology Disruptions

Learning from Experiments

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Summary

The Internet infrastructure is evolving into a new phase, bringing in new disruptive technologies such as space networks, quantum computing and blockchain platforms. We provide a brief synthesis of some of our work in these areas with the most important take-aways.

Emerging Technology Disruptions: Learning from Experiments

The recent string of large-scale technology investments over the last few years, mostly led by the cloud/internet players, and in areas as varied as cyber-security, space internet, blockchain, quantum computing and the likes, points to some interesting inflection points in the technology innovation eco-system. It basically highlights the rapid emergence of disruptive technologies, that in essence, build on top of the latest disruptive business and technology cycles that we have witnessed over the last couple of decades, centered around the deployment of Internet and data technologies at scale.

We have been heavily involved in working on these technologies, with some of the lead internet/cloud players. Although most of the work is still at design phases and primarily at experimentation stages, some significant observations are emerging, in terms of what will likely end up being the priority and focus in terms of investments and technology developments, where killer applications are likely to emerge, and what challenges one would need to overcome.

Some of the work we have been doing is described along the five key areas listed below:

• Internet Intersects Space Technologies:

The space is race is on again, and this time primarily focused on building a new generation of low earth orbits (LEO) satellite constellations, to large-scale Internet broadband delivery. At the heart of it, a simple equation: for the cloud/internet players to keep their business models going, more Internet is needed, and to more people around the world. Breakthrough in space technologies have lead to a drastic reduction in the cost of launching satellites, building them and operating them, and as such a new era has opened. We have been actively working on some of the latest designs bringing in Internet knowhow into the new generation space and satellite technologies. In fact, a lot of the last two decades of learning deploying the backbone of the Internet infrastructure (4G/5G, Hyper Scale data centers, Submarine networks, Internet wide routing and quality of services, network wide cyber-security, etc.) provide a first set of solutions to a lot of the challenges of Low Earth Orbit satellite constellations, augmenting satellite networks with designs that have been proven and deployed at scale in the Internet.

• Into the Quantum Era:

Compute technologies are the common denominator for the growth of a lot of the technologies we are witnessing today, from AI to IoT to Blockchain and others. Evolving them is the challenge to crack for those that would want to win the technology race, and quantum computing has been one of the key breakthroughs to go after, and a lot

of progress has been made in building the new generation of Quantum Computers. Yet, the first major commercial breakthrough of Quantum technologies are emerging in an adjacent area – that of Quantum Internet cyber-security, with the goal of making the encryption technologies way more robust, leveraging a new generation of key distribution and management technologies. Some of these quantum technologies are likely to become the main focus of high security networks, and possibly mandated over time. Our work in this area has been focused on ways of operationalizing these technologies and taking them into the real world, and learnings from the field are so far, very exciting.

• Blockchain moving ahead:

Blockchain is by now, a technology that everyone knows about and very few have managed to commercially leverage at scale, and this is not because of lack of trying. Tons of applications are running, and some even commercial, especially in areas that have to do with bringing a new generation of Fintech applications to market. Yet, a lot remains to be done, on some of the most fundamental aspects of it, as far as making the blockchain platforms robust, scalable, usable and manageable at scale. Efforts are full speed into that, but will take few additional cycles on the engineering development side, and results are likely to be seen in the emergence of key breakthrough in the decentralized data management, data sharing and exponentially more efficient use of compute/storage/networking resources at scale. This is likely to be supported by the major initiatives launched by cloud players offering blockchain platforms as a service, leveraging the scale, cost dynamics and ecosystem pull of large scale public clouds. We have been working on the intersection of blockchain and the Internet infrastructure, which from experience will open up a new wave of applications, leveraging these platforms. From there, killer apps will very likely emerge. We just don't them yet.

• Artificial intelligence itself needing disruptions:

AI has had lots of lives, and we are just witnessing one of its best times. A new era of computing, the flood of data coming out of all the new Internet business models, and the highly competitive data driven economy, lead to incredible advances in how AI is used and is by now, almost a feature in a lot of advanced products coming to market. Yet, this has been the case for numerical AI specifically, in the form of machine and deep learning models, while the other branch of AI, symbolic AI, has seen very little progress. Our work has focused on developing models where symbolic AI would come in to address some of the challenges of numerical AI, as far as cost of training, complexity of learning and efficiency of reasoning. This in some sense is a repeat of some of the initiatives run in the mid 90s when numerical and symbolic AI converged, and as such, we shall expect a revival of hybrid models over the next few years. This leads us to believe that the next decade will see a lot more of synergies between the different intelligent computing technologies, with AI being one of the most fundamental components, with a new set of applications emerging out of that.

- A new era in the delivery of Web Scale Software:

Approaches for building software systems have changed drastically over the last few years, and at the heart of it, two fundamental drivers: the move to the cloud and the emergence of large-scale open source software and developer communities. A lot is tried, and some is adopted, and becomes the norm. We have seen that with the first generation of cloud based software, leveraging virtualization and cloud compute models, followed by a new era of containerization of software at scale, and into new models showing promise in areas such as server less compute and other models. Yet, a lot of these developments all call for a common thread: the automation of software delivery, and deployment at scale, leveraging advanced API models, machine learning for software integration and delivery, and allowing through that the development of rapid release of software applications at scale. This is bound to continue, and will be a key competitive differentiator for the application developers aiming at leveraging the new generation of cloud based compute architectures.

Besides the ongoing disruptions we are seeing at the moment, one shall expect the emergence of a totally new set of applications and business models over the next decade, that would drastically change what we know today. This is likely to lead to the emergence of new technology leaders over the next decade, displacing the ones we know and live with today. This time, as it was the always the case before, those embracing change would be the leaders to stay, and others would be absorbed or disappear. Put simply, just like basic genetics!

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