



Sanqi Li

The Energy Internet is an important segment of overall Industrial Internet solutions. We expect Huawei to empower E2E Energy Internet solutions through partnership and open ecosystem foundations. >>

Key “Things” about Energy

— An Interview with Sanqi Li, Huawei Chief Scientist

By ICT Insights

ICT Insights magazine recently interviewed Sanqi Li, Huawei Chief Scientist, about the Energy Internet. What is the Energy Internet? How will it impact ICT? Dr. Li gives us an in-depth and detailed report on the challenges and opportunities, technologies and products, and ecosystems and transformation methodologies in this new field.

Energy Internet Generates New Business Models

ICT Insights: Recently, the Energy Internet has become a very hot topic of discussion and debate. How do you see the Energy industry changing, and what are the opportunities?

Dr. Li: Today, we are living in the new digital world, where we expect more disruptive innovations across traditional industries over the next 10 years than what we have seen over the past 50 years. The Energy Internet is no exception, particularly in the green energy sector. Jeremy Rifkin states in his book “*The Zero Marginal Cost Society*” [Palgrave MacMillan, 2014; ASIN: B00JIG9AYO] that since the industrial revolution (over the last 150 years) energy efficiency has improved from 2 percent to 13 percent. It is important to note that such energy efficiency actually contributed 86 percent to global economic growth. Over the next 40 years, this new revolution is expected to increase energy efficiency to about 40 percent, accelerating the potential for economic growth.

ICT Insights: What are the business models that support this change? The energy sector has traditionally been a strong vertical silo; can they make the business case for change?



Dr. Li: Recently, we have seen the coexistence of three different business models used in forming Energy Internet solutions: the incumbent transformation model, the green energy startup model, and the cloud-overlay light-asset model.

- **Incumbent transformation model:** Incumbents in the energy sector are traditionally monopolized, vertically integrated, highly regulated, heavily asset driven, and highly segmented in silos of energy generation, transmission, conversion, storage, and consumption. They will be in a constant struggle between a sustaining OPEX-focused model and a disruptive growth-focused model, between closed systems and openness, and between a diminishing monopoly and a new ecosystem value proposition as a part of transformation.

For example, Industry 4.0 activities in Europe have been largely emphasizing how to embrace such transformations given European industries’ leadership positions in manufacturing and infrastructure from the previous industrial revolution.

- **Green energy startup model:** This model will likely remain a minority option in this early stage of development but has enormous potential to disrupt the existing energy. Green energy opportunities extend from more traditional generation and transmission to include natural resources, technology, economics, and marketing. In the U.S., companies such as Tesla Motors continue to invest in renewable energy. Tesla recently announced plans to build a “giga-factory” for batteries so it can produce an electric car for the mass market and possibly make batteries for city-level solar energy storage. Collaborations and partnerships among greentech companies and incumbent utilities are essential to driving the transition towards decentralized Energy Internet solutions.

- **Cloud-overlay light-asset model:** Unless incumbents are able to embrace the transformation to disrupt, they can be disrupted by pure Over-the-Top (OTT) cloud platform players. Perfect examples are Uber and AirBnB startups in the consumer space, where they can quickly establish new creative monopoly business models based on their pure software-defined light-asset cloud platform without owning any heavy assets (cars and hotels). They simply rely on their customer front-end and relationship management software asset

to differentiate and compete. Telecom service providers have seen a massive disruption when non-traditional players such as Apple, WhatsApp, Facebook, and Tencent started providing OTT voice and messaging services.

Some incumbents in the energy sector in China have been trying to build strategic partnerships with leading pure cloud overlay players to accelerate their digital transformation. Such partnerships are likely to be difficult, since the core energy business (and thus, the core value delivered to the consumer) is still very asset-heavy, and utility-priced.

ICT Insights: Can a century-old, utility-based industry really change all that much? Partnering with Internet technology companies seems pretty far away from what we think of when we look at the traditional Energy industry.

Dr. Li: Every business will become a digital business in the new digital world. The Energy industry is already leveraging technology to increase production and transmission efficiency, lower costs through automation, and reduce manual labor with remote meter reading, online bill processing, and hands-off infrastructure management systems.

In recent years, the ICT industry has been going through major software-defined transformation ranging from virtualization and automation across computing, storage, and network resources to highly distributed cloud service platforms and Big Data analytics. In contrast, most incumbent enterprise IT infrastructures in production today were built with 1990s technology, using highly fragmented and vertically integrated stacks. This heavy-weight foundation not only causes runaway eighty percent IT OPEX, but creates an inflexible platform that is incapable of supporting the upcoming cloud-based and Big Data-driven digital transformation.

The essence of the Energy Internet is to digitally transform the heavy-asset-oriented Energy industry through software-defined light-asset capabilities empowered by the newly transformed ICT industry, leveraging the three basic business models.

The Energy Internet is part of Industrial IoT, which captures the new industry revolution across manufacturing, energy, agriculture, transportation, and other industrial sectors of the economy, accounting for nearly two-thirds of the global GDP.

3-Layer Industrial Internet Architecture

ICT Insights: How does the Energy Internet relate to Machine-to-Machine (M2M) and Internet of Things (IoT) trends that we hear so much about?

Dr. Li: The Energy Internet is part of Industrial IoT, which captures the new industry revolution across manufac-

turing, energy, agriculture, transportation, and other industrial sectors of the economy, accounting for nearly two-thirds of the global GDP. In general, the Industrial IoT solution platform is vertically formed through a so-called three-layered Internet model:

- Communication Internet across various carrier, wireless, field, enterprise, and home networks.
- Industrial Internet, which digitally transforms all devices, equipment, and facilities in the physical world and hence connects them through sensors via the Communication Internet.
- (Digital) Logistics Internet, which encompasses the cloud data centers with advanced software analytics and data intelligence capabilities to empower new technologies and business innovations.

ICT Insights: What is Huawei doing in research and product development that fits into this vision of the future? What technology can be applied to the Energy Internet?

Dr. Li: In the communications industry, energy sourcing, power efficiency, green-energy technologies, and energy storage have been key topics

for quite some time. Just as the Energy industry changes have helped telecommunications transform, we believe that the telecommunications and ICT industries can help the Energy industry transform as well.

As a primary ICT infrastructure and platform provider, Huawei has been investing substantially across all three Internet layers for many years.

At the Communication Internet layer: Huawei has successfully driven the transformation of telecom networks from voice to data, from fixed to mobile, and from TDM to IP over the last ten years, forming the current-generation Communication Internet. Moving forward, the next-generation Communication Internet will focus on IoT services beyond human-to-human communication. SDN, NFV, Cloud, and 5G technologies will drive scalability, robustness, agility, and App-awareness across vertical markets. Network infrastructure will be transformed to a distributed cloud network across not only carrier networks but also non-carrier networks such as enterprise networks, data center networks, in-field networks, and home networks.

At the Digital Logistics Internet layer (i.e., cloud data center): About five years ago, Huawei executives made a major strategic decision to invest in the Cloud-based data center infrastructure market. Cloud technologies, along with disruptive IT business transformation, have fundamentally changed data center infrastructure requirements, including virtualized and containerized servers, software-defined storage, and software-defined networks to cloud infrastructures and platforms.

Since 2011, Huawei has achieved sustained annual double digit growth in the cloud-based data center infrastructure space. Huawei today is among the top four server product providers in the world. Our data center equipment has been deployed in more than 400 data centers, and our OpenStack-based Cloud software infrastructure, FusionSphere, has been installed in over 120 data centers around the world, largely in the enterprise market. Our Hadoop/Spark-based Big Data analytics engine, FusionInsight, has been deployed in the core of enterprise businesses,

including key worldwide implementations in leading banks and tier-one telecom operators. Today, Huawei has emerged as a leading global data center infrastructure solution provider.

At the on-premise Industrial Internet layer, Huawei has focused mainly on building ecosystem foundations across various industry silos:

- **Communication modules:** Commonly shared by various industry devices to connect to a wide range of dynamic networks (short range, long range, industry, carrier, home, etc. through multiple generations), communications modules must meet different service requirements for latency, bandwidth, power consumption, reliability, security, and so on. Huawei has been working closely with leading automotive manufacturers for telematics; governments and public safety organizations for Smart Cities; leaders in education to connect classrooms and remote schools; and dozens of other industries to create solutions to common cross-industry connection challenges.

- **Unified OS in IoT devices (Huawei LiteOS initiative):** 100 billion rapidly emerging, highly diversified IoT devices will be connected to the Internet by 2025 with a wide range of constraints including CPU, memory, power, network, life-cycle, and many others. It is critical to develop a unified OS across diversified IoT devices for functional abstraction, software programmability, connectivity, and hardware decoupling.

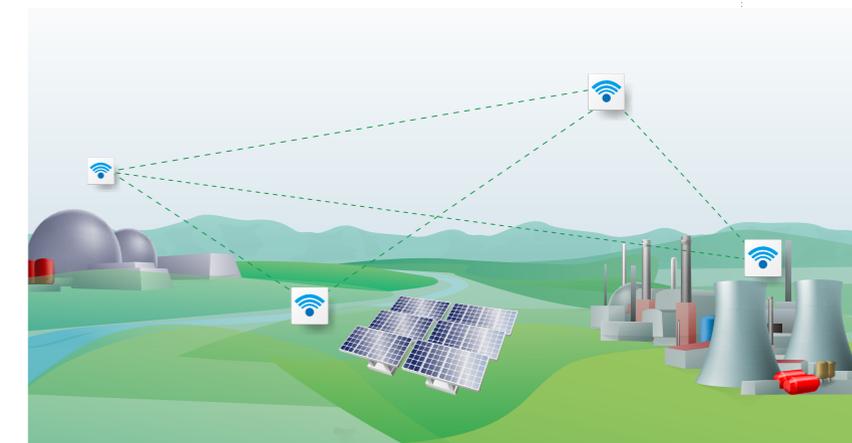
- **IoT gateway:** An IoT gateway often sits in the middle between IoT devices and telecommunication networks, not only providing the necessary network connectivity, but also supporting additional intelligent functions such as event processing, protocol conversion, data aggregation, security, and Big Data streaming. Most existing industry field networks today are fragmented and proprietary, and the IoT gateway can serve as an overlay device to connect diversified industry field networks to industrial management and IT-based systems in a more standardized and open framework.

Notice that all the above three major Huawei developments have

been addressing the fundamental first steps toward industry digital transformation: making industry on-premise devices digitally connect to the Communication Internet and digitally interact with the Digital Logistic Internet.

Since 2010, in the rapidly emerging green energy field, Huawei has focused on Photovoltaic (PV) inverters, which directly connect solar panels to local and public electric grids, and on other deployable energy solutions. Today, Huawei is a top supplier of PV inverters in the China market in addition to having achieved rapid growth in Europe and other international markets, with a total global installed capacity of about 10 GW. Our success is largely due to the significant technology advantages that achieve high efficiency, high reliability, and low OPEX, and are driven by the need to power ever-expanding networks around the world.

PV inverters are a critical component in solar energy systems but far from forming E2E Energy Internet solutions. In one example, Huawei adopted our eLTE devices to digitally connect all PV inverters



along with other existing electric grid devices to the mobile Communication Internet and integrated our cloud infrastructure solution at the enterprise centralized operation and management DC, essentially forming the basis of the future E2E Energy Internet framework.

Open Cooperation and Distributed Intelligence

ICT Insights: The Internet of Things (IoT) is also a very popular topic these days, what do you think are the future IoT technology trends, what technical changes? What is driving these changes, and what are the potential benefits for the Energy Industry?

Dr. Li: IoT solutions can be further categorized into consumer IoT and industry IoT. Today, we have seen significant early success in the consumer IoT space, largely driven by OTT players. Their cloud-overlay and light-asset-only model successfully decoupled user experiences, business intelligence, and service enrichment from the traditional heavy-asset sectors while creating new, and sometimes dominant, value propositions. Industry IoT is still in an early emerging stage, which requires

horizontally crossing multiple industry sectors, which is traditionally very difficult.

Sensors in industrial systems have been connected and integrated for decades, especially in the Energy industry (remote oil platforms, power meters, energy distribution networks), but have thus far lacked the openness, programmability, and agility that is predicted with the Energy Internet. Connecting things in the Energy industry will continue and accelerate, driving the real challenges around the data and context, and in realizing the value of the data and identifying new initiatives driven by that data.

Without large traditional industry enterprise participation and collaboration, pure OTT players must meet great challenges to be successful in the Industrial Internet. The data and operations of the Energy industry are locked within incumbent Energy industry systems. There is not a strong culture of openness and cross-industry ecosystems today, limiting the potential collaboration and innovation options available. So the first prediction is that openness and cooperation to share data currently embedded in Energy systems will become routine.

The second prediction is that dispersion will occur. The Energy industry has been traditionally divided into multiple sectors from generation and conversion to transmission, storage, and consumption. Like most Industrial Internet solutions, the Energy Internet solution needs to have an IoT platform across all the three Internet layers from cloud DC to network edge and then to on-premise industry devices, across multiple industry sectors. Today, the major challenge in building such an Industry IoT platform is where and how to build its distributed intelligence, especially at the distributed network edges. In other words, a substantial amount of IoT platform functions such as session connectivity, event processing, data aggregation, data streaming, discovery, and security will push to distributed network edges, closer to the consumers of energy, and closer to on-premise machines and devices.

ICT Insights: The IT industry talks about “Cloud” as a consolidation and centralization effort, but you are predicting that processing will spread beyond the cloud? Doesn’t this conflict with the IT trend?

Dr. Li: There are three different models about where such distributed network edges are defined to support IoT edge intelligence: overlay, underlay, and native.

The overlay model assumes that distributed network edges are located at different data centers (e.g., on-premise or central hybrid cloud). Such a model has certain limitations as on-premise data centers are typically owned by one enterprise to cover one specific sector, hence all the cross-sector M2M connectivity (which can be very substantial) has to be carried out in the central cloud DC and DC interconnects that do not scale.

The underlay model is simply to integrate such IoT edge middleware intelligence into the on-premise network devices. From a telecom providers point of view, such distributed network edges occur at their external access networks, such as industry field networks, Wi-Fi access, enterprise networks, and home networks. Obviously such networks only cover local area IoT connectivity and hence are fundamentally limited to specific local devices and data, and only in their specific sectors.

The third model is called the native model, more from the telecom network operator perspective. Distributed network edge intelligence can be integrated into the telecom network infrastructure, where edges can be dynamically distributed either at access, metro, or core networks depending on requirements and demand. Being based in the distribution of the network, this model allows a single site, location, or region to be aggregated into a logical processing hub. Logically, an oil field, a power generation plant, and a neighborhood served by a power substation are all examples of geographically related and energy sector aligned telemetry, which is most meaningful in the local context. This model

has unique advantages to provide intelligence nearby to the objects and resources that are being measured and managed.

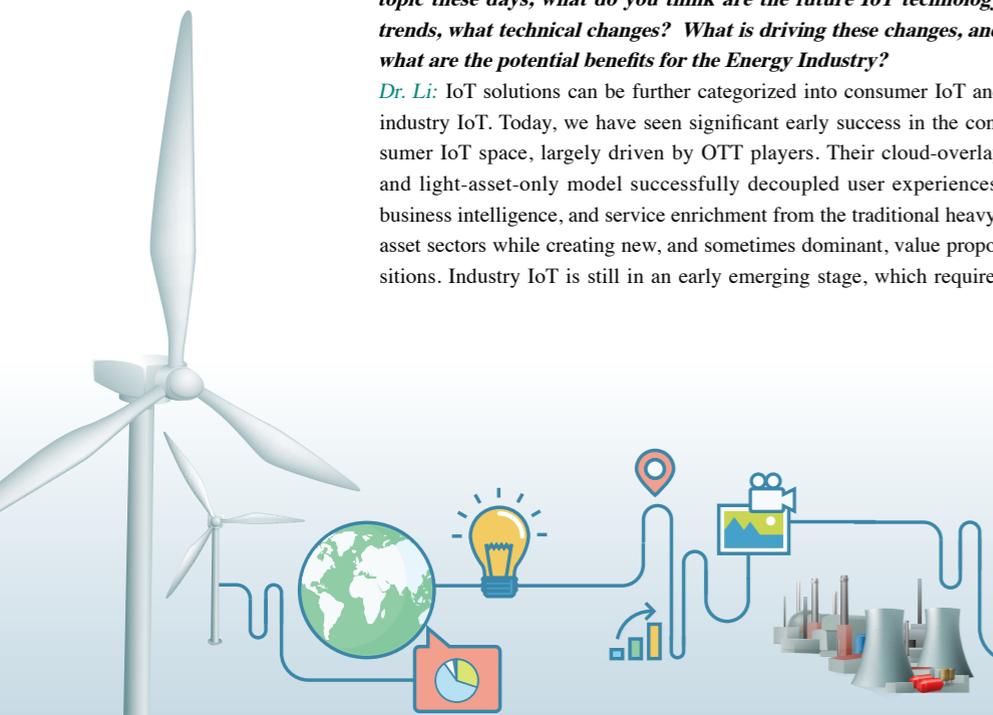
In the long run, all three business models will co-exist. Huawei is currently developing its IoT platform with emphasis on building IoT edge middleware intelligence uniformly in support of all three business models. This solution strategy is differentiated from pure OTT players by enabling our partnership with major industry players and building a common foundation and ecosystem.

Energy Internet Revolution

ICT Insights: The traditional telecommunications industry was also very siloed and vertically aligned 20 years ago, like the Energy industry today, until it was first hit by Internet expansion. Huawei has already experienced this Internet transition and fast-paced evolution, and has accumulated a variety of skills and experience. How does this experience help the Energy industry transform and evolve to the Energy Internet?

Dr. Li: There is a great analogy between what has happened in the telecom industry over the last 10 to 20 years and what is happening now in the energy industry. They both are monopolized and highly regulated industries. Telecom has successfully made three network infrastructure transformations: from voice-centric to data-centric, from TDM-based to IP-based, and from fixed-oriented to mobile-oriented, forming the basis of the content-driven Communication Internet today. Especially over the last 10 years, we have been ob-

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Communication Internet to efficiently cope with such content dynamics, but they have not actively participated in the content ecosystems until very recently.

If you look 10 years ahead at the energy industry, the Energy Internet will undergo transformation much like what content dynamics went through on the Communication Internet. Huawei certainly has gained substantial experience and knowledge in building network infrastructure migration and transformation in support of such content flow dynamics, which is valuable as the Energy Internet matures and evolves. This will obviously include significant existing infrastructure migration and transformation while protecting the integrity and investment of current heavy assets and processes.

The Telecom industry largely missed a golden opportunity to leverage both their hard-asset and soft-asset strengths to build new value before the encroachment of OTT services into even their core service silos (voice and messaging). The incumbent players in the energy industry sector should study the lessons learned from the telecom industry sector, seeking to protect sustaining business while expecting and embracing disruptive business changes.

In recent years, the Telecom industry has initiated a new wave of transformation across network infrastructures, data centers, operations, and business-enabling platforms, empowered by rapidly emerging SDN,

servicing a paradigm shift about how content has been produced, processed, converted, distributed, stored, and consumed across the Communication Internet. To a great extent, telecom operators have been successful in building their

NFV, cloud, Big Data, and distributed system technologies. Huawei's overall strategy towards this transformation is called SoftCOM, basically embracing Software-Defined-X where X stands for network infrastructure, data center, operation and business transformation enabling. Software is commonly referred to as a light asset once it is decoupled from any hardware-based heavy asset, hence has significant cost advantages in terms of distribution, integration, operation and business management, service agility, and collaboration.

In the Industrial Internet, digital transformation implies very much the same as Software-Defined-X. That is, through the abstraction and programmability of heavy-asset industry devices one can then leverage the light-asset nature of software across the three Internet layers to accelerate the E2E digital transformation. Such an optimized combination of heavy-asset infrastructure and light-asset software will fundamentally change the traditional operation and business models to allow energy industry enterprises to become more lean, agile, efficient, and super-scalable vertically and horizontally. In fact, the current new wave of telecom industry transformation shares much more in common with the upcoming industry IoT transformation. Our direct experiences and rich knowledge gained from the current telecom industry transformation are key drivers for Huawei to strongly contribute to the newly emerging Energy Internet transformation.

ICT Insights: For the Energy Internet to succeed, what are Huawei's biggest challenges and difficulties?

Dr. Li: In reality, what is holding us back are not technologies, but the legacy silo systems in place and their associated vertical and fragmented organizations and traditional inward-focused and process-driven corporate cultures. This is true of both the telecommunications industry and of the major incumbent players in the energy industry.

The new digital economy is a shared and leveraged economy and the fundamental requirements of Energy Internet solutions require horizontal integration and open relationships across every associate energy industry sector ranging from production and conversion to distribution, storage, and consumption. This will form new ecosystems with unknown and emerging new business models. Such transformation will obviously have a direct impact on current sustaining business models of various vertically integrated segments and silos, which have been traditionally monopolized and highly regulated through the previous industrial revolutions.

ICT Insights: What is Huawei's position on the Energy Internet? Can Huawei help build the Energy Internet ecosystem?

Dr. Li: Huawei is a world leading ICT infrastructure solution provider, especially in forming the next-generation Communication Internet and building new cloud-based data center infrastructure for the Digital Logistic Internet. Our Communication Internet products and solutions have been expanded from telecom networks to networks at enterprise, industry, and home premises. The new digital world is based on shared

economies and collaborative commons. In recent years, Huawei has been recognized as a major technical contributor in many emerging open source communities, a cornerstone of partnership, integration, and collaboration. We see Huawei as an excellent partner contributing value to the new ecosystems, but these ecosystems will need to be driven by the energy industry itself.

Toward the rapidly emerging IoT solutions, Huawei has been developing a new cloud-based IoT platform with emphasis on IoT edge intelligence at the distributed network edges to truly enable horizontally scalable IoT solutions across various industry sectors and on-premise local network silos. For the on-premise Industrial Internet, our main focus has been on providing key components such as common communication modules and IoT gateways. Huawei is promoting a unified and scalable open source OS software framework for the industry adoption across various IoT devices through our LiteOS project initiative. To support and accelerate IoT industry alliances, Huawei has established strategic partnerships with key leading technology companies in Europe across various industry sectors, such as SAP, Accenture, ABB, Audi, NXP, STM, and Fraunhofer. In China, Huawei has established strategic partnerships with key players of different industry sectors to empower the government-led "Internet+" transformation.

The Energy Internet is an important segment of overall Industrial Internet solutions. We look for Huawei to empower E2E Energy Internet solutions through partnership and open ecosystem foundations. Achieving E2E Energy Internet solutions will require ICT infrastructure and IoT platforms in place across all three Internet layers to truly empower the collaboration and partnership among the three business models (i.e., incumbent transformation, green energy startups, and cloud-overlay light assets). Huawei has been well positioned to drive these transformations and partnerships from business, solution, and technology perspectives. ▲

