Keeping the world connected, without sacrificing privacy

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Smart phones, vehicles, thermostats, fitness monitors and other internet-connected devices have made our lives far more convenient, but the amount of personal data they upload to the cloud has raised concerns

about privacy. In addition, uploading ever-increasing amounts of data is expensive and time-consuming.

A multi-university team led by University of Michigan industrial operations and engineering assistant professor Raed Al Kontar envisions a new kind of connected device infrastructure. Called the Internet of Federated Things, it could do more for its users while greatly reducing the amount of data that's shared. The paper, published in *IEEE Access*, is titled "The Internet of Federated Things (IoFT)."

We sat down with Kontar recently to learn more about his vision.

Why do we need a new model for connected devices?

The sheer amount of data that today's devices produce is beginning to overwhelm the old, cloud-based Internet of Things. In addition, there's a need for decisions to be made more and more quickly. In an autonomous car, for example, there often isn't time to upload data to the cloud and wait for it to be processed and sent back before taking action.

At the same time, the connected devices at the edge of the Internet of Things have become more and more powerful. Today's flagship cell phones, for example, are more powerful than many laptops, and Tesla has boasted that the computer that runs its Autopilot system is as powerful as 150 MacBook Pros.

We envision a new model that takes advantage of that power and does more data processing and decision making on edge devices instead of on cloud-based servers. The server would act as more of a coordinator, aggregating key findings from edge devices and enabling the network as a whole to learn from them.

What are the advantages to the IoFT outlined in your paper?

There are a lot of potential advantages, but maybe the most important from a consumer perspective is that it enables your devices to have greater functionality while sharing a lot less data. For example, instead of your cell phone uploading every detail of your daily activity to the cloud for processing, it could process the data locally and share only the results. That's a big improvement from a privacy perspective.

There are also advantages for businesses and other entities that, today, rely heavily on the cloud. For example, privacy regulations make it very difficult for hospitals to share data and work together to develop new innovations. But in an Internet of Federated Things, hospitals could collaborate in a more sophisticated way, sharing key findings without the need to release raw data from individual patients. There are also cost advantages that come from less data being transmitted and a reduction in the computing burden on cloud-based servers.

In addition, a system where more decisions are made by edge computing devices can be far faster and more resilient than one where all processing is done remotely. That's going to be more and more important as our vehicles and other infrastructure like power grids become smarter and more reliant on computing.

Are there any tech companies, or others, who are already doing this?

Google is using this model in some of its mobile applications and Microsoft has begun to follow suit. But really, the idea is in its infancy. There are a lot of decisions to be made and a lot of problems to be solved. And the goal of the paper is to get the ball rolling in that direction.

What are the hurdles to getting this model into more

widespread use?

There are a lot of interesting problems to be solved. Maybe the most obvious is standardizing and coordinating data. Data that's located on one central server can be randomized, shuffled and processed in many interesting ways. That becomes more difficult when data is partitioned out over many different devices that aren't always accessible.

Another problem that's perhaps less obvious but no less important is equity. If I have an IoFT of millions of smartphones processing data, it's natural to ask the newest devices to do the most work, because they're faster and probably have more data. That could put an undue burden on those devices, and it could also result in the under-representation of data from older devices—which are likely to be owned by less affluent users.

Like any new technology there is much to do to bring this technology to widespread use, and I look forward to tackling those challenges in the months and years ahead.

More information: Raed Kontar et al, The Internet of Federated Things (IoFT), *IEEE Access* (2021). DOI: 10.1109/ACCESS.2021.3127448

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