

Anywhere, Anytime, Immersive Communications

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The main focus of the traditional telecommunications industry over the past century or so has revolved around enabling inter-personal interactions. This includes point-to-point interactions (which happens when one person picks up a phone and calls another) as well as point-to-multi-point communications (such as when broadcasters transmit a signal that is received by millions of people).

While this paradigm remains important to the future of the communications industry, another set of opportunities is emerging that requires an entirely different way of thinking about communications. Computer and communications equipment are becoming so sophisticated that machines themselves (and by themselves) are driving demand for communications services. It seems difficult to believe, but already today, a growing number of communications sessions are initiated by machines to interact with:

- One or more machines
- One or more humans
- Both humans and machines simultaneously

Some of the applications that we are talking about are straightforward enough.

- They include technologies like Follow Me or Find Me services in which a call to one number triggers the network or device to make another call to where the intended recipient may be reached.
- Other applications are a little more exotic and complex – such as a centralized security system that detects a break-in at a remote facility many miles away, triggering voice calls and e-mail notifications to police and office managers, while instructing surveillance equipment to begin recording developments. In this scenario, an event occurs, triggering machines to contact other machines as well as people over the telecommunications network.

In both scenarios, events are causing machines to make calls without human intervention. Machines are not only generating traffic over the network, but also they are creating demand for value-added services. We live today in a world in which we are not only surrounded by devices – phones, PDAs, computers, servers, etc. – but also are interacting with devices that can initiate communications with people and other devices. As a result, we are not just connected, but immersed in a communications environment.

Untethering M2M

Communication among machines, and between humans and machines, has to-date largely been restricted to tethered local wired communication. However, emerging communication technology and services are targeting machine-to-machine (M2M) and human-to-machine communications from anywhere at anytime using wireless local and wide-area networks.

For instance, the emergence of low-power and low-cost sensor and actuator nodes (such as radio frequency identification, or RFID, tags) capable of communicating wirelessly using standardized interfaces and protocols is accelerating the growth of anything-to-anything communications.

Initial market penetration is focused in vertical markets such as healthcare, where the value proposition is immediately visible. RFID tags and other types of sensors are being used by hospitals to track the location of equipment (such as crash carts), medications and even patients.

But consumer applications are also emerging. There is a lot of excitement around developing new business models that use near field communications (NFC) to customize marketing messages to users as they pass billboards or other physical advertising mediums. So, for example, a pedestrian walking out of a convention center may pass an advertisement and then receive a text message on her cell phone that her favorite coffee shop is just around the corner and that a significant discount is available on her next mocha latte.

Service providers have a significant role to play in enabling M2M applications with their mobile cellular and broadband access networks in the coming years. Not surprisingly, initially the major growth is likely to be in the developed nations of North America, Europe and Asia-Pacific, subsequently spreading to other regions as the industry matures.

Examples of Anything-to-Anything Immersive Communications Service

There are applications of M2M communications in a variety of domains, such as home automation and control, e-health, enterprise asset tracking and in enriching the entertainment experience. Consumers now have the ability to remotely monitor and control home devices and appliances conveniently, either from inside or outside the home via their cell phones or personal digital assistants (PDAs) and through personal computers or laptops with Internet access. The impact of these developments can perhaps be best illustrated by following a day in the life of Kathleen, a hypothetical working mother (Figure 1).

Figure 1: Day in the life of home automation scenario

7:00 AM	Kathleen wakes up to the alarm; blinds are drawn up and the coffee pot is turned on automatically
9:00 AM	Kathleen leaves for work and notices on her way out that the lawn is too dry; uses cell phone to change settings to increase watering time
10:00 AM	Kathleen thinks she may have forgotten to turn on the slow cooker; checks over the Web and makes sure it is indeed on
12:00 PM	Kathleen receives call from her son Bob's school saying school will close ahead of usual time, at 1 PM
12:30 PM	Kathleen adjusts thermostat from work over the Web so that home is comfortable when Bob arrives
1:00 PM	Kathleen calls Bob and asks him to go home and stay at home
1:10 PM	Bob calls Kathleen from door front and Kathleen opens the door for Bob; deactivates alarm
2:00 PM	Bob wants to watch a movie and calls Kathleen; Kathleen orders a movie from work over the Web for Bob to watch
3:00 PM	Kathleen gets a warning that her pet dog is not in the house anymore; Kathleen calls Bob and confirms they are both out together

The underlying requirement for these services is M2M communications.

Numerous technological advances will also enable the rapidly aging populations of industrialized nations to stay at home safely, rather than be cared for in an institutionalized environment. Technology-enabled services range from virtual aides and assistants who can perform daily activities – like balancing checkbooks and helping with personal business correspondence – to medical-monitoring devices that can not only track key vital statistics, but also take action (such as administer an insulin shot) when conditions so warrant. The systems can detect anomalies in everyday activities of the elderly and inform family members or healthcare providers.

A growing number of enterprises are automating asset-tracking activities to streamline business processes and increase productivity. Consider a hospital environment where many high-value assets – such as wheelchairs, stretcher beds and IV pumps – are routinely misplaced. Technologies like RFID, which interact with base stations throughout the facility can take the guess work out of finding these assets and make it possible to provide more patients with better access to the resources they need while under the care of the facility. Asset location information can be integrated with dispatch applications to make it easier for doctors and nurses to find and use the equipment closest to where the service needs to be provided.

Alcatel-Lucent is currently engaged with the University of Pittsburgh Medical Center (UPMC) to develop intelligent software for asset tracking that incorporates data fusion from different localization technologies, sophisticated data mining and interfaces to a variety of hospital applications.

NFC technology in popular devices – such as mobile phones – is opening up a whole series of new applications. Consider these prototype applications developed by Alcatel-Lucent Bell Labs. Imagine Kathleen strolling in the city and noticing a Pop Band poster at the bus stop. Being a great Pop Band fan, she touches the poster with her NFC-enabled mobile phone to collect all the available information (concert dates, ticket prices, etc.).

Returning home, she touches the family TV set with her mobile phone, signaling to the communications network that she is home. Immediately, the TV's user guide displays all the information Kathleen collected during the day: Kathleen clicks on the Pop Band icon and re-experiences all the related information. She can now select the appropriate concert date and buy tickets for two (Figure 2).

Figure 2: Cross-media advertising



Later in the evening, Kathleen calls her best friend to give her the good news about the Pop Band concert. During the call, the real-time content inspection service detects that the conversation is about the pop star and immediately pushes related and relevant content from the Internet to Kathleen.

This information will provide her sufficient context in order to spend more time with her friend. Even when the conversation deviates to her latest visit to the Louvre Museum, the service pushes all relevant information on the museum.

The Future \$40 Billion M2M Market

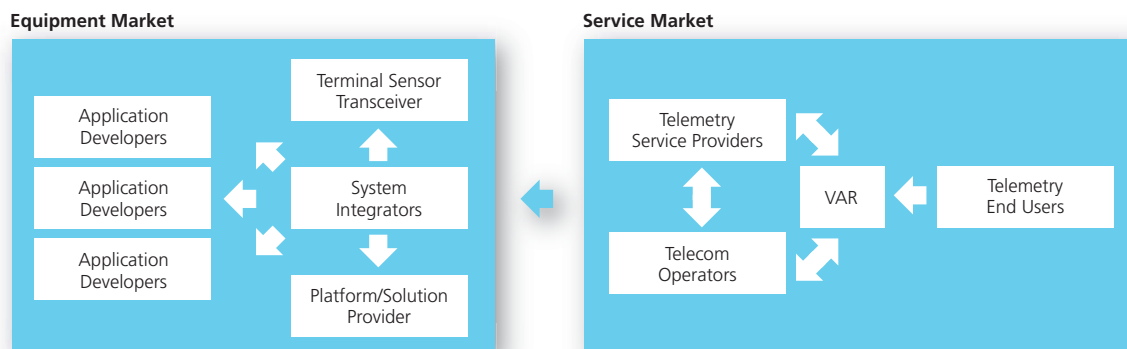
Strategy Analytics estimates the worldwide M2M communications market will reach \$40 Billion USD by 2011¹, with more than 500 million machines connected to each other generating communications traffic. The growth is expected to accelerate as the underlying technology infrastructure evolves from a fragmented, niche environment to a mature market that has mature standards.

For example, sensor communication in the home environment used to be a privilege of the rich. But with wireless standards such as Zigbee² and Z-wave, numerous vendors of home automation products have emerged, resulting in more affordable solutions. Similarly, standards have been developed for asset-tracking RFID tags.

Telecommunications operators, mobile communications operators and cable service providers have an opportunity to grow their revenue by enabling new applications and M2M communications services. Saturation in voice-penetration and relatively stagnant or declining average revenue per user are driving operators to accelerate broadband data networks deployment and provide data communication-related application and services.

The always-on data networks being deployed can be leveraged to connect anything to anything at anytime from anywhere. Beyond providing transport of information, operators can augment service platform infrastructure with new service enablers that exploit machine-enabled information. Management infrastructure also can be augmented with remote management of networked devices such as sensor networks in the home-automation network. These added enablers will result in new, intuitive communication schemes that enrich the consumer's experience, and that will increase the service provider's average revenue per user and reduce customer churn.

Figure 3: Telemetry value network



1 Strategy Analytics, \$40 Billion cellular M2M opportunity hinges on Bluetooth and Zigbee Sensors, Industry Report, March 2006.

2 K. Sohraby, D. Mimoli, T. Znati, Wireless Sensor Networks Technology, Protocol and Applications, John Wiley and Sons, 2007.

With the introduction of these new applications, new stakeholders come into play in the communications value chain. For example, the introduction of intelligent electricity metering in the home introduces the electricity supplier into the value chain. The cross-media application introduces content provider and advertising agencies into the value chain. In fact, the multitude of stakeholders justifies the more appropriate term of “value network,” instead of value chain, to show the complex nature of interactions between these stakeholders.

The value network for telemetry applications is illustrated in Figure 3. In this new ecosystem, relationships between the various stakeholders need to be established in order to define, among other things, the roles of the partners, the interfaces between the parties, the business logic and the revenue streams.

Technology and Network Impact

The remote provisioning and management of the M2M network is an important technological enabler if service providers are to roll out these applications as part of their home services offering. Consumers cannot be burdened with the task of maintaining the home network, yet they must have some flexibility to add other devices/sensors to the network at their will. Consumers also have come to expect good quality for the services offered by their service providers. For issues with the home broadband service, the consumer is used to immediately calling the service provider to fix the problem remotely, for which remote monitoring capabilities have been built into the set of tools operators use to manage their services. When a home-sensor network service is offered, a similar set of tools that enables them to remotely manage the network will be required. In e-health applications, the need for high reliability and security will drive additional requirements, further enhancing the value that can be added by service providers. Additional features specific to sensor networking and its requirements need to be added to the existing set of management features. New data object models and name-value pairs for sensor network management will have to be defined.

Intelligent middleware makes application creation intuitive. Application servers should not be burdened with low-level complexities of the sensor network communication such as addressing, interference management, link data rates and routing. A layer of processing that abstracts the sensor network operation and presents a simple interface to the application to utilize the network is highly desirable.

Consider the home environment, for example. An application requirement may be to turn off all lights in the house. With intelligent middleware, a single command from the application server will trigger the middleware to send messages to each of the light switch sensors in the house. Using this approach, the addresses, types or locations of light switches are hidden from the application. Intelligent middleware also can be designed to perform sophisticated data correlation to determine the context and forward data to appropriate application servers. This enables sensor-sharing and results in cost-savings.

Immersive Business Models

Anytime, anywhere machine-to-machine communications will result in the entry of new players into the traditional value network. Telecommunication operators will need to take on new roles and relationships if they want to bank on additional revenue streams for these applications.

The first challenge is to define the innovative business model. Innovation, which has been largely driven from a technology perspective in the past, will need to be complemented with substantial efforts by all stakeholders into business model innovation.

For example, billing system technology should take into account the need for complex revenue-sharing models and possibly collect usage information on finer spatial and time scales. There likely will be a shift away from subscription-based models toward targeted advertisement-based models where services are paid for by a combination of end-user fees and advertising sponsorships. Another feature to expect is that business models will become region-specific because of varied user perceptions and regulatory differences.

The second challenge is the go-to-market strategy, which requires a carefully orchestrated introduction of these new roles to the target audience. In general, two basic approaches are possible. The first is a vertically integrated strategy (Apple's iTunes approach). Market and consumer pressures will force this initially closed approach to open up to other players. An alternative approach is to build a consortium comprised of stakeholders who have sufficient clout together to negotiate and position the innovative business model into the market.

Business model evolution has already started with the introduction of IPTV applications in the telecommunication operator space where operators are engaged in a new relationship with content providers. Further efforts need to be undertaken in different spaces to build the relationships and develop business models that optimize investments in immersive M2M technologies.

Conclusion

Intelligent devices combined with machine-to-machine communications offer the potential to enrich end-user experiences. Alcatel-Lucent has developed and continues to develop technology enablers for such applications and services. But bringing such services to fruition requires a concerted effort by the industry as a whole. Communications service providers, being end-to-end solution providers for traditional services, are well-positioned to bring together the different players and have the opportunity to capitalize on the "first mover advantage." The keys to success will be a focus on the value created for the end users, new business models and an ecosystem where all participants can be successful. Taking these steps now will enable a competitive advantage in this important market. ✱

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