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Location Based Services Case Study

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Location Based Services have been presented by press and industry as a set of applications that may deliver significant profit to the mobile phone industry, and possibly beyond. These applications promise high margins with relatively low additional costs, and therefore high profitability. The key questions are which applications will be demanded and how different parts of the value chain will benefit from these demands.

At the Core-Edge Working Group, we are attempting to frame questions like these in a context of Core-Edge dimensions. Such dimensions for this particular case are enumerated below, but the general framework is that the Core represents the backbone of the network, e.g. centralized carriers operating long-haul equipment, and the edge represents the fingertips of the network, e.g. individuals holding handsets or other consumer devices.

Definition

Location Based Services (LBS) are simply applications that utilize users' current locations. The following examples should help clarify the concept.

- Asset tracking: enable organizations or individuals to track the locations of their assets, e.g. companies tracking mobile employees.
- Way-finding: help people find their way, e.g. by showing their positions on maps or by providing directions.
- Traffic management: aggregate many users' locations and then provide driving routes based on traffic patterns discerned.
- Emergency response: enable emergency responders to find out the locations of people requesting emergency response.
- Mixed-reality games: involve people playing games in the real physical world.
- Targeted shopping: provides users details about nearby shopping possibilities.
- Location-aware instant messaging: augment traditional instant messaging services with location information.
- Location-aware billing: enable services to bill users based on where they are using the service, e.g. mobile phone roaming.

Core-Edge Dimensions

In the context of Location Based Services, we have applied the Core-Edge Framework to differentiate the following two dimensions.

Collection: What core and edge components are used to collect location information?

This dimension concerns how much core network resources are involved in collecting the locations of users. At the edge extreme, users collect their own locations, perhaps by looking at street signs or landmarks, and then inputting their locations into applications when necessary. At the core extreme, location information is determined solely by central operators, perhaps through the analysis of satellite photographs.

In practice, applications on the core side are heavily dependent on core network resources to determine location, e.g. mobile phone antennas. Conversely, applications on the edge side are heavily dependent on handheld devices to determine location, e.g. GPS receivers. As you can see, though, this dimension is a continuum. Both examples just mentioned involve both traditional core and edge components, but use them in different ways and to different degrees.

- *Operation.* What core and edge components are needed to operate the application?

This dimension concerns what happens physically in terms of use of resources when a given application is operated. At the core extreme, the application is run solely in a centralized location, e.g. by the provider, using extensive network resources. At the edge extreme, the application is run solely by a user with an edge device, e.g. PDA, and does not rely on any core network resources at all.

Again, this dimension is also a continuum with most applications using both edge and core components. For example, an application squarely on the edge side would be a GPS handheld (edge) device that places itself on a map that is stored within its memory banks. The only core components used in this case would be receiving signals from the GPS satellites, which do not involve any traditional core firms.

Pushing that application more to the core side might involve using assisted GPS, where the edge device would rely on local GPS receivers and subsequent ground transmitters to help determine its location. Moving further to the core would be the same application, but with the maps stored centrally in an operator's memory banks, and sent over wireless internet as needed. As the application involves more and more core components, it moves more and more to the core side in this dimension.

Some Examples	Collection Core	Collection Edge
Operation Core	Tracking employees through their mobile phones.	Asset tracking in a national retail chain using RFID scanning and centralized inventory databases.
Operation Edge	Getting listings of nearby shops on your mobile phone from pre-stored lists.	Having a GPS handheld track a path traveled.

Core-Edge Competition

Core and edge components in the Location Based Services market involve very different types of firms. Core collection components, e.g. antennas, are administered by mobile phone operators, and core operation components, e.g. internet infrastructure switches, are administered by Internet Service Providers and telecommunications companies. On the other hand, edge collection components, e.g. RFID scanners and handheld GPS receivers, are essentially consumer products delivered by a variety of different types of firms including mobile phone handset providers and chip manufactures. Edge operation components similarly involve consumer products firms as well as software divisions or companies.

Core-Edge Properties

In the previous section, we presented the fact that core and edge based products may compete. Why might one or the other win out in the marketplace? We are developing a framework for thinking about this question. Consider the following properties that we believe are contributory factors.

- *Precision.* How precise is the location information?
- *Processing Power.* How much processing power does the application need?
- *Energy.* How much power is needed to run the application?
- *Cost*. How much does the application cost to deliver?
- *Speed*. How fast is the application?
- *Regulation*. How do regulations affect the delivery of the application?

Each type of service will have some intrinsic requirements, e.g. speed, and different firms will have intrinsic limitations, e.g. precision. As such, for given type of services, we can expect core or edge firms to be in a better starting position to capture more of the profits of the service.

We have additionally identified the following properties that may not be present in all types of services. These properties may help firms capture even more of the profits from a given service

because they involve intrinsic capabilities of either the core or edge side.

- *Centralized Information (Core).* The very nature of being on the core side concerns collecting and operating information using centralized network resources. They also allow for central storage of information, which opens up new service models (unavailable to edge applications) where information is distributed from the central facility to edge devices as needed, with the central facility maintaining its authority of the information in terms of being a reliable place to acquire the latest information.

  This can be valuable in the marketplace for a number of reasons, e.g. decreased cost through economies of scale and increased customer satisfaction through reliability. Additionally, once information is centralized in this fashion, users could potentially seamlessly switch between modes of accessing the needed information stored in the central facility.

  Example: switching between mobile phone and PDA. The information is maintained in one place (the central facility), and does not need to be maintained by the user for each of the devices they interact with. For location based services, this capability is somewhat peripheral to the central purpose of those applications, but nevertheless important. For instance, privacy information could be stored centrally, so that when users move between location-aware devices, the desired level of privacy would be automatically maintained.

- *Aggregation of Information (Core).* Being squarely on the core side fundamentally involves interactions with multiple users or multiple pieces of information. To the extent that applications rely on only information associated with the user that is operating the application, this many-to-one relationship isn't terribly useful beyond potential economies of scale or scope.

- *Distributed Networking (Edge).* To some extent, we can expect most location based services to involve some sort of edge component so that a given user can interact with the location information. However, we can also expect core based firms to be significantly less interested in the edge devices beyond their capability to integrate into the service delivery.

  The use of distributed networking so far has primarily involved computers directly talking to each other of the Internet, e.g. peer to peer file sharing. Yet in so doing, they have still relied on core network resources, as their directly connected packets were usually traveling over the Internet. In the context of location based services, consider services that help you connect with those people in nearby locations, e.g. in a bar. An edge device may be able to detect, through distributed networking, all of the devices in an area, and then alert you to people that you may want to communicate with based on your preferences.

Core and edge firms may exploit these inherent capabilities to deliver services in which they have a distinct advantage in the marketplace. Assuming there is widespread demand for a variety of location based services, we may see some types of services being offered in a primarily core way and others in a primarily edge way.

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- Wireless and Mobile Commerce Opportunities for Payments Services
- Two-Tier Support Business Models
- The Impact of the Internet on the Future of the Financial Services Industry
- Pricing Products and Services in the High-Tech Industry

The Center for eBusiness has recently entered into Phase II, focusing more explicitly on business value, while at the same time including technologies beyond the Internet in its purview. Our goal, in part, is to reduce that timeline through basic and applied research, engagement with industry sponsors, and the sharing of best practice, and the MIT's credo of combining rigor with relevance is well served.

We are co-located with MIT Sloan's Center for Information Systems Research and the Center for Coordination Science to facilitate collaboration. Our cross-campus collaborations include work with the Media Lab, AutoID Center, Computer Science and AI Lab, and Communications Futures Program.

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