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Capturing Value from Early Stage Technology in Open Standard Environments: The Case of Wi-Fi

By

Yong Zhang

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of
Master of Engineering in Telecommunications Technology Management

Department of Systems and Computer Engineering

Carleton University

Ottawa, Canada, K1S 5B6

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Capturing Value from Early Stage Technology in Open Standard Environments: The Case of Wi-Fi

Submitted by

Yong Zhang

in partial fulfillment of the requirements
for the degree of Master of Engineering in
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ABSTRACT

This research examines how new firms capture value from an early stage technology built on open standards. The relationship between six attributes of new Wi-Fi service providers' business models and company performance is examined first and then new and established service providers are compared based on attributes of their business models. Ten hypotheses were tested using data drawn from 22 new and 40 established providers of Wi-Fi services in North America. The results suggest a business model for new service providers that entails: (i) offering more services and targeting more markets than those offered and targeted by established rivals; (ii) pricing the core service at 65% of established rivals' average price; (iii) partnering with more companies than established rivals do; (iv) partnering with more different types of companies than established rivals do; and (vi) partnering with at least one large company.

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1. INTRODUCTION

The objectives of this research are to:

- develop a model that relates attributes of a new firm's business model with the value the new firm captures from technology built on an open standard
- test hypotheses anchored around the model using data drawn from providers of Wi-Fi services in North America

Wi-Fi is short for wireless fidelity. Wi-Fi refers to any type of network based on the 802.11 wireless local area network (WLAN) open standard family, including 802.11b, 802.11a, and dual-band.¹ A mobile user who wishes to access the Internet uses a Wi-Fi product to access a hardware device or a computer's software to connect to a wired local area network. The hardware device or the software is referred to as an access point. Access points are important for extending the physical range of service to which a wireless user has access and for providing heightened wireless security.

¹ The term Wi-Fi was previously used in place of the 2.4GHz 802.11b standard, in the same way that Ethernet is used in place of the IEEE 802.3 standard. The Wi-Fi Alliance expanded the use of the term Wi-Fi to include other wireless networks.

This research follows the inductive portion of the descriptive theory building process described in Carlile and Christensen (2005). The specific outcomes of this research are the results of testing ten hypotheses that:

- relate attributes of new firms' business models with their performance
- compare new and established firms based on the attributes of their business models

This research makes two contributions. First, it examines a case of new market disruption that entails competition anchored around the use of the same early stage technology and not competition anchored around the development of two different technologies. The literature stream that examines the phenomenon of disruptive technologies has risen to particular prominence (Adner, 2002; Adner & Zemky, 2003; Christensen, 1997; Christensen & Raynor, 2003; Christensen, Anthony & Roth, 2004). The dominant perspective of the new market disruption phenomenon is, in essence, a supply-based view that focuses on the competition between two technologies. Established firms improve one technology while new firms improve another technology. New firms start out developing technologies with inferior performance. To succeed, new firms must serve isolated market niches first and, as their technology matures, expand to displace technologies from mainstream market segments (Christensen, Anthony & Roth, 2004). The displacement of established firms is driven by the superior performance offered by the technology of the new firms and the difficulties that established firms encounter trying to reconfigure their resources, processes and values to match the performance of the new

firms' technology (Christensen, Anthony & Roth, 2004).

This research contributes to the literature by examining the case of new market disruptions in which both incumbents and attackers compete using the same technology, one that is defined and evolved by open interoperable standards. Established and new firms compete without improving different technologies along separate trajectories.

The second contribution this research makes is that it empirically tests the relationship between attributes of the new firms' business models and their performance. Hypotheses development was anchored around a model that focuses on the role of the business model in capturing value from early stage, open standard technology.

This effort contributes to the development of a descriptive theory of competition in open environments. Academics studying competition based on the use of open standards and open source software, academics formalizing the phenomenon of technology disruptions, and top management teams of new wireless networks companies will be the most likely audience to find this research useful. Academics will be interested in the model developed to clarify the role of a business model in capturing value from early stage open technology and in the distinction made between competition anchored around developing two technologies and competition anchored around the use of one open technology. Top management teams of new firms will be interested in the associations that were found to exist between different attributes of business models and company performance.

The thesis is organized into seven chapters. Chapter 1 is the introduction. Chapter 2 provides a literature review and identifies the lessons learned from reading it. Chapter 3 develops the research model and hypotheses anchored around it. Chapter 4 describes the research method used to test the hypotheses. Chapter 5 provide the results and Chapter 6 discusses these results. Chapter 7 provides the conclusions of this research, identifies the limitations of the research, and suggests future research avenues.

2. LITERATURE REVIEW

This chapter has been organized into six sections. Section 2.1 reviews the literature on competition between two technologies. Section 2.2 reviews the literature on business models. Sections 2.3 and 2.4 review the literature on products and services and open standards respectively. Section 2.5 reviews the partnerships literature. Finally, section 2.6 provides the key lessons learned from reviewing the literature.

2.1 Competition between two technologies

The literature stream that examines how disruptive and established technologies compete has risen to particular prominence (Christensen, 1997; Christensen & Raynor, 2003; Christensen, Anthony & Roth, 2004). The dominant perspective is, in essence, a supply-based view. Established firms improve one proprietary technology while new firms improve a different proprietary technology. New firms start out developing technologies with inferior performance. To succeed, new firms must serve isolated market niches first and, as their technology matures, expand to displace technologies from mainstream market segments (Christensen, Anthony & Roth, 2004). The displacement of established firms is driven by the superior performance offered by the technology of the new firms and the difficulties that established firms encounter trying to reconfigure their resources, processes and values to match the performance of the new firms' technology (Christensen, Anthony & Roth, 2004).

Recently, efforts have been made to provide a demand-based perspective of the competition between two technologies (Adner, 2002, 2004; Adner & Zemky, 2003). The

demand-based perspective posits that the threat of disruption depends on such factors as the rate of technological advance, the number of firms using each technology, and the ability of firms to price discriminate (Adner & Zemky, 2003).

2.2 Business models

A business model is a managerial equivalent to a hypothesis. You start with a hypothesis, test it with action, and revise it when necessary (Magretta, 2002). A business model describes the logic of a business system for creating value. It is an abstraction that serves as the basis for executing the firm's business processes (Peterovic Kittle & Teksten, 2001).

A good business model answers the fundamental questions: Who is the customer? What does the customer value? How do we make money in this business? It provides the underlying logic for a company to deliver value to the customer at an appropriate cost (Magretta, 2002).

Timmers (1998) defines a business model as the architecture for the product, service and information flows, including the description of (i) the various business actors and their roles; (ii) the potential benefits for the various business actors; and (iii) the source of revenues.

To Osterwalder and Pigneur (2002), a business model is comprised of four main elements: (i) the value proposition, (ii) the customer relationship, (iii) the infrastructure and (iv) the

financial aspects.

Figure 1 illustrates the business model for the mobile business developed by Camponovo and Pigneur (2003). At the centre of the model is the user who has mobility-related needs. In order to fulfil these needs, three necessary and complementary supporting blocks are needed: (i) communications, including the different networks that provide transmission facilities, (ii) technology, comprised by the required hardware, including network equipment, mobile devices and platforms, and (iii) the services, including applications, content and supporting services. These blocks are then constrained by the regulatory and social context.

Figure 1. Mobile business framework

The literature on business models focuses on capturing value from proprietary technology (Camponovo & Pigneur, 2003; Chesbrough & Rosenbloom, 2002). It assumes the existence of important technology assets that are under the exclusive control of a firm. Established and new firms take technology to market through a venture shaped by a

specific business model, whether explicitly considered or implicitly embodied in the act of innovation. The inherent value of technology remains latent until it is commercialized in some way (Chesbrough 2002).

Building on Andrews (1971), Chesbrough and Rosenbloom (2002) argue that a business model has six functions:

1. articulate the value proposition, i.e., the value created for users by the offering based on the technology
2. identify a market segment, i.e., the users to whom the technology is useful and for what purpose, and specify the revenue generation mechanisms for them
3. define the structure of value chain within the firm required to create and distribute the offering, and determine the complementary assets needed to support the firm's position in this chain
4. estimate the cost structure and profit potential of producing the offering, given the value proposition and value chain structure chosen
5. describe the position of firm within the value network linking suppliers and customers, including identification of potential complementors and competitors
6. formulate the competitive strategy by which the innovating firm will gain and hold advantage over rivals

2.3 Products and services

Product development is critical because new products are becoming the nexus of competition for many firms (Clark & Fujimoto, 1991). In industries ranging from

software to cars, firms whose employees quickly develop exciting products that people buy are likely to win (Brown & Eisenhardt, 1995).

A new firm must put together products and services together in ways that create the greatest value for the market segments they target (Anderson, Carpenter & Narus, 2001). The core product or service includes the least number of “things” that customers consider absolutely essential to do business with any supplier (e.g., payment terms, customer services for problems with the product or the service). A new supplier may decide to add to the core product or service other products or services to attract a broader market or distinguish it from other suppliers. These other products and services benefit the consumer either in the acquisition of or the use of the core product or service (Potter, 2004). The breadth of the offer mix is measured as the number of products and services a new firm offers (Sommers, Barnes & Stanton, 1995).

2.4 Open standards

Telecommunications products and services rely on standards due to inter-working requirements set by customers. Products and services of firms operating in rapidly changing industries such as highly telecommunications, computing and electronics are highly interdependent with standards. Superior returns accrue to firms with uniquely valuable systems of strategic attributes, which include the firms’ strategic assets, as well as the products and services that they combine to produce for customers (Barnett, Greve & Park, 1994; Levinthal, 1998).

WLANs based on the open standards IEEE 802.11 are flexible communication systems transmitting data over electromagnetic waves, usually implemented as an extension to a wired LAN (Malladi & Agrawal, 2002). The Wi-Fi Internet access business started recently. It is a promising industry created by the emergency and wide adoption of the IEEE 802.11 standards. An emerging industry is characterized by a continuously changing and complex environment, which creates important uncertainties at the levels of technology, demand and strategy (Porter, 1980). At the technological level, uncertainties are typically caused by rapid technological development and the battle for legitimizing standards. Concerning demand, despite a generalized consensus about the huge potential of mobile business services, nobody actually knows how to exploit the new possibilities brought by technology to create valuable services that customers are willing to pay. Finally, strategic uncertainties are a common situation in emerging industries. It is difficult to formulate strategies because there are no established rules for the game. As a consequence, actors must experience with a variety of strategic approaches and constantly reposition themselves in order to find the most favourable competitive position in the industry (Camponovo & Pigneur, 2003).

Owing to the unexpected difficulties of deploying (third generation communications) 3G networks and services, significant concerns are arising among mobile network operators and other important players about the so-called "Piranha" technologies like WLAN, which seem to have the potential to be disruptive and dislocate the profits of 3G operators by delivering wideband services earlier (Zweig, 2001).

Whether WLAN is a threat or a complementary technology to 3G is an unresolved issue (Lehr & McKnight, 2002). Both technologies provide broadband data communication services. A significant share of 3G revenues may be displaced from mobile operators towards WLAN providers (Laurent & Geraci, 2002). Conversely, mobile operators could employ them in a complementary way, providing enhanced service in particular locations through WLAN while offering ubiquitous coverage and permanent network connection through cellular networks (Laine, 2002).

Unlike providers of 3G services, providers of WLAN services do not require a license to operate. Compared to 3G service providers, WLAN service providers can deploy their networks with much smaller investments. Consequently, many Wireless Internet Service Providers (Wi-Fi ISPs) are entering the wireless market. These players include incumbent firms from the telecommunications industry (i.e., mobile network operators, wireline network operators, Internet Service Providers) as well as new players such as start-ups, technology enablers, venues and communities. This diversity is likely to result in fundamentally different strategic approaches (Camponovo & Pigneur, 2003).

The future structure of the Wi-Fi Internet service business is not clear. Herslow and Navarro (2002) suggest that Wi-Fi ISPs can be organized based on their pricing and coverage. Accordingly Wi-Fi ISPs can be classified as: Hot Spot Wi-Fi ISPs, Facility Owners Wi-Fi ISPs, Wide Area Wi-Fi ISPs and Network Community Wi-Fi ISPs. Sputnik (2002) claims that the future of 802.11 networks will take three directions: Private networks, free public access networks (communities) and paid subscriber networks.

Verma and Beckman (2002) examine what strategic approaches Wi-Fi ISPs can employ. They differentiate: primary business models (extend traditional ISP models offering WISP services for monthly subscription fees), emerging business models (offering the occasional usage of Wi-Fi ISP's services using micro payments) and neighbourhood area networks (NAN). NANs are non profit networks of end users who share their WLAN hotspots. NANs organize to cover an extensive area or a single location (Pozar, 2001).

2.5 Partnerships

Partnerships can be examined using different perspectives: transaction cost economics (Williamson, 1985, 1991; Hennart, 1988), social networks (Gulati, 1995; Ahuja, 2000), resource dependency (Pfeffer & Nowak, 1976), strategic choice (Porter, 1980, 1986), and organizational learning (Khanna, Gulati, & Nohria, 1998; Mowery, Oxley, & Silverman, 1996). Each of these perspectives offers unique insights about alliances and partnerships.

Yoshino and Rangan (1995) emphasized three characteristics of alliances:

1. Two or more firms unite to pursue a set of agreed upon goals while remaining independent subsequent to the formation of the alliance.
2. The partner share the benefits of the alliance and control over the performance of assigned tasks, perhaps the most distinctive characteristic of alliances and the one that makes them so difficult to manage.
3. The partner firms contribute on a continuing basis in one or more key strategic areas, for example, technology and products.

Faulkner (1995) classifies the motives for alliance formation into four factors: (i) need for specific assets not currently possessed; (ii) need to lower transaction costs; (iii) need for speed to market; and (iv) need to reduce financial risk.

Byrne, Brandt and Bort (1993) suggested that a virtual cooperation was comprised of a network containing independent companies, suppliers, customers and in some cases competitors. The actors are linked together by information technology and share costs, skills and markets. The benefit of belonging to a virtual cooperation is the increase in power and flexibility for individual corporations.

Strategic interdependence between organizations describes a situation in which one organization has resources or capabilities beneficial to but not possessed by the other (Gulati, 1995). Another reason for the formation of strategic alliances is to take advantage of complementary assets (Barringer & Harrison, 2000; Chung, Singh & Lee, 2000).

From a strategic choice perspective, strategic alliances are a mechanism or firms to enhance their competitive positioning or market power (Porter, 1986). New firms form partnerships with companies other than established firms to increase their customer base (Rabeau, 1999).

2.6 Lessons learned

This section describes the key lessons learned from the review of the literature.

The business environments are moving from regulated and proprietary to open standard environments

As Benett (2002) suggested, open standards offer no differentiation and erode competitive advantage along the axis that has been standardized. Survivors are forced to rethink their strategies and offer value in new ways. Providers of electricity and telecommunications services under deregulation provide good examples of this phenomenon. Open source leads to better, less expensive software. Open hardware creates commodity pricing around hardware. The new access technologies pave way for new players.

Unlike 3G, Wi-Fi Internet service providers do not require a license to operate and can deploy their network with much smaller investment. Consequently, a plethora of different Wi-Fi Internet Service Providers is currently trying to take advantage of this opportunity to enter the wireless market. These players include incumbent firms from the telecommunications industry (i.e. mobile network operators, wireline network operators, Internet Service Providers) as well as new players such as start-ups, technology enablers, venues and communities. This diversity is likely to result in fundamentally different strategic approaches (Camponovo & Pigneur, 2003).

It is evident that business environments are moving to open standard environments. Open standards environments are markedly different from environments dominated by regulation and proprietary technology.

Need to study competition between new and established firms using the same disruptive technology

The dominant perspective of the new market disruption phenomenon is, in essence, a supply-based view that focuses on the competition between two technologies. Established firms improve one technology while new firms improve another technology. The displacement of established firms is driven by the superior performance offered by the technology of the new firms and the difficulties that established firms encounter trying to reconfigure their resources, processes and values to match the performance of the new firms' technology (Christensen, Anthony & Roth, 2004).

Recently, the demand-based perspective of the competition between two technologies posits that the threat of disruption depends on such factors as the rate of technological advance, the number of firms using each technology, and the ability of firms to price discriminate (Adner & Zemky, 2003).

While these perspectives are useful, they provide little guidance managers who need to compete using a new technology that builds on open standards and hence it is available to new and established firms.

The attributes of business model such as value proposition, market segment, and go-to market partner strategy are important in early stage of open technology such as Wi-Fi

A business model describes the logic of a business system for creating value. It is an abstraction that serves as the basis for executing the firm's business processes (Petrovic, 2001). Chesbrough (2003) and Chesbrough and Rosenbloom (2002) identified six functions of a business model: (i) articulate the value proposition, (ii) identify a market segment, (iii) define the structure of the value chain within the firm, (iv) estimate the cost structure and profit potential of producing the offering, (v) describe the position of the firm within the value network, and (vi) formulate a competitive strategy.

The future structure of the Wi-Fi industries and markets is not clear. Herslow and Navarro (2002) suggest that Wi-Fi ISPs can be organized based on their pricing and coverage. Sputnik (2002) claims that the future of 802.11 networks will take three directions: Private networks, free public access networks (communities) and paid subscriber networks.

However, it appears evident that from the perspective of new firms in the Wi-Fi Internet access markets, the decisions about the value proposition, the market, and the go-to-market partner strategy serve the other functions identified by Chesbrough and Rosenbloom (2002). Decisions about the structure of the value chain, cost structure and profit potential of producing the offering are followed the decisions about the value proposition, target market and go-to-market strategy. The competitive strategies by

which a new firm will gain competitive advantages over established firms is embodied in its decisions about the value proposition, target market and go-to-market strategy.

3. RESEARCH MODEL AND HYPOTHESIS DEVELOPMENT

3.1 Research model

This research examines how attributes of a new firm's business model captures value from an early stage open technology. An open technology is one built on and evolved by open standards. This research examines the case in which new entrants and established firms both build businesses anchored around the same open technology Wi-Fi during the early stages of the technology.

Figure 2 provides the model used to anchor this research. It builds on the research on the role of business models in capturing value from innovation (Chesbrough, 2003; Chesbrough & Rosenbloom, 2002; Gagnon, 2003). Hypotheses 1 to 6 relate six attributes of a new firm's business model to the firm's performance. Hypotheses 7 to 10 compare new and established firms based on their business models' attributes.

In Figure 2, three functions of a new firm's business model affect the value captured from an early stage open technology: value proposition, market segment, and go-to-market partner strategy. While a business model has functions other than the three identified in Figure 2, these three functions are the dominant ones for new firms that use early stage technology based on open standards.

Figure 2. Research model

Chesbrough (2003) and Chesbrough and Rosenbloom (2002) identified six functions of a business model: (i) articulate the value proposition, (ii) identify a market segment, (iii) define the structure of the value chain within the firm required to create and distribute the offering, (iv) estimate the cost structure and profit potential of producing the offering, (v) describe the position of the firm within the value network linking suppliers and customers, and (vi) formulate a competitive strategy by which the firm will gain and hold competitive advantages.

From the perspective of a new firm, the decisions about the value proposition, the market, and the go-to-market partner strategy serve the other functions identified by Chesbrough (2003) and Chesbrough and Rosenbloom (2002). Decisions about the structure of the

value chain, and decisions about cost structure and profit potential will follow decisions about the value proposition, the market, and the go-to-market strategy. The competitive strategies by which a new firm will gain competitive advantages over established firms is embodied in its decisions about the value proposition, target market and go-to-market strategy.

The research model in Figure 2 identifies the key decisions that the top management team of a new firm must make are organized into three of the functions of a business model identified by Chesbrough (2003) and Chesbrough and Rosenbloom (2002). The top management team of a new firm needs to define a value proposition latent in the new technology (Chesbrough & Rosenbloom, 2002). This requires decisions on the number of services and products the new firm offers.

A market focus is needed to know how to define and configure the products and services, set priorities, and resolve tradeoffs that arise while carrying out business activities. For a new firm, decisions on how many markets to pursue and how much to charge customers are critical.

For a new firm that competes using an early stage open technology, the decisions on the partners required to execute its go-to-market strategy are the most important. The top management team, as part of the new firm's go-to-market strategy, needs to decide how many partners its go-to-market strategy requires, how different from each other these partners should be, and whether or not to set up partnerships with one or more large

companies.

3.2 Hypothesis development

A new firm must put together products and services together in ways that create the greatest value for targeted market segments (Anderson, Carpenter & Narus, 2001). Each new firm offers a core product or service. The core product or service is the fundamental functional performance that a product or service must provide to solve a customer's basic problem. The core product or service includes the least number of "things" that customers consider absolutely essential to do business with any supplier (e.g., payment terms, customer services for problems with the product or the service). A new supplier may decide to add to the core product or service other products or services to attract a broader market or distinguish it from other suppliers. These other products and services benefit the consumer either in the acquisition of or the use of the core product or service (Potter, 2004). The breadth of the offer mix is measured as the number of products and services a new firm offers (Sommers, Barnes & Stanton, 1995). The broader the offer mix, the greater the potential to increase the number of customers the firm attracts and the greater the number of opportunities to increase the dollar value of the average sale per customer. It is predicted that new firms that have a greater number of products and services will be able to satisfy more customers' requirements resulting in better performance. Therefore,

Hypothesis 1a

Number of products and service is positively related with a new firm's performance.

Hypothesis 1b

Number of products is positively related with a new firm's performance.

Hypothesis 1c

Number of services is positively related with a new firm's performance

Segmentation and targeting are key elements of marketing planning. Segmentation involves dividing the market of potential customers into subgroups. Targeting involves identifying those target markets that can be served profitably by the capabilities of the firm (Sternthal & Tybout, 2001).

With early stage proprietary technology, a supplier first evolves the technology to satisfy the needs of one or a few market niches and then expands to other markets. Addressing the needs of many target markets at once is not recommended. Early stage technology built on open standards can be adopted faster than proprietary technology in many different markets simultaneously. Open standard technology costs less to deploy and can generate commercial benefits across markets faster. In the case of Wi-Fi, the cost of establishing a hotspot is low. The cost of operating a hot spot ranges between \$50-\$100, the cost per month of a DSL line for a small hotspot. The cost of additional equipment, antennas, and faster connections such as a T1 line for a large hotspot is far lower than the cost of setting up a cellular node. Success of Wi-Fi requires wide coverage, not addressing the needs of one niche at a time. Busy locations with thousands of regular visitors can generate hundreds of Wi-Fi connections per day. Even a small hot spot, with

only a few connections a day, can make money for a small business owner. Hot spots generate direct revenue to business owners as well as significant indirect benefits. High-speed wireless Internet access is an amenity that increases the quality of the customer experience. Hot spots can foster loyalty, increase the amount of time customers spend in the venue and increases opportunities to sell more goods and services. It also becomes a platform for future value-added services such as location-based marketing, loyalty programs, and content distribution. The greater the number of markets the new firm can efficiently serve, the greater is its expected performance. Therefore,

Hypothesis 2

Number of target markets is positively related with a new firm's performance.

In many cases, new firms can offer products and services equivalent to those of established firms but at lower prices. These new firms exploit the opportunities that arise when established firms have large overheads such as high R&D or high costs of maintaining a brand, or high profit expectations (Potter, 2004). Christensen, Anthony and Roth (2004) identify the possibility that low-end disruptive innovations can occur when the products and services offered by established firms are overpriced relative to the value existing customers can use. A new firm that offers big savings to customers disrupts established ways of doing business (Potter, 2004). Many new firms establish themselves by first offering low prices to the market's most price sensitive customers. A lower price can attract a greater number of customers to purchase the new firms' products and services. As the new firms continue to grow they can attract the largest customers (Potter,

2004). Therefore,

Hypothesis 3

Price of core product or service is negatively related with a new firm's performance.

New firms, as part of their go-to-market strategy, partner with other firms to reduce their cost of customer acquisition, and increase the number of new and repeat sales. New firms form partnerships with companies other than established firms to increase their customer base (Rabeau, 1999). New firms use their go-to-market partners to bring them customers they cannot attract themselves given their capabilities. It is predicted that new firms with a large number of go-to-market partners will perform better than those firms with a small number of partners. Therefore,

Hypothesis 4:

Number of go-to-market partners is positively related with a new firm's performance.

Researchers in the field of competitive aggressiveness have found that heterogeneous top management teams are more aggressive than homogeneous teams (Ferrier, 2001). We predict that go-to-market partner composition shapes the lenslike cognitive structures that defines the collective field of vision of the top management team responsible for the new firm's marketing and sales strategy. Go-to-market partner heterogeneity refers to the extent to which the new firm's go-to-market strategy is comprised of different partner types. High go-to-market partner heterogeneity increases awareness in sensing strategic

problems and increases the decision making ability of the new firm to make aggressive competitive attacks on established firms. Homogeneous partners have similar functions, markets, and geographic characteristics. Homogenous go-to-market partners have limited capability to provide access to different market segments. Increasing the number of partners that serve the same customers served by existing partners will not necessarily bring more customers to the new firm. Therefore,

Hypothesis 5

Go-to-market partner heterogeneity is positively related with a new firm's performance.

Sometimes a new firm establishes partnerships with one or more large distributors or powerful companies to reduce advertising expenses (Potter, 2004), increase market legitimacy and improve the likelihood of a successful attack on established competitors. If a new firm can only establish partnerships with small, non-powerful companies they need to rely on a relatively large number of small partners to build their customer base and may not obtain the legitimacy brought about by partnering with a large company. It is predicted that new firms with large partners perform better than new firms without large partners. Therefore,

Hypothesis 6

Performance of new firms with at least one large partner is greater than the performance of new firms with no large partners.

New firms focus their efforts on the core products and services enabled by the early stage technology built on open standards. They act quickly to develop the new products and services to satisfy the requirements of early customers. New firms are more likely to develop specific applications and solutions at an early stage of the technology.

Established firms prioritize sustaining innovations over disruptive innovations. They find themselves locked-into the resources, processes and values that they have in place already. Established firms have resource conflicts between their existing markets and the new product opportunities they identify (Bower & Christenen, 1995). It is predicted that during the early stage, new firms will offer more products and services anchored on the technology based on open standards, than established firms. Therefore,

Hypothesis 7a

Number of products and services offered is greater for new firms than established firms.

Hypothesis 7b

Number of a products offered is greater for new firms than for established firms.

Hypothesis 7c

Number of services is greater for new firms than established firms.

An established firm has a tried business model that connects the firm, its go-to-market partners and the customer base (Chesbrough & Rosenbloom, 2002). Faced with an early stage technology built on open standards, the logic of the established firm's business

model as well as customer and partnership arrangements constrain the search for the most suitable business model for capturing value from the new technology. Managers reinforce current mental models reducing the motivation to search for new customers and new partners. New firms do not have a user base or a well-tried business model. They will actively search for the right business model to capture value from the new technology built on open standards. New firms are motivated to search for customers and go-to-market partners during the early stages of the technology built on open standards. Therefore,

Hypothesis 8a

Number of target markets is greater for new firms than for established firms.

Hypothesis 8b

Number of go-to-market partners is greater for new firms than for established firms.

New firms are better able than established firms to implement low cost business models. For example, new firms may not be subject to the same regulations imposed on established firm and can benefit from price-discrimination strategies (Clark, 1996, 1997; Ono & Aoki, 1998). Low cost business models allow new firms to reduce their prices in an effort to attract customers away from established firms. Therefore,

Hypothesis 9

Price of core product or service is lower for new firms than established firms.

Ferrier (2001) argued that heterogeneous teams increase a firm's competitive aggressiveness. Given that new firm's go-to-market strategies need to be more competitively aggressive than those of established firms, it is expected that partner heterogeneity will be greater for new firms than for established firms. Therefore,

Hypothesis 10

Go-to-market partner heterogeneity is greater for new firms than for established firms.

3.3 List of hypotheses

The hypotheses that are tested in this research are:

Hypothesis 1a

Number of products and service is positively related with a new firm's performance.

Hypothesis 1b

Number of products is positively related with a new firm's performance.

Hypothesis 1c

Number of services is positively related with a new firm's performance

Hypothesis 2

Number of target markets is positively related with a new firm's performance.

Hypothesis 3

Price of core product or service is negatively related with new firm's performance.

Hypothesis 4

Number of go-to-market partners is positively related with a new firm's performance.

Hypothesis 5

Go-to-market partner heterogeneity increases a new firm's performance.

Hypothesis 6

Performance of new firms with at least one large partner is greater than the performance of new firms with no large partners

Hypothesis 7a

Number of products and services offered is greater for new firms than established firms.

Hypothesis 7b

Number of a products offered is greater for new firms than for established firms.

Hypothesis 7c

Number of services is greater for new firms than established firms.

Hypothesis 8a

Number of target markets is greater for new firms than for established firms.

Hypothesis 8b

Number of go-to-market partners is greater for new firms than for established firms.

Hypothesis 9

Price of core product or service is lower for new firms than established firms.

Hypothesis 10

Go-to-market partner heterogeneity is greater for new firms than for established firms.

4. RESEARCH DESIGN

This chapter describes the unit of analysis, study period, sample, data collection, and data analysis.

4.1 Unit of analysis

The unit of analysis is a company located in Canada or the United States that as of January 2005 provided Wi-Fi services.

4.2 Study period

The study period starts in June 1999 and ends in February 2005. The introduction of the IEEE 802.11b open standard by IEEE 802.11 Working Group in June 1999 marked the start of the study period. The end of data collection in February 2005 marked the end of the study period.

4.3 Sample

The sample is comprised of companies that as of January 2005 provided Wi-Fi Internet public access services in North America.

Each company in the sample is an Internet service provider located in North America that sells Wi-Fi services as their core business or an important line of business. The sample excludes providers of Wi-Fi services for brand customers.

4.3.1 Sample selection

To select the sample, a four step process was followed. First, three phrases were entered into the search utilities of two directories on the Web, Wi-Fi Zone (www.wi-fizone.org) and WiFi411 (www.wifi411.com), and two business databases, Business Source Premier Database (www.library.carleton.ca/eresources/db_descriptions_1.html#bsp) and Factiva Database (www.factiva.com). The phrases entered into the search utilities of these three resources were: (i) Wi-Fi Internet Access Service Providers, (ii) Wireless Access Providers, and (iii) Hotspots. Four online directories and databases that include information of Wi-Fi service providers were selected: WiFi411, Wi-Fizoon, Factiva and Business Source Premier.

In the second step, all the Wi-Fi service providers located in Canada and the United States were identified from the searches carried out in the first step.

In the third step, Wi-Fi suppliers that sold Wi-Fi services to brand companies were eliminated from the sample. These service providers do not sell their services to consumers.

In the fourth step, companies for which information about their the time that the Wi-Fi ISP started operations, go-to-market partners, the price for Wi-Fi Internet access services, the products and services related to the Wi-Fi services and so on were not available at home page, news archives page, company's products and services pages, partnership page,

and privacy statement page and so on were eliminated.

4.3.2 Samples for new and established firms

The sample is split into two: (i) new firms and (ii) established firms. The new firms sample includes service providers that started operations after January 1, 2001 and for which Wi-Fi services is their core business.

The established firms sample includes firms that started operations prior to December 31, 2000. Established firms operated Internet or voice services before they started their Wi-Fi businesses. For the established firms, Wi-Fi is not their only line of business.

January 1, 2001 was selected as the date to split the sample because prior to that date no service provider was established for the sole purpose of delivering Wi-Fi services. While the IEEE 802.11b open standard was introduced in June 1999, many interoperability issues remained. These issues needed time to be worked out. Adoption of WLAN began towards the end of 2000 and the new Wi-Fi firms started in 2001.

4.4 Data collection

Information on products and services offered, the number of products, partners, prices and the date the company started delivering Wi-Fi services were obtained from companies' websites. For each company website, the following pages were examined to collect information: home page, news archives page, company's products and services pages, partnership page, and privacy statement page.

Information on the number of hotspots and the number of markets was obtained from www.wifi411.com by clicking on the company's name and checking every page that had information on the company's hotspots and every page that had information on the company's markets.

Most of the information required was obtained from companies' websites and www.wifi411.com. If a piece of information was missing (e.g., date company started operations), the information was searched for using the Factiva Database www.factiva.com and www.wi-fizoom.com.

4.4.1 Target markets

WiFi411.com uses the type of business that operates in the location where the access points are deployed to segment the Wi-Fi market. For the purpose of this research, the target markets used were those used by WiFi411.com. WiFi411.com organizes the Wi-Fi market into 12 categories:

1. Airport
2. Café/Restaurant/Bar/Club
3. Arena/Campground/Park/Beach
4. Convention center/Theatre
5. Hotel
6. Marina
7. Office
8. Residence
9. Retail business

- 10. School
- 11. Train station/Truck stop
- 12. Others

The target markets for each company in the sample were identified using www.wifi411.com or www.wi-fizone.org. The writer first selected the company's name in these two websites and then proceeded to the pages that included the location types where the company operated hot spots. Then, each of the 12 market segment categories shown above was coded as a "1" if the company had deployed hot spots in that market segment and as "0" if the company had not.

4.4.2 Types of partners

In this research, a Wi-Fi ISP's go-to-market partner is a firm that helps the ISP provide its products and services to customers.

Go-to-market partners were organized into four types: (i) carrier/Internet service provider; (ii) technical, (iii) roaming, and (iv) channel.

A partner was classified as a carrier/Internet service provider if the partner was a wireline or wireless carrier or Internet broadband access provider and shared their resources including their customer base. The carrier/ISP partners normally provided the IP Internet access backbone for the Wi-Fi ISP's hotspots.

A partner was a technical partner if it provided the Wi-Fi ISP the Wi-Fi related hardware

or software platform or products to deploy hotspots.

A partner was a roaming partner if it enabled the Wi-Fi ISP's end users the roaming function for when they travel to other locations.

A partner was classified as a channel if the partner acted as an agent when signing up new hotels, airports, cafes, and other public spaces that provide end users with Wi-Fi Internet access.

4.4.3 Large partner

New firms were grouped into two groups: "At least one large partner" and "No large partner". A new firm was classified in the "At least one large partner" group if the new firm has at least one partner if the partner was listed on a stock exchange in the United States. If the partner is listed on a stock exchange, it is a large partner; otherwise it is a small partner. To find out if a company was listed on a stock exchange, I examined the filings with the Securities and Exchange Commission found at <http://www.sec.gov/edgar/searchedgar/companysearch.html>. If the company was found for the fiscal year 2003, I concluded that it was a large company.

A new firm was classified the "No large partner" group if all of the new firm's partners were not listed in the securities exchange.

4.5 Variable measurement

This section describes how the variables in this research were measured.

Number of products

The number of products was measured as the total number of Wi-Fi products the service provider offered customers as of January 2005.

Examples of Wi-Fi products include the hardware that turns a location into a hotspot or connects the end user device to the Wi-Fi access point, routing access points, user cards, security software, and client software.

Number of services

The number of Wi-Fi services was measured as the total number of services the service provider offered customers as of January 2005.

Examples of Wi-Fi services include: technical support, installation, configuration, staff training, online billing, online assistance, and support forum.

Number of products and services

The number of products and services was measured as the sum of the number of products and the number of services the service provider offered customers as of January 2005.

Number of target markets

The number of target markets was measured by counting the location types for which the Wi-Fi ISPs established at least one hotspot.

Number of go-to-market partners

The number of Wi-Fi partners was measured by counting the number of companies that helped the service provider sell its products and services.

Partner heterogeneity

Partnership heterogeneity refers to the extent to which the service provider's go-to-market partners are comprised of many different types.

Partner heterogeneity was measured as $1 - \sum P_i^2$, where P_i is the percentage of go-to-market partners of type i .

A service provider with high partner heterogeneity has partners in many partnership types.

A service provider with low partner heterogeneity has partners in a small number of partnership types.

Large partner

Service providers were classified into two groups: "At least one large partner" and "No large partner. The variable large partner was coded as "1" if the new firm had at least one large partner and coded "0" if the new firm did not.

Price

The price refers to the price of the core service provided by every Wi-Fi service provider: the flat monthly rate charged with unlimited usage. Measuring price in this manner avoids the problems that arise when comparing prices of different types of subscriptions and payment methods in use today.

Performance

Performance is measured as the ratio of the number of service provider's hotspots and the number of months the service provider was in operation as of January 2005.

The implicit assumption that underlies the measurement of performance used in this thesis is that the value of a company is positively related to the number of hotspots deployed. This is consistent with the research that measures company performance using the growth in the number of establishments a company acquires as clients (Dess & Beard, 1984).

Many companies that exploit a technology at an early stage are small companies.

Financial data for small companies is not publicly available. The Wi-Fi market is no exception. Financial data for many new ISPs was not available. This data could not be used to measure performance.

4.6 Data analysis

4.6.1 Descriptive statistics

The data collected was coded and calculations were performed to calculate partner heterogeneity and performance. Descriptive statistics were calculated for all the variables in the study. For each variable the following was calculated: mean, minimum and maximum value, standard deviation, skewness and kurtosis statistics, standard errors of the skewness and kurtosis statistics, and histograms.

4.6.2 Hypotheses 1 to 5

Hypotheses 1, 2, 4 and 5 predict that the number of products and services, number of target markets, number of go-to-market partners, and partner heterogeneity of a new firm are positively related to its performance and that the price of the core service is negatively related to new firm performance.

To test each of the hypothesis 1 to 5, it is first determined whether or not the variables involved were normally distributed. If the data were normally distributed, Pearson correlation analysis would be used to determine the associations between performance and the explanatory variables. If the data were not normally distributed a Spearman correlation analysis would be used.

If the correlation coefficient between number of products and services and performance is positive and significant at $p < .10$ (one tailed), Hypothesis 1a will be supported.

Otherwise, the hypothesis will not be supported. Hypotheses 1b and 1c are variants of hypothesis 1a. They will be tested in the same way.

If the correlation coefficient between number of target markets and performance is positive and significant at $p < .10$ (one tailed), Hypothesis 2 will be supported.

Otherwise, the hypothesis will not be supported.

If the correlation coefficient between price of core service and performance is negative and significant at $p < .10$ (one tailed), Hypothesis 3 will be supported. Otherwise, the hypothesis will not be supported.

If the correlation coefficient between number of go-to-market partners and performance is positive and significant at $p < .10$ (one tailed), Hypothesis 4 will be supported.

Otherwise, the hypothesis will not be supported.

If the correlation coefficient between number of partner heterogeneity and performance is positive and significant at $p < .10$ (one tailed), Hypothesis 5 will be supported.

Otherwise, the hypothesis will not be supported.

4.6.3 Hypothesis 6

Hypothesis 6 predicts that new firms with at least one large partner perform better than new firms without large partners. A Mann-Whitney U Test will be used to compare the means of performance between the two groups. If the mean rank difference is significant

at $p < .10$, it will be concluded that the performance between the two samples is significant.

4.6.4 Hypotheses 7 to 10

Hypotheses 7, 8a, 8b and 10 predict that the number of products and services, number of target markets, number of go-to-market partners, and partner heterogeneity will be greater for new firms than for established firms. Hypothesis 9 predicts that the price of the core service will be lower for new firms than for established firms.

For each variable that is normally distributed, a T test will be used to compare the means of the variable between the two samples. For each variable that is not normally distributed, a Mann-Whitney U Test will be used to compare the means between the two samples. If the mean differences between the two samples or the rank difference is significant at $p < .10$, it will be concluded that the differences in means between the two samples is significant.

5. RESULTS

This chapter provides the results of this research.

5.1 Sample

5.1.1 New firms

The new firm sample is comprised of 22 companies. Each company in the new firm sample is an Internet service providers located in North America, started operations after January 2001, has the delivery of Wi-Fi services as their core business, and competes directly with established Internet service providers in the Wi-Fi market.

A total of 364 Wi-Fi Internet service providers were found by searching WiFi411, Wi-Fizoon, Factiva and Business Source Premier. Of the 364 Wi-Fi Internet service providers found, 180 were located in North America. Of the 180 North American Wi-Fi Internet service providers, 119 were firms that started to provide telecommunication services after January 1, 2001. Of these 119 firms, only 30 make Wi-Fi their core business and directly compete with established firms in the Wi-Fi market. Of these 30 Wi-Fi Internet service providers, there were eight for which the data required for this research was not available. This left 22 companies in the new firm sample.

Table 1 provides the name of the 22 Wi-Fi Internet service providers in the new firm sample, their location, and the month and year they started operations.

Table 1. Names of companies in the new firm sample, the locations of their headquarters, and the month and year they started operations

	Name of service provider	Location of headquarters	Month and year service provider started operations
1	BOLDstreet	Ottawa	April 2003
2	Boingo Wireless	Santa Monica	December 2001
3	Broadband Oasis	Florida	July 2002
4	Deep Blue Wireless	California	December 2001
5	DragNFly Wireless	Eden Prairie	March 2001
6	eWassco	Tulsa	December 2001
7	Fatport	Vancouver	August 2003
8	HotPoint Wireless	Chicago	December 2002
9	iDockUSA	Rhode Island	January 2002
10	iWiFi.us	Boise	March 2003
11	Island Communications	Toledo	October 2002
12	Mwax	Phoenix	November 2002

13	RVLogon.com	Quartzsite	August 2003
14	surfnride	Florida	December 2002
15	Seacoast Wireless	Portsmouth	April 2003
16	Urban Hot Spots	New York	August 2001
17	v-link	Ft. Lauderdale	December 2002
18	Wi-Fi Guys, LLC	Finland	December 2002
19	wisper	Pittsburgh	December 2003
20	Wise Zone	Landover	September 2002
21	WiFi-Texas	Austin	January 2003
22	WEBbeams	Evanston	August 2003

5.1.2 Established firms

Of the 180 North American Wi-Fi Internet service providers, 61 were firms that started to provide telecommunication services before January 1, 2001. Twenty one of the 61 companies were eliminated because the data required for this research was not available or the company solely provided Wi-Fi services to their branded customers. Thus, the established firm sample was comprised of 40 companies. Table 1b provides the names of the 40 service providers in the established firm sample, the location of their headquarters

and the month and year they started operations.

Table 2. Names of companies in the established firm sample, location of their headquarters and month and year they started operations

	Name of service provider	Location of headquarters	Month and year service provider started operations
1	AT&T Wireless GoPort	Redmond	September 1997
2	Bell Canada	Montréal	April 1998
3	FibreTech Telecommunications Inc.	Kitchener	May 2000
4	iPass	Redwood Shores	January 1999
5	QGO	Pawtucket	June 2000
6	SaskTel Mobility	Regina	June 1999
7	Satcom Systems, Inc.	Sandpoint	May 2000
8	SBC FreedomLink	San Antonio	February 2000
9	Sunflower Broadband	Lawrence	July 1999
10	T-Mobile USA	Dallas	March 1998
11	TelAlaska	Anchorage	October 1999

12	Telerama	Pittsburgh	August 2000
13	TELUS Mobility	Scarborough	July 1998
14	U-Mobile Networks Ltd.	West Vancouver	September 1999
15	Verizon Wireless	Irvine	August 1998
16	aXcess2go	Kirkland	December 1999
17	Coastside Net	Half Moon Bay	February 2000
18	FrogNet	Athens	October 1999
19	Good Digital	Billings	August 1999
20	Gorilla Networks, Inc.	Taylors	February 2000
21	Highmark Communications	Port Angeles	February 1999
22	Hotspotzz Network	Salt Lake City	October 2000
23	IntelliWave	Athens	March 2000
24	Internet Texas	Granbury	July 1999
25	iWave Canada, Inc.	Toronto	June 2000

26	Netlink IP Communications	Brunswick	December 1998
27	OASIS Wireless	Vancouver	November 1999
28	Pacific DirectConnect	Honolulu	March 2000
29	Pocketinet.com	Walla Walla	July 1999
30	RoomLinX	Vancouver	August 2000
31	Sierra Tel Internet	Oakhurst	September 1999
32	Smart City Networks	Las Vegas	November 2000
33	Spot On Networks	Norwalk	February 2000
34	Tantella Wireless	Bentonville	January 1998
35	Telerama Wireless	Pittsburgh	August 1999
36	Verizon Online	Inglewood,	December 1999
37	Winbeam	Greensburgh	February 1998
38	Wireless2LAN	Houston	October 2000

39	Worldwide Connections Online Services	Alexandria	April 1999
40	X-Wires Communications	Iowa City	September 2000

5.2 Descriptive statistics

Table 3 provides the descriptive statistics for the new firm sample. The following eight variables are examined: (i) number of partners, (ii) partner heterogeneity, (iii) number of services offered, (iv) number of products offered, (v) number of segment markets targeted, (vi) price of Wi-Fi service and (viii) change in the number of hotspots per months in operation.

Table 3. Descriptive statistics: new firms
(Sample size = 22)

	Minimum	Maximum	Mean	Std. deviation	Skewness		Kurtosis	
					Statistic	Std. Error	Statistic	Std. Error
Number of products and services	2.00	7.00	3.50	1.471	1.478	0.491	1.454	0.953

Number of products	1.00	5.00	2.50	1.336	.659	.491	-.432	.953
Number of services	.00	4.00	1.00	1.023	1.172	.491	1.949	.953
Number of target markets	1.00	10.00	4.95	2.319	.338	.491	.083	.953
Price	9.95	39.50	24.57	7.26	-.256	.491	.183	.953
Number of go-to-market partners	1.00	27.00	5.36	6.351	2.357	.491	6.198	.953
Partner heterogeneity	.0000	.7200	.34	.273	-.299	.491	-1.656	.953
Number of hotspots / months in operation	.20	83.30	8.92	20.561	2.907	.491	8.435	.953

Examination of the skewness and kurtosis statistics shown in Table 3, suggest that three variables are not normally distributed: number of services, number of go-to-market partners, and number of hotspots/number of months in operation. For each of these three variables, skewness is outside two times the standard error of the skewness statistic. For the two variables: number of go-to-market partners and number of hotspots/number of months in operation, the kurtosis is less than -2 or greater than $+2$. The other variables in Table 3 are normally distributed.

Appendix A provides the histograms of the variables for the new firm sample.

Table 4 provides the descriptive statistics for the variables of the sample for established

firms.

Table 4. Descriptive statistics: established firms
(Sample size = 40)

	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
					Statistic	Std. Error	Statistic	Std. Error
Number of products and services	2.00	5.00	2.77	.862	1.223	.374	1.317	.733
Number of Products	.00	3.00	.40	.709	1.964	.374	3.941	.733
Number of Services	1.00	4.00	2.37	.628	.828	.374	.574	.733
Number of target markets	1.00	9.00	3.35	2.547	.693	.374	-.779	.733
Price	19.95	79.99	37.95	10.46	1.618	.374	5.917	.733
Number of go-to-market partners	.00	5.00	.850	1.231	1.602	.374	2.517	.733
Partner heterogeneity	.00	.60	.052	.160	2.813	.374	6.332	.733

Examination of the skewness and kurtosis statistics of the table 4 led me to conclude that only one variable is normally distributed: the number of target markets. For this variable, skewness is within two times the standard error of the skewness statistic and the kurtosis is within -2 and $+2$. The other variables are not normally distributed.

Appendix B provides the histograms of the variables in the sample for established firms.

5.3 Spearman correlations for business model attributes: new firm sample

For the new firm sample, Table 5 provides the Spearman correlation coefficients for the seven explanatory variables in the research model.

For the variables in Table 5, two tailed tests of the alternative hypothesis at $p < 0.01$ showed that number of go-to-market partners is associated with partner heterogeneity. Tests at $p < .10$ showed that number of products is associated with number of services.

Table 5. Spearman correlations for the explanatory variables: new firm sample
(Sample size = 22)

	Number of products and services	Number of products	Number of services	Number of target markets	Price	Number of go-to- market partners
Number of products and services	1.00					
Number of products	.716 (.000)***	1.00				
Number of services	.265 (.234)	.420 (.052)*	1.00			
Number of target markets	.356 (.104)	.206 (.357)	.268 (.229)	1.00		
Price	.331 (.133)	-.115 (.609)	-.0220 (.325)	.136 (.547)	1.00	

Number of go-to-market partners	.359 (.101)	-.035 (.876)	.298 (.177)	.203 (.364)	-.133 (.554)	1.00
Partner heterogeneity	.154 (.493)	-.121 (.590)	.130 (.563)	-.122 (.585)	-.008 (.973)	.776 (.000)***

*p < .10 (2 tailed)

**p < .05 (2 tailed)

***p < .01 (2 tailed)

5.4 Spearman correlations for performance: new firm sample

For the new firm sample, Table 6 provides the Spearman correlation coefficients for the attributes of a new firm's business model and performance. The last column of Table 6 indicates whether or not a hypothesis is supported based on the results of the Spearman correlation analysis.

Table 6. Spearman correlation coefficients for performance in the new firm sample
(Sample size = 22)

	Performance (Number of hotspots/months in operation)	Hypothesis to which the correlation relates
Number of products and services	.492** (.020)	Hypothesis 1a is supported p < .10
Number of products	.197 (.189)	Hypothesis 1b not supported p < .10
Number of services	.374** (.043)	Hypothesis 1c is supported p < .10
Number of target markets	.672*** (.000)	Hypothesis 2 is supported p < .10

Price	-.055 (.808)	Hypothesis 3 is not supported $p < .10$
Number of go-to-market partners	.620*** (.001)	Hypothesis 4 is supported $p < .10$
Partner heterogeneity	.349* (.056)	Hypothesis 5 is supported $p < .10$

* $p < .10$ (1 tailed)

** $p < .05$ (1 tailed)

*** $p < .01$ (1 tailed)

For the correlations in Table 6, two tailed tests of the alternative hypothesis at $p < 0.10$ suggest that:

1. Number of services is positively related to a new firm's performance
2. Number of target markets is positively related to a new firm's performance
3. Number of go-to-market partners is positively related to a new firm's performance
4. Partner heterogeneity is positively related to a new firm's performance

5.5 Mann-Whitney U test for comparing performance based on partner size

Hypothesis 6 predicted that the performance of new firms that had established partnerships with large companies was greater than the performance of the new firms who only had small size partners. Table 7 shows the results of using the Mann-Whitney U test to compare performance in the "no large partner" and "at least one large partner" samples. The results indicate support for hypothesis 6. The mean rank difference is significant at $p < .05$. New firms with at least one large size partner perform better than new firms with no large size partners at $p < .05$.

Table 7. Mann-Whitney U test comparing performance between “No large partner” and “At least one large partner” samples

	Sample	N	Mean rank	Sum of ranks
Performance	No large partner	13	9.00	117.00
	At least one large partner	9	15.11	136.00
	Total	22		

Test Statistics

	Performance
Mann-Whitney U	26.00
Wilcoxon W	117.000
Z	-2.80
Asymp. Sig. (2 tailed)	.029

5.6 Spearman correlations for business model attributes: established firm sample

For the established firm sample, Table 8 provides the Spearman correlation coefficients for the attributes of their business models for Wi-Fi services.

For the variables in Table 8, two tailed tests of the alternative hypothesis at $p < 0.05$ showed that (i) number of partners is associated with partner heterogeneity and (ii) number of target markets is associated with price.

Table 8. Spearman correlations for the business model attributes of the established firm sample

(Sample size = 40)

	Number of products and services	Number of products	Number of services	Number of target markets	Price	Number of go-to-market partners
Number of products and services	1.00					
Number of products	.565*** (.000)	1.00				
Number of services	.624*** (.000)	.242 (.133)	1.00			
Number of target markets	.037 (.819)	.243 (.131)	-.091 (.575)	1.00		
Price	-.037 (.819)	.173 (.287)	-0.214 (.185)	.378 (.018)**	1.00	
Number of go-to-market partners	-.055 (.735)	-.038 (.814)	.049 (.766)	.106 (.514)	-.055 (.738)	1.00
Partner heterogeneity	-.094 (.564)	-.215 (.182)	.085 (.602)	-.346 (.129)	-.210 (.193)	.476*** (.002)

*p < .10 (2 tailed)

**p < .05 (2 tailed)

***p < .01 (2 tailed)

5.7 Mann-Whitney U tests for comparing new and established firms samples based on their business model attributes

Number of products and services

Hypotheses 7a predicted that the number of products and services offered is greater for new firms than established firms. Hypotheses 7b and 7c were variants of hypotheses 7a and were used to examine number of products and number of services between new firms and established firms. Tables 9, 10 and 11 show the results of using the Mann-Whitney U tests to examine hypotheses 7a, 7b and 7c respectively. The results of the Mann-Whitney tests support Hypotheses 7a, 7b and 7c. Each of the mean rank differences shown in Tables 9, 10 and 11 is significant at $p < .05$. New firms offer a greater number of products and services than established firms during the early stage of Wi-Fi technology.

Table 9. Mann-Whitney U test comparing number of products and services offered by new firms and established firms

	Sample	N	Mean rank	Sum of ranks
Number of products and services	New firms	22	37.70	829.50
	Established firms	40	28.09	1123.50
	Total	62		

Test Statistics

	Number of products and services
Mann-Whitney U	303.500
Wilcoxon W	1123.500
Z	-2.181
Asymp. Sig. (2 tailed)	.029

Table 10. Mann-Whitney U test comparing number of products offered by new firms and established firms

	Sample	N	Mean rank	Sum of ranks
Number of products	New firms	22	48.77	1073.00
	Established firms	40	22.00	88000
	Total	62		

Test Statistics

	Number of products
Mann-Whitney U	60.000
Wilcoxon W	880.000
Z	-5.925
Asymp. Sig. (2 tailed)	.000

Table 11. Mann-Whitney U test comparing number of services offered by new firms and established firms

	Sample	N	Mean rank	Sum of ranks
Number of services	New firms	22	16.52	363.50
	Established firms	40	39.74	1589.50
	Total	62		

Test Statistics

	Number of services
Mann-Whitney U	110.500
Wilcoxon W	363.500
Z	-5.184
Asymp. Sig. (2 tailed)	.000

Number of go-to-market partners

Hypothesis 8b predicts that the number of go-to-market partners of new firms is greater than the number of partners of established firms. Table 12 shows the results of using the Mann-Whitney U test to compare the number of partners between the new firms and established firms samples. The results support hypothesis 8b. The mean rank difference is significant at $p < .05$. New firms have a larger number of partners involved in their get-to-market strategies than do established firms.

Table 12. Mann-Whitney U test comparing the number of go-to-market partners for new firms and established firms

	Sample	N	Mean rank	Sum of ranks
Number of partners	New firms	22	45.55	1002.00
	Established firms	40	23.77	951.00
	Total	62		

Test Statistics

	Number of partners
Mann-Whitney U	131.00
Wilcoxon W	951.000
Z	-4.706
Asymp. Sig. (2 tailed)	.000

Price

Hypothesis 9 predicts that the price of the new firms' core products is lower than the price of established firms' core products. Table 13 shows the results of using the Mann-Whitney U test to compare price between the new firm and established firm samples. The results support hypothesis 9. The mean rank difference is significant at $p < .05$. Price of core products offered by new firms is lower than price of core products offered by established firms.

Table 13. Mann-Whitney U test comparing price between the new firms and established firms samples

	Sample	N	Mean rank	Sum of ranks
Price	New firms	22	16.11	354.50
	Established firms	40	39.96	1598.50
	Total	62		

Test Statistics

	Performance
Mann-Whitney U	101.500
Wilcoxon W	354.500
Z	-4.998
Asymp. Sig. (2 tailed)	.000

Partner heterogeneity

Hypothesis 10 predicts that partner heterogeneity of new firms is greater than partner heterogeneity of established firms. Table 14 shows the results of using the Mann-Whitney U test to compare partner heterogeneity between the new firms and established firms samples. The results support hypothesis 10. The mean rank difference is significant at $p < .05$. Partner heterogeneity is greater for new firms than established firms.

Table 14. Mann-Whitney U test comparing partner heterogeneity between new firms and established firms

	Sample	N	Mean rank	Sum of ranks
Partner heterogeneity	New firms	22	42.16	927.50
	Established firms	40	25.64	1025.50
	Total	62		

Test Statistics

	Partner heterogeneity
Mann-Whitney U	205.500
Wilcoxon W	1025.500
Z	-4.311
Asymp. Sig. (2 tailed)	.000

5.8 T test to compare the number of target markets between the new firms and the established firms

Hypothesis 8a predicts that the number of target markets of new firms is greater than the number of target markets of established firms. Table 15 shows the results of using the independent T test to compare the number of target markets for the new firms and established firms samples. The results support hypothesis 8a.

Table 15. T Test comparing the number of target markets of new firms and established firms

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
Target market	Equal variances assumed	1.366	.247	2.44	60	.017	1.604	.655	.293	2.916
	Equal variances not assumed			2.51	46.979	.015	1.604	.637	.321	2.888

The results in Table 15 indicate that the difference between the means is significant at $p < 0.05$. The t is positive, thus the number of target markets served by new firms is larger than the number of target markets served by established firms. Table 3 indicates that the mean of the number of target markets served by new firms is 4.95, while Table 4 shows that the mean of the number of target markets served by established firms is 3.35. The number of markets served by new firms is 1.5 times greater than the number of markets served by established firms (rounding off $4.95/3.35 = 1.5$).

5.9 Summary

Table 16 provides the results of testing the hypotheses.

Table 16. Results of testing hypotheses

Hypothesis Number	Hypothesis	Test Outcome	Rationale
1a	Number of products and services is positively related with a new firm's performance	Supported	Spearman correlation coefficient is positive and significant (.374 $p < .10$)
1b	Number of products is positively related with a new firm's performance	Not supported	Spearman correlation coefficient is not significant at $p < .10$
1c	Number of services is positively related with a new firm's performance.	Supported	Spearman correlation coefficient is positive and significant (.374 $p < .10$)
2	Number of target markets is positively related with a new firm's performance.	Supported	Spearman correlation coefficient is positive and significant (.672 $p < .10$)
3	Price of core product or service is negatively related with a new firm's performance.	Not supported	Spearman correlation coefficient is not significant at $p < .10$

4	Number of go-to-market partners is positively related with a new firm's performance.	Supported	Spearman correlation coefficient is positive and significant (.620 $p < .10$)
5	Go-to-market partner heterogeneity is positively related with a new firm's performance.	Supported	Spearman correlation coefficient is positive and significant (.349 $p < .10$)
6	Performance of new firms with at least one large partner is greater than the performance of new firms with no large partners	Supported	The mean rank difference of Mann-Whitney test is significant $p < 0.05$
7a	Number of products and services offered is greater for new firms than established firms.	Supported	The mean rank difference of Mann-Whitney test is significant $p < 0.05$
7b	Number of products offered is greater for new firms than established firms.	Supported	The mean rank difference of Mann-Whitney test is significant $p < 0.05$
7c	Number of services offered is greater for new firms than established firms.	Supported	The mean rank difference of Mann-Whitney test is significant $p < 0.05$

8a	Number of target markets is greater for new firms than for established firms.	Supported	T test is significant at $p < 0.05$ level (2-tailed) and $t > 0$
8b	Number of go-to-market partners is greater for new firms than for established firms.	Supported	The mean rank difference of Mann-Whitney test is significant $p < 0.05$
9	Price of core product or service is lower for new firms than established firms.	Supported	The mean rank difference of Mann-Whitney test is significant $p < 0.05$
10	Go to market partner heterogeneity is greater for new firms than for established firms.	Supported	The mean rank difference of Mann-Whitney test is significant $p < 0.05$

6. DISCUSSION OF RESULTS

This research examines how attributes of a new Wi-Fi service provider's business model (i) relate with the value the firm captures from technology built on an open standard and, (ii) compare with the attributes of established service providers' business models. Ten hypotheses were tested using data drawn from 22 new and 40 established providers of Wi-Fi services in North America.

6.1 Summary of results

Hypotheses 1 to 6 posit that six attributes of a new service provider's business model are related to company performance measured as the ratio of the number of hotspots and the number of months the service provider was in operation as of January 2005. The six business model attributes examined are: (i) number of products and services, (ii) number of target markets, (iii) price of core service, (iv) number of go-to-market partners, (v) go-to-market partner heterogeneity, and (vi) size of partners.

The variants of Hypothesis 1 predicted that the number of products and services offered by new Wi-Fi service providers were positively related to company performance. The Spearman correlation coefficients for performance and (i) number of products and services (0.492) and (ii) number of services (0.374) shown in Table 6 were positive and significant at $p < 0.05$. These findings provided support for hypotheses 1a and 1c.

Hypotheses 1b was not supported. The number of products offered by a new Wi-Fi

service provider was not related to company performance. The Spearman correlation coefficient for performance and number of products, 0.197, was not significant at $p < 0.05$.

Hypothesis 2 predicted that the number of target markets addressed by a new Wi-Fi service provider was positively related to company performance. This prediction was supported. The Spearman correlation coefficient for performance and number of target markets shown in Table 6 was positive and significant (0.672, $p < .01$).

Hypothesis 3 predicted that the price of the core service of a new Wi-Fi service provider was negatively related to company performance. This hypothesis was not supported. Indeed, as indicated in Table 6, the Spearman correlation coefficient for performance and price, 0.195, was not significant $p < 0.05$.

Hypothesis 4 predicted that the number of go-to-market partners of a new Wi-Fi service provider was positively related to company performance. This prediction was supported. Table 6 shows that the Spearman coefficient of correlation for performance and number of partners was positive and significant (0.620, $p < 0.01$).

Hypothesis 5 predicted that a new Wi-Fi service provider's partnership heterogeneity was positively related to company performance. This hypothesis was supported. The Spearman correlation coefficient for partner heterogeneity and performance was positive and significant (0.349, $p < 0.10$).

Hypothesis 6 predicted that new Wi-Fi service providers with at least one large go-to-market partner performed better than new Wi-Fi service providers with no large partners. This hypothesis was supported. Table 7 shows that the mean rank difference of the Mann-Whitney U test is significant at $p < 0.05$ and that the mean rank for the “At least one large partner” sub-sample is greater than that of the “No large partner” sub-sample.

To examine whether or not partner size and company performance were linearly related in the “At least one large partner” sample, the number of employees of each partner were collected and three Spearman correlation coefficients relating performance and partner size were calculated. For each of the nine new firms in the “At least one large partner” sample, Appendix C provides data on the number of employees for each partner, the average number of employees of partner firms, and the sum of all the employees of partner firms. The Spearman correlation coefficient for average size of partners and performance was -0.400, the correlation coefficient for size of largest partner and performance was -0.227, and the correlation coefficient for performance and total number of partners’ employees was -.294. None of the three coefficients was significant at $p < .10$. Thus, we conclude that there is no linear relationship between performance and partner size for the new firm sample with at least one large partner.

The set of hypotheses 7 to 10 compared new and established service providers in terms of five attributes of their business models: (i) number of products and services offered; (ii) number of target markets served; (iii) number of go-to-market partners; (iv) price of core

service; and (v) go-to-market partner heterogeneity.

Hypothesis 7 and its variants predicted that the number of products and services is greater for new Wi-Fi service providers than it is for established ones. This set of hypotheses was supported. New Wi-Fi service providers offer (i) more products and services, (ii) more products and (iii) more services than do established service providers. Table 9, 10 and 11 show that the mean rank difference of the Mann-Whitney U tests are significant at $p < 0.05$ and that the mean ranks for the new firms sample are greater than the corresponding ones for the established firms.

Hypothesis 8a predicted that the number of target markets is greater for new Wi-Fi service providers than established Wi-Fi service providers. This hypothesis was supported at $p < 0.05$.

Hypothesis 8b predicted that the number of go-to-market partners is greater for new Wi-Fi service providers than for established Wi-Fi service providers. This hypothesis was supported. Table 12 shows that the mean rank difference of the Mann-Whitney U tests are significant at $p < 0.05$ and that the mean rank for the new firms sample is greater than the corresponding one for the established firms sample.

Hypothesis 9 predicted that the price of the core service is lower for new Wi-Fi service providers than for established Wi-Fi service providers. This hypothesis was supported. Table 13 shows that the mean rank difference of the Mann-Whitney U tests are

significant at $p < 0.05$ and that the mean rank for the new firms sample is lower than the corresponding one for the established firms sample. Tables 3 and 4 show that for new and established firms, the mean prices of the core service are \$24.57 and \$37.95 respectively. This suggests that, on average, new Wi-Fi service providers price their core service at 65% ($24.57/37.95 * 100$) of the average price of established Wi-Fi service providers. Hypothesis 10 predicts that go-to-market heterogeneity is greater for new firms than for established firms. This hypothesis was also supported. Table 14 shows that the mean rank difference of the Mann-Whitney U tests are significant at $p < 0.05$ and that the mean rank for the new firms sample is greater than the corresponding one for the established firms sample.

6.2 Discussion of results

The results of this research identify specific guidelines that may be useful when designing a successful business model for a new Wi-Fi service provider.

The results suggest that a Wi-Fi service provider should:

1. Offer more services than those offered by established rivals
2. Target more markets than those targeted by established rivals
3. Price the core service at 65% of the price of established rivals
4. Partner with more companies to execute a go-to-market strategy than established rivals do
5. Partner with more different types of companies than established rivals do
6. Partner with at least one large company

7. CONCLUSIONS, LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

7.1 Conclusions

We begin the thesis by developing the research model which relates attributes of a new firm's business model with the value the new firm captures from technology built on an open standard. Then ten hypotheses were developed anchored around the research model and tested using data drawn from 22 new and 40 established providers of Wi-Fi services in North America.

From the data analysis and the above discussion on the relationship between the six business attributes and performance, we can draw conclusions as follows:

1. The number of products and services offered by new Wi-Fi service providers were positively related to company performance.
2. The number of target markets addressed by a new Wi-Fi service provider was positively related to company performance.
3. The number of go-to-market partners of a new Wi-Fi service provider was positively related to company performance.
4. A new Wi-Fi service provider's partnership heterogeneity was positively related to company performance.
5. Performance of new firms with at least one large partner is greater than the performance of new firms with no large partners.

From the data analysis and the above discussion on the comparison between the new firms and the established firms in term of five attributes of their business models: number of products and services offered; number of target markets served; number of go-to-market partners; price of core service; and go-to-market partner heterogeneity, we can draw conclusions as follows:

1. Number of products and services offered is greater for new firms than established firms.
2. Number of products offered is greater for new firms than established firms.
3. Number of services offered is greater for new firms than established firms.
4. Number of target markets is greater for new firms than for established firms.
5. Number of go-to-market partners is greater for new firms than for established firms.
6. Price of core product or service is lower for new firms than established firms.
7. Go-to-market partner heterogeneity is greater for new firms than for established firms.

This thesis has the following contributions:

1. This research contributes to the literature by examining the case of new market disruptions in which both incumbents and attackers compete using the same technology, one that is defined and evolved by open interoperable standards. Established and new firms compete without improving different technologies along separate trajectories.

2. The second contribution this research makes is that it empirically tests the relationship between attributes of the new firms' business models and their performance by anchoring around a model that focuses on the role of the business model in capturing value from early stage, open standard technology.

7.2 Limitations of the research

The first limitation is the research studied only the period of early stage since Wi-Fi industry and markets are in the early stage. The Wi-Fi business industry is a very recent one and the different players are still experimenting with a variety of business models in order to conquer a sustainable and profitable position in this promising industry.

The second limitation is that this study focuses on the perspective of Internet public service providers. It cannot be argued that this study reflect the all players in the Wi-Fi industry.

The third limitation is that this study focuses on the Wi-Fi service providers in North America. It cannot be argued that this study reflect the all Wi-Fi Internet service providers all in other places.

Last, there is a limitation of the data gathering, such as inadequacy of certain sources and low profile of small companies.

7.3 Suggestions for future research

During this project we have come across a number of interesting issues in the field of Wi-Fi industry and markets. There are many things that can be researched further:

First, the future research can develop a model that captures the salient relationships between the business model attributes and the performance for the late stages of Wi-Fi business markets. Other attributes of business model which are important to those stages of Wi-Fi business market may need to be investigating in order to gain the insights into Wi-Fi industries.

Second, the future research can examine how the business model captures the value in the open standards environment from the hotspots owner perspective. Whether should they use a WLAN network in their premises to attract more clients or deploy a WLAN network to their clients themselves?

Third, from the legal aspects, there is a legal aspect/commitment in offering Internet access in a public environment. Are there more obstacles in offering public WLAN access?

Fourth, from the technical perspective, what impact will this have on the existing Wi-Fi markets and players if the advent of a replacing technology appears?

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Appendix A. Histograms for the variables examined: new firms**A 1. Histogram for the number of services** **A 2. Histogram for the number of target markets**

A 3. Histogram for price

A 4. Histogram for number of go-to-market partners

A 5. Histogram for partner heterogeneity

A 6. Histogram for performance (number of hotspots/months in operations)

A 7. Histogram for the performance of new firms with at least one large partner

A 8. Histogram for the performance of firms without large partners

A 9. Histogram for number of products and services

A 10. Histogram for number of products

Appendix B. Histograms for the variables examined: established firms**B 1. Histogram for the number of products** **B 2. Histogram for the number of services**

B 3. Histogram for the number of target markets

B 4. Histogram for price

B 5. Histogram for the number of go-to-market partners

B 6. Histogram for partner heterogeneity

B 7. Histogram for number of products and services

**Appendix C. Average number of employees of the partners of the new firms
included in the “At least one large partner” sample**

	Carrier/ISP	Technical	Roaming	Channel	Average number of partners' employees	Sum of partners' employees
1. Boingo Wireless	Infonet (1,085) Telecom Italian (12,300) EarthLink (3,335)	Netgear (207)	RoomLinX (300) Telmex (40,353)		9,597	57,580
2. DragNFly Wireless	Swisscom (20,470)				20,470	20,470
3. Urban Hot Spots	Covad (1,100)				1,100	1,100
4. Wi-Fi Guys, LLC		Pronto Networks Inc. (344) Intel (79,700) Proxim (344)	iPass (330)	YDI (82)	16,160	80,800
5. Wisper		Proxim wireless network (344) Dell (46,000)		Walnut Capital (800)	15,714	47,144
6. WEBbeams		Covad (1,100)			1,100	1,100

7. HotPoint		Dell (46,000)	Ipass (330) Goreremote (205)		1,711	46,535
8. Deep Blue Wireless			Ipass (330)		330	330
9. Broadband Oasis		Intel (79,700) Hewlett Packard (151,000)	Proxim (344)		77,014	231,044

* Numbers in brackets refer to number of employees.

Spearman correlations for performance and partner size
(Sample size = 9)

	Performance (Number of hotspots/months in operation)
Number of employees of largest partner	-.400 (.286)
Average number of employees of largest partners	-.227 (.557)
Sum of partners' employees	-.294 (.442)

* $p < .10$ (2 tailed)

** $p < .05$ (2 tailed)

*** $p < .01$ (2 tailed)