Future micro operators business models in 5G

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Abstract
This paper focuses on creating an approach and discussing the coopetitive business models of Micro Operators (µO) in the indoors/small cell 5G environment. We define the µO as an entity that combines connectivity with specific content services in spatially confined domains and is dependent on appropriate spectrum resources. We review the literature of 5G business models and develop a framework to discuss the exosystemic, competitive and scalability elements of µO business models. Our findings indicate that the µO concept which has a natural role in the small cell/indoor environment can bring significant value added that complements existing communications services.

Introduction

The development towards the fifth generation (5G) of mobile communications has been understood to mean a shift towards small cells and indoors coverage in a situation where many larger mobile network operators (MNOs) compete by offering mobile broadband through a variety of different parallel access networks from 3G, 4G, and 5G to even WiFi. It is expected that in the future the number of mobile broadband subscribers will increase the same way as the data rates they demand for their services is increasing (Cisco white paper 2014). Consequently, placing significant demands for spectrum availability and usage efficiency should be undertaken. This has led the industry to seek new spectrum, as well as spectrum and infrastructure sharing, network function virtualization (NFV), and a variety of other technologies in order to improve network performance and efficiency. In general, the introduction of 5G has been related to several benefits ranging from considerably *increased* data volume and (guaranteed) user data rates, the number of connected devices, service reliability, mobility support up to 500 km/h to accuracy of terminal location. Additionally, 5G can tackle the problems related to a considerable decrease of energy consumption, latency, operating expenditures and service deployment time.

In small cell indoor environment, the MNOs competitive landscape has changed dramatically. Compared to outdoor environment, many property owners have chosen to offer free broadband for their customers in their premises or use license-exempt frequencies for their own purposes. More importantly, the local services required in different public, commercial, industrial or mixed-use premises or spaces may be rather specific, and it may be impossible or not feasible for an MNO to offer such services. Therefore, one of the new business concepts emerging from the various indoor / small cell operations is the **Micro Operator (µO) concept**. A µO can be considered as an entity that offers 1) *mobile connectivity combined/locked with specific, local services*, is 2) *spatially confined* to either its premises or to defined (but narrow) area of operation, and is 3) *dependent on appropriate available spectrum resources*. Due to the comparatively small size and limited resources of the µOs, the most likely µOs to emerge with required scale and scope of operations have either to serve a specific and necessary purpose and/or have a large enough user base. Good examples of such include hospitals and universities in the public domain, large-scale entertainment or sport venues, big shopping malls or retail chains in the commercial domain, and large-scale industrial spaces. In addition, these kinds of µOs are big enough to represent a lucrative business opportunity for MNOs, even if additional investments in the customer segment are required.

To date, the literature on 5G related business models is still in its infancy. However, some observations can be made based on existing literature. Zhang et. al (2015) Have discussed a cloud-assisted business model. They pay attention to densification of the network by providing open access to small cells with the aim of bringing value to customers through flexibility, security, efficiency, scalability, low costs, and, also profitability when there is small cell accessibility. Andrews et. al (2014) Have presented a collaborative business model. They discuss network infrastructure sharing in a heterogeneous (HetNet) environment for maximizing users' data rate and creating more revenue.

Rasheed et. al (2015) Discussed incentive and reputation business model to support cooperative network architecture and revenue generation. As the benefits of the discussed business model, they see possibilities for upgrading performance, connections, capacity, coverage of the network, quality of service, efficient network resource utilization (also from environmental perspective) and new cooperative or innovative services. Rasheed et. al (2015) discussed also brokerage business model that bring different kind of buyers and sellers together through auctions to enjoy network services.

Hattachi & Erfanian (2015) discuss asset provider, connectivity provider and partner-service provider business models. The role of these business models is to support different kinds of customers and various levels of partnership activities. The value of these models would be the possibility to share infrastructure, receive particular network capabilities, enable software-oriented capabilities, provide anything as a service, achieve real-time network sharing, provide best IP connectivity, support self-configuration of the network and enable the provision of combined service offerings.

As the above examples show, the current literature lacks a coherent perspective on µO business models although some framing elements can be recognized for them. The fundamental dilemma of the µOs is their business model as dependent on the appropriate spectrum, content, site, or availability of other resources, therefore, some kind of cooperation is required for efficient use of resources for instance amidst inevitable competition with other service providers in order to differentiate their services and have competitive advantage. In strategy literature, this kind of situation has been coined as coopetition, parallel competition and cooperation Brandenburger & Nalebuff (1996). While not all µOs require licensed spectrum, in this paper we focus on such cases where licensed spectrum is a natural choice due to the amount of broadband subscribers within the µO's coverage. According to (Bengtsson & Kock 2000), when the need for external resources is high and a firm's position in the industry is strong, it is more likely to cooperate with competitors, thereby adopting coopetition strategy. For the µO the situation is exactly this with a slight twist: they are dependent on the resources of the MNO while having a "local monopoly" within their spatial confines.

By defining the µO-MNO relationship as coopetitive, we seek to address the context and process (Bengtsson et. al 2010) aspects of the µOs' business model. With a focus on the public, commercial and industrial µOs, the two-fold research question we explore in this paper include is as follows:

How we can approach the coopetitive specificities of the µO business model?

How the coopetitive µO business models may scale?

The rest of the paper is as follows. Section II defines and discusses coopetition as the context for µO-MNO relationship, Section III provides a business model framework for analysis, and Section IV presents the methodology and data analysis of the paper. In section V and conclude with discussion and conclusions.

The coopetitive context of µO-MNO relationship

Inter-firm interdependences have traditionally been viewed through the lenses of two opposite perspectives – either competitive or cooperative. Competition promotes a self-interest-oriented behavior since any action bound to accumulate profits provides benefits for one firm at the expense of the others (Padula & Dagnino 2007). While competition can be regarded as a negative- or zero-sum game, cooperation implies a positive-sum game where the performance of the cooperating firms is mutually dependent. Brandenburger & Nalebuff (1996) emphasized the limitations of both paradigms as accounting only for one part of the reality, and suggested combining competition and cooperation via coopetition. Studies in this vein perceive coopetition as a win-win relationship and focus on balancing value creation and value capture (Gnywali et. al 2008).

For the purposes of this paper we define *coopetition as a relationship between multiple actors simultaneously involved in cooperative and competitive relationships, regardless of whether their relationship is horizontal or vertical*. This definition not only reflects the nature of µO-MNO relationship, but also allows accountability for the process and context features of coopetition and overcoming the dyad bias as there typically several MNOs and a myriad of third parties such as content providers active in the µO's business domain. To characterize further the µO-MNO relationship, we refer to Casadesus-Masanell & Llanes (2011) who present open source, proprietary and mixed-source (including open-core, open-edge) business models to study interaction among firms. It is evident that both µO and MNO need to adopt at least an open-edge approach to let the µO to "plug-in" to MNO's services seamlessly.

The current theoretical and empirical research on innovation-related coopetition strategy suggests that it is suitable for creating incremental improvements in current products and services. From the perspective of MNOs, this is a valid argument for favoring coopetitive strategies. Coopetition has also been regarded as an effective way for generating radical innovations in certain sectors (Ritala & Hurmelinna-Laukkanen 2009). Whether the µO concept is a radical innovation or not can be debated, but it rests on the idea that coopetition is a new business model in itself aimed at improving firm's performance and increasing collaboration with other business actors (Kotzab & Teller 2003).

Business model approch

Lying at the intersection of entrepreneurship and strategy, the business model concept can be seen as a bridge between abstract strategies and the practical level of decisions and actions amidst the uncertainties of the modern business context (Afuah 2004; Chesbrough & Rosenbloom 2002; Richardson 2008; Alt & Zimmerman 2001; Shafer et. al 2005). For instance, Zott & Amit (2010) conceptualize business model as a 'boundary-spanning' set of activities aimed at creating and appropriating value. Morris et. al (2005) viewed the concept of the business model as a set of decisions related to the venture strategy, architecture, and economics of firm (value creation and capture) that need to be addressed to create sustainable competitive advantage in the chosen markets.

The concept of the business model (Figure 1) typically covers a variety of elements, as there is a myriad of conceptualizations available for a business model. Zott & Amit (2010) argue that a business model functions to exploit a business opportunity. When built around the opportunity, the business model can be claimed to consist of elements when, what, how, why and where the firm is acting to create and capture value when exploring and exploiting opportunities.

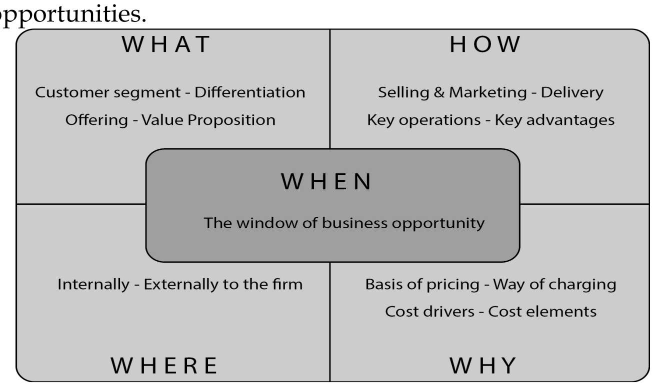

FiGure 1. Business Model definition.

The extant literature on coopetition is still short on explaining the link between coopetition and business models (Bengtsson & Kock 2000). Zott et. al (2011) argued that the business model can be considered as a new unit of analysis spanning both the firm and network levels of analysis and it can enhance holistic understanding of business dynamics. For understanding the specificities of the µO's business models in coopetitive contexts, we need thus to map the networked or ecoystemic nature of business models. In addition, we need to study the scalability of the business models. In the following sections, we discuss the ecosystemic nature (A) and scalability (B) of µO business models.

4C Business Model

The ecosystemic nature of value co-creation and co-capture can be demonstrated by layering the concept of the business model. In web 2.0 context, Wirtz et. al (2010) discuss four business models: connection, content, context and commerce business models. Yrjölä et. al (2015) interpreted these business models as a *layered 4C-model*, where "lower" level business model is required for the "higher" level to exist. These layers are the domains where opportunities for value co-creation and co-capture in the ecosystem exist. A value creation and capture framework offers homogeneous types through its ability to capture the genuine players and offers value compared with other models that lead to duplication (Conte 2008). This 4C-model can be applied either to examine a single layer player or a player that is active in all four layers (Yrjölä et. al 2015). To conclude, the 4-C model (Figure 2) describes the structure and interaction in the ecosystem from the business model perspective.

The first layer is concerned with *connection*-related business model where a stakeholder provides connection related services. In the µO case, connectivity is a concern for the µO as MNOs are offering parallel connectivity services to their customers. The availability of alternative connectivities may pose a threat for the µO if it monetizes connectivity unless there is a possibility for local monopoly due to unavailability or poor quality of the alternative connectivity. Also, dependency on infrastructure or spectrum provided by an MNO may restrict opportunities to monetize connectivity.

The second layer is the business model focusing on monetizing *content*. At the content layer, all sorts of online content services (e.g. mobile video streaming) are classified (i.e. relevant, up-to-date and interesting) and are accessible conveniently for the end user. The content might be peer-to-peer / user-oriented contents (i.e. exchange of personal content), web browsing contents (i.e. information storage) and online collected and selected educational and entertainment / center-oriented contents (audio, video, text etc.). The key is to understand who owns and can monetize content or whether it is freely accessible to end users as in the case of advertisement content.

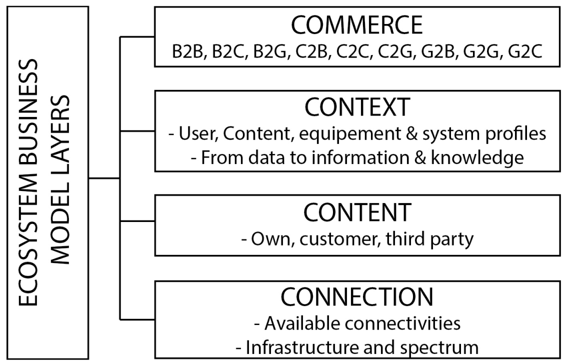

FiGure 2. the 4-c model.

The third *context* layer concerns the ability to create and monetize user, content, equipment / user device and system profiles and turn (big) data into meaningful information and knowledge. At this layer, the information that already exists on the internet can also be structured and aggregated to create less complex services through search and navigation (e.g., Google) and provide relevant and useful context for the content. It helps the users to identify the content that they need and it leads to a more transparent market. Through 5G networks all of the businesses would be available on mobile and there would be variety of services based on the users' profiles, time, place and history data latency" (Hossain et. al 2014). The context stakeholders will provide information about the network, service, device and users' profile.

The fourth layer concerns *commerce*, the ability to monetize any or all of the connection, content, or context specific resources, actors or activities related to the ongoing communications. At this layer, we can recognize business (B), consumer (C) and public/government (G) types of communications (Mitola III et. al 2014). Thus, B2B (business-to-business), B2C and B2G communications as well as C2B, C2C and C2G or G2B, G2C and G2G communications may be monetized at this layer.

Business Model Scalability

Building on Stampfl et. al (2013) and Yrjölä et. al (2015) applied the following scalability factors in conceptualizing the design of the business model:

Technology: *the scalability of infrastructure and autmatic processes reduce the transaction costs.*

Cost structure: *high value proposition with low costs can be achieved through access to spectrum resource opportunistically.*

Revenue structure: *having sustainable and continuous revenue generation where the current customer has essential role.*

Legal, regulatory and policy adaptability: *neglecting this issue leads to creating a firm scalability barrier.*

User orientation: *addressing and solving the problems should be based on the user's current knowledge and in a simple way (i.e. need pull) by applying network externalities to maximize switching costs.*

For µOs, the scalability may stem from different factors, depending on the type of µO in question. According to Bondi (2000), in the technology context, scalability is the capability of a system, process or network to deal with an increasing amount of load or being able to expand to have room for growth. Discussing the notion of scalability in conjunction with the business model leads to creating a framework for estimating business/growth potential (Nielsen & Lund 2015).

emperical examination

In this section we will examine the coopetitive specificities and scalability of μOs possible business models. First we have identified different domains where the μOs could emerge including public, commercial and industrial domains. Within these domains we have further identified two distinct example cases for which we provide a generic business model analysis. Table 1 below summarizes our key findings.

Public μOs: Universities and Hospitals

The two public μO cases examined were Universities and Hospitals. These two cases were selected because both cases require specific services that connect consumers of different kind to interact with the locally available specialized services and personnel, while also requiring a wider set of services provided by third parties. A specific requirement for all public μOs is the high reliability and security requirement placed on them.

University. Regarding connectivity, in the university environment the local μO could serve additional mobile broadband (MBB) and machine-to-machine (M2M) services for students, employees and companies located within the university campus. Building on connectivity the content services could include specific educational services and materials provided through third-party systems. From the context perspective, the laboratories and other research environments might also require virtual and augmented reality services (VR/AR) and IoT services to manage and utilize the campus premises. In addition, accurate positioning might be needed for the context to enable experiments with different research content and activities ongoing in the premises. Regarding the commercialization of services within the university domain, enhanced multimedia services and big data and may play a major role for universities in the future. The scalability of the possible campus μO stems from the size of the ecosystem, especially regarding the number of end-users for the service, but also from the number of companies and other services active in the university domain. The openness of the innovation environment is also a key issue.

Hospital. Future hospitals utilize a wide variety of medical devices and sensors that utilize various access technologies (connectivity) and the location and status (context) of which needs to be known all the time. The content related to patient records and managing hospital processes requires high reliability and high security (identification of users, security of data transfer and communications), that the μO need to be able to provide. The commercial side of the hospital environment is related to the potential of introducing, testing, and integrating new medical devices and services rather than servicing the patients with normal broadband connectivity. The scalability of the potential hospital μO may stem from opening up the regulative environment of hospitals, but also form the amount and security of data produced and utilized in hospitals, and the level of interaction/communications needed. A specific coopetetive scalability opportunity for hospitals is the home-hospital patient journey, as hospitals seek efficiency by integrating home care activities with hospital treatment.

Commercial μOs:Shopping malls/chains and mass events

The commercial μOs analyzed include shopping malls/chains and mass events. The same way as with the public μOs, the commercial μOs have a deep coopetitive interface with MNOs as they serve the consumers. A common element for all commercial μOs is requirement for high scalability.

Shopping malls/chains. The connectivity opportunities for shopping malls/chain μOs are in local MBB and related content that in most cases could be seen as related to advertising or to locally available entertainment, where also specific mobile applications (and related data collection opportunities) may have a role. As customer profiling and location are key requirements for shops to improve conversion rates that data could also be sold to shops as a commercial activity of the μO, but within the privacy requirements of the customers. The scalability potential of the shopping mall/chain μO may stem from the opportunity to serve several sites, number of consumers in the vicinity, and customer profiling.

table 1. Business Model definition.

	Public (University/ hospital)	Commercial (Shopping mall or chain / mass event)	Industrial (Manufacturing/construction)
Connection	Additional MBB & M2m (Uni) Medicad M2M/D2D, MBB (Hospital)	Local MBB (Shopping) Hige user density MBB (Mass event)	M2M (Manufacturing) IoT Adhoc M2M (Construction)
Content	Educational services (Uni) Patient data (Hospital) Virtual / augmented reality data	Entertainment Advertising Event related content	Process/ product big data (for both)
Context	Location services (Uni) Indoor positioning (Hospital) Building automation	Mobile Apps Content specific automation Indoor positioning / building automation	Location data (for both)
Commerce	Enhanced multimedia services (Uni) Big data (Uni) 3rd party UE/ devices / services (for both)	Customer data & profiles Customer profiling	Customer/ supplier services (for both)
Scalability	Size of ecosystem Amount of data Openness of innovation environment Regulation Amount of data Security of data Level of interaction Hospital processes Home/hospital patient journey	Multi-site potential Number of customers Customer profiling/ big data Privacy issues 3rd party rights Event specific requirements	M2M/ IoT platform capability Case specificity Big data / standards Inward/ outward data flows
	High reliability and security required	High scalability required	Accurate positioning required

Mass events. Mass events require high user density MBB connectivity. To enable monetizing the event-specific content (e.g., video feeds), user identification capability for billing a high number of customers is mandatory by the µO, thus highlighting the need for cooperation with and MNO. A specific feature in many mass events is related to the rights of the µO to use the event content. E.g., in sports events the distribution right of the event may be sold to media broadcasters, thus restricting the µO's right to utilize the content. Thus, the scalability potential of the µO may stem from demand for the content and the 3rd party rights to it.

Industrial µOs: Manufacturing and Construction

The industrial µO cases differ from the public and commercial cases in that that they do not typically serve a big amount of end users but a may provide connectivity for a big amount of sensors or other connected machines or devices (M2M, D2D) that require advanced platform capabilities. Also, accurate positioning is required from industrial µOs.

Manufacturing and *Construction* In manufacturing there is a high connectivity requirement is for M2M communications for content such as process or product big data. In addition, location as a context may be a crucial element in managing the manufacturing process. The commercial element in manufacturing µO business is the opportunity to connect to customers' and suppliers' information systems. Construction differs from manufacturing in its need for adhoc M2M, as the construction sites are active only for a short period of time and then move elsewhere. But, construction resembles manufacturing regarding the type of content, context, and commerce elements of their business model. The scalability of industrial µOs may stem from platform capabilities, standardization of big data structures handled and inward-outward flows of information in the system.

Discussion and conclusions

Despite some discussion on 5G business models can be found in the research literature, µO business models are a neglected area. As the µOs combine connectivity with local services and are dependent on appropriate available spectrum, it appears evident that they face a coopetitive business environment and relationships with its partners. While the emergence of µOs is currently challenged by spectrum availability and lack of suitable infrastructure, 5G could change the business ecosystem with breakthroughs in technology and policies to open the market for more competition. To provide an approach to µO business in 5G, we have discussed the connection, content, context and commerce related business models of the µOs together with the sources of scalability for their operations. Several notions can be made from our analysis: what are the enabling elements for µO business, what is the potential for growth and scalability, what is the point of control in the ecosystem, and what is the specific value added of the µO concept.

In our analysis we have found several enabling elements for µO business. The traditional MNO business model is challenged in small cells and indoor domains as the local player might have a local monopoly to the environment. The practical implication of this is that the deployment of the network may be difficult. However, the opportunity space is vast. Different industry verticals are facing the need for digitalization with distinct requirements. The emergence of µOs to locally meet the needs of could provide a scalable platform with potential for growth. The µO concept has also potential for bringing significant value added in locally needed specific services in small cell/indoor environments as they have a local point of control in their service ecosystem.

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