Stakeholder Value Network Analysis

For the Mobile Services Ecosystem

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ABSTRACT

The mobile services ecosystem has evolved and continues to evolve at a rapid pace adjusting to the different players competing to be part of the value creation and capture. This thesis attempts to capture a holistic view of the entire ecosystem and performs a stakeholder value network analysis on the ecosystem and its members. The qualitative model lists, maps and identifies the stakeholders and the monetary, goods / services, information, participation and public benefit value flows between the stakeholders in the ecosystem. The quantitative model attaches numerical values to the different value flows based on a characterization of needs and the importance of the sources fulfilling those needs and creates a value network that is then analyzed to produce relative importance of stakeholders from various perspectives and a ranking of the importance of different types of direct and indirect value flow loops in the system thus creating a framework for strategic ecosystem analysis.

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TABLE OF ACRONYMS

AMPS	Advanced mobile phone system
APP	Application
ARPU	Average revenue per user
ASIC	Application specific integrated chip
CDMA	Code division multiple access
CPU	Central processing unit
DPI	Deep packet inspection
DRM	Digital rights management
GPRS	General packet radio service
h/w	Hardware
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet protocol
ITU	International Telecommunications Union
LTE	Long term evolution
MTTF	Mean time to failure
NASA	National air and space agency
NEBS	Network equipment-building system
NOAA	National oceanic and atmospheric administration
NPU	Network processing unit
OTT	Over the top
s/w	software

1 Introduction

This thesis was a result of the desire to use the tools of systems thinking to a subsystem of interest. The subsequent sections of this chapter will briefly initiate the reader to some background information on the subject at hand, the motivation of the author to tackle the problem at hand, the general objectives behind the thesis, the specific objective of the thesis and an overview of the organization of the document to follow.

1.1 Background

There is a significant body of work on both the stakeholder analysis techniques that have been used so far and different analyses on the current state of the art in the Mobile services industry in the literature. Traditional stakeholder analysis techniques have been applied to various systems since 1984 when they were first used by Freeman. The emphasis was on the capture of direct interactions between stakeholders. The previous work at the System Architecture group at MIT was to expand the stakeholder value network analysis concepts to as varied a set of systems as possible to be able to refine the methodology to capture indirect interactions between stakeholders and develop a rich model of the subsystem under consideration. The Mobile services industry is covered by publications and research by Light Reading, Heavy Reading, Unstrung, Canalys, Frost and Sullivan, Wireless week, and many other industry publications. Historically, phones were the earlier mobile devices and therefore voice has been the first and still dominant service over true mobile devices. The general consensus is that even though Average revenue per user (ARPU) for voice services still dominates most mobile operators' revenue source, growth in ARPU for voice is very flat. It is the ARPU for data services that is growing at a significant pace. With increasing ARPU for data services come the varied challenges of maintaining relevance in the value chain where the user and

applications are laying claim to a bigger portion of the revenue at the expense of the data carrying pipes. The mobile operators are being forced to look at the cost structures in their business and develop infrastructure that does not scale linearly in cost with increase in subscribers. This is leading to the push towards an all IP fourth generation (4G) network infrastructure. Data services, which are the growing part of these operators businesses, are pushing the deployment of 4G technologies with the legacy cash cow – voice behind in the race. There is also a push in different parts of the world to reign in some of the costs of mobile services like roaming (recently regulated by the EU) and also to improve interoperability between networks in different parts of the world. The US wireless market is dominated by to equally significant technologies CDMA (Verizon wireless, Sprint) and GPRS (AT&T, T-Mobile) whereas the rest of the world has been predominantly GPRS with some pockets of CDMA in Asia and Eastern Europe. The wireless market is in a state of transition from a voice-centric revenue model to an increasingly data-centric one. This leads into the motivation behind this thesis in the subsequent section.

1.2 Motivation

The history of the modern commercially available handheld mobile phone begins in the early 1980s with the Motorola DynaTAC 8000x analog phone using the Bellabs AMPS communications network. These were the times when mobile voice was a novelty service and mobile operators and hardware equipment providers together made this available for an increasingly eager population of users. It was a business in the early days focused on signing up as many subscribers as possible and then retaining them. Then came the internet revolution of the 1990s and 2000s which brought a whole range

of services and information to people's desktops and laptops. The natural evolution of all this information spilled over to the mobile domain in the early 2001 timeframe and is still ongoing with extensive 4G deployments being announced in many markets around the world. Just as the internet changed the revenue models of many businesses of the pre-internet age, the revenue models of the mobile industry are also going through a similar transformation. Mobile operators who were a virtual monopoly in the early years now have to counter the many Over-the-top (OTT) providers of IP based applications. Over-the-top in this context means services that use the network resources but the revenue disproportionately goes to the application providers rather than to the mobile operators and the users of these services do not care much about the details of the underlying network. In conjunction with the all-you-can-eat pricing models (one fixed price for virtually unlimited bandwidth) the end customer has become accustomed to, they have seen the need to change their thinking so that they are not reduced to a commoditized pipe for bits without being able to capitalize on the explosion of demand for high-speed access to bandwidth. There was a perceived need to develop a structural framework to look at this changing ecosystem and to make sense of how the industry works today and then maybe use the developed framework to help in the strategic analysis of business decisions made by the members of this ecosystem. The overall objectives of this thesis are:

- To further refine the stakeholder modeling technique developed by the MIT System Architecture group and apply it to the mobile services industry

- To provide a framework that can provide specific insights and recommendations for the mobile services ecosystem using the results of the qualitative and quantitative stakeholder analyses.

1.3 Specific objective

The analysis in this thesis will be done first for the entire ecosystem. The ecosystem will then be analyzed from the perspective of the industry group (network hardware vendors), which Starent Networks (the thesis writer's place of work) belongs to and is a central player in. It is the focus of this thesis work to develop the baseline which can then be used in the future to be able to identify a prioritized set of growth opportunities for Starent networks. The project will focus on the external stakeholder interface and identify the priorities in that space which may consequently drive the rest of the organization. Summarizing the specific goal of this thesis in the To-By-Using format (Crawley 2007) we have the following:

To identify the most important stakeholders and the highest value-producing interactions among stakeholders in the mobile services business ecosystem, thereby creating a framework to analyze the industry **by** conducting a rigorous qualitative and quantitative stakeholder analysis **using** the stakeholder value network analysis approach.

To identify the most important stakeholders and the highest value-producing interactions among stakeholders for network hardware vendors, thereby creating a framework to analyze the industry from their perspective **by** conducting a rigorous qualitative and quantitative stakeholder analysis **using** the stakeholder value network analysis approach.

1.4 Overview

The chapters in this thesis are organized as follows. Chapter 2 develops the qualitative aspects of the model starting with identifying the stakeholders, putting them in an organized map, identifying their roles, objectives, needs and inputs and concludes by identifying the value flows involved in the map. Chapter 3 develops the quantitative aspect of the model starting with value flow scoring, value loop listing, and value loop score computation. Chapter 4 contains the analysis based on chapters 2 and 3 and some observations regarding the same. Chapter 5 concludes the thesis by summarizing the methodology used and drawing conclusions from the analysis, highlighting the contributions of the thesis and suggesting areas of further work.

2 Qualitative model

The qualitative model involves identifying the stakeholders, mapping them logically in groups, taking the abstraction one level up (to level-0) and then taking it down a level to level-2 for an understanding of what lies at one level below the level at which we are performing the analysis. Then the roles, objectives, needs and inputs satisfying the needs are identified for each of the stakeholder. These inputs and sources providing these inputs result in developing the value flows coming into each stakeholder and eventually results in the development of the value flow network for the entire ecosystem.

2.1 Identifying the stakeholders

A brief description of the stakeholders (with examples) in the ecosystem follows.

- Casual consumers of mobility – these are the average users that consume mobile services (regular occasional user using a low to mid-range handset)
- Power users of mobility – these are heavy users of network resources (business users, multiplayer gamers)
- Mobile operators - those providing services involving mobility to the mobile consumer (Cellcos like Verizon wireless, Sprint, AT&T, T-Mobile, Vodafone, Orange, Bharti Airtel, Reliance, Tata mobile, China Mobile, China Telecom, Clearwire)
- Advertisers - those firms (or agents acting on their behalf) wanting to advance their product penetration and reach using mobility (anyone who has products to market that will be benefited by consumer mobility information).

- Mobile content developers and owners - those who have products and information to offer to the consumers of mobile services (casual users and power users).(ESPN, Nascar, Formula 1, FIFA, BBC, Viacom, Universal, Vivendi, Google)
- Network hardware vendors - equipment vendors supporting mobility and the end-to-end delivery of mobile services (Ericsson, Motorola, Alcatel/Lucent, Starent Networks, Nokia Siemens Networks)
- Services software vendors – these enable delivery of mobile services with value add software that complements the hardware and is part of the infrastructure (Billing, charging, storage, content delivery, performance monitoring, spectrum optimization software – Bridgewater, Camiant, Funk, IBM, Computer Associates, SUN)
- Handset vendors.- primary consumer interface of value delivery (Nokia, Research in Motion, Palm, Sony Ericsson, LG, Samsung, HTC, Apple)
- Technical Forums and Standards bodies – these bodies facilitate interoperability of disparate equipment (3GPP, WiMax Forum, ITU, IEEE, LTE World Summit)
- Government and agencies (FCC, Network Equipment-Building System(NEBS), UL, International Governments,)
- Contract manufacturers – these take designs and make a product hardware cards or handset devices that service both network hardware vendors and handset vendors (Plexus, HTC, Flextronics, Jabil Circuit)

- Mobile Applications(APPs) developers - these software vendors develop non-infrastructure type applications for various ecosystem members (Handango, Google, Game developers, small scale submitters to various APP stores)
- Chip vendors – developers of handset chips, equipment CPUs, NPUs, radio frequency chips (Intel, Qualcomm, Broadcom, Vitesse, Freescale semiconductor, Texas Instruments, AMD)
- Systems integrators - these firms specialize in taking heterogeneous network components and put a solution together for the mobile operators (Ericsson, Alcatel/Lucent, Nokia Siemens Networks)

2.2 Stakeholder map

The level-1 (base level) stakeholder map is as indicated in Figure 1. Levels in this context are levels of abstraction the system in being viewed from.

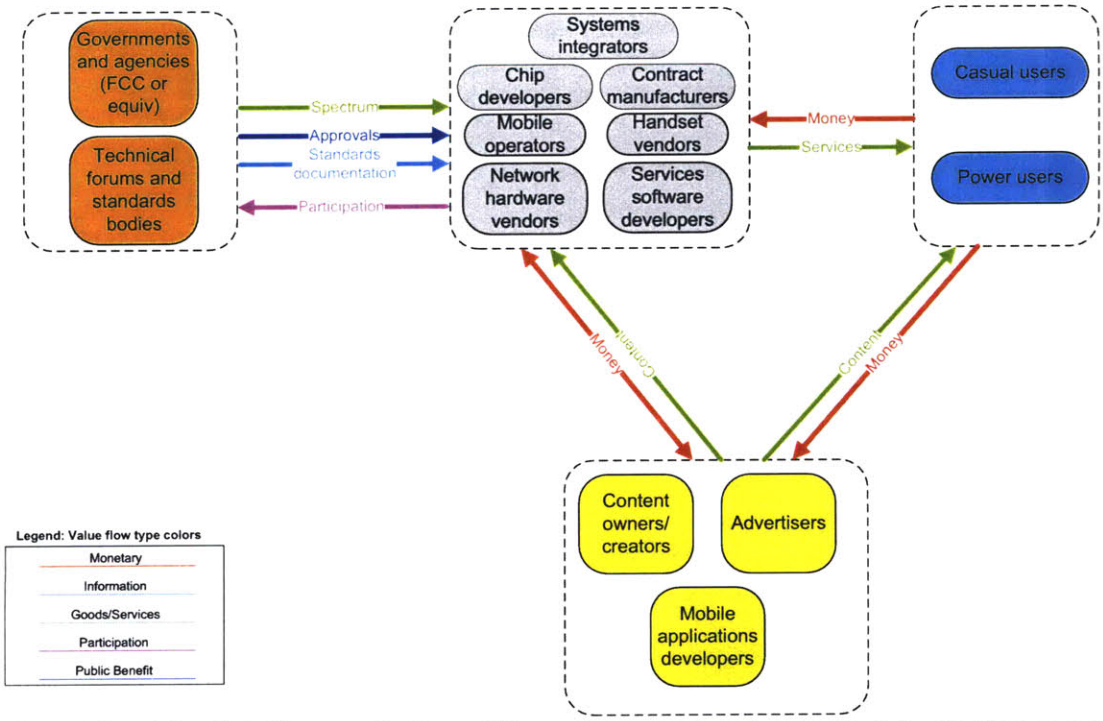


Figure 1 Level-1 stakeholder map for the mobile services ecosystem showing the infrastructure group (gray), content group (yellow), user group (cyan) and government/standards bodies group (orange) and how they relate to each other using the types of value flows shown

The level-1 stakeholder map of the mobile network ecosystem as shown above comprises four different groups of stakeholders. The gray colored group is the entities involved in the development of the infrastructure that makes offering mobile services possible. This group of stakeholders centers on the mobile operators and all the stakeholders that supply hardware, software or services to them. The stakeholders colored cyan are end users of mobile services. They have been divided into casual and power users based on how heavy their resource usage in the network. The stakeholders colored yellow are those that have something to offer in terms of content or software applications (that are either enablers for content delivery or are content in their own right) for the cyan colored group to use. This group also includes advertisers who also have content (though not usually mobile content, but regular products sold via the mobile medium). The orange colored stakeholders are the governments, government agencies and the standards bodies/forums.

The value flows shown in the stakeholder map are of five types each coded with their own color as shown in Figure 2 below:

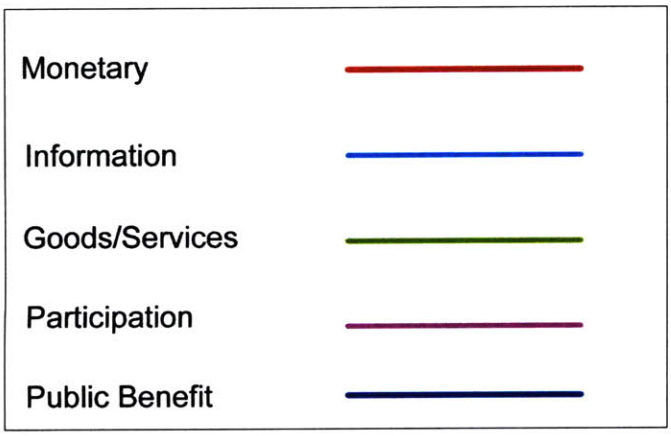


Figure 2 Value flow color scheme

After identifying the main stakeholders in the system under analysis, it is a very illuminating step to perform the one-UP and one-DOWN analysis to be able to identify the broader context in which the system under consideration is operating within (for the level-0) and enough details to be better able to identify the interactions within the different sub categories of the stakeholders. The analysis to take a one-level UP and one-level down view of the ecosystem produced a traversal in abstractions as described below. A level-0 one-up step produces the following aggregated stakeholder list which nicely aggregated along functional roles. The four bullets below summarize the functional segregation in the ecosystem.

- Mobility Users (the Who)
- Mobility Providers (the How)
- Mobile Content (the What)
- Influencers (Governments, Standards bodies, Forums, the Who else)

which helps in understanding the context within which each of the stakeholders operates and is also graphically shown in Figure 3.

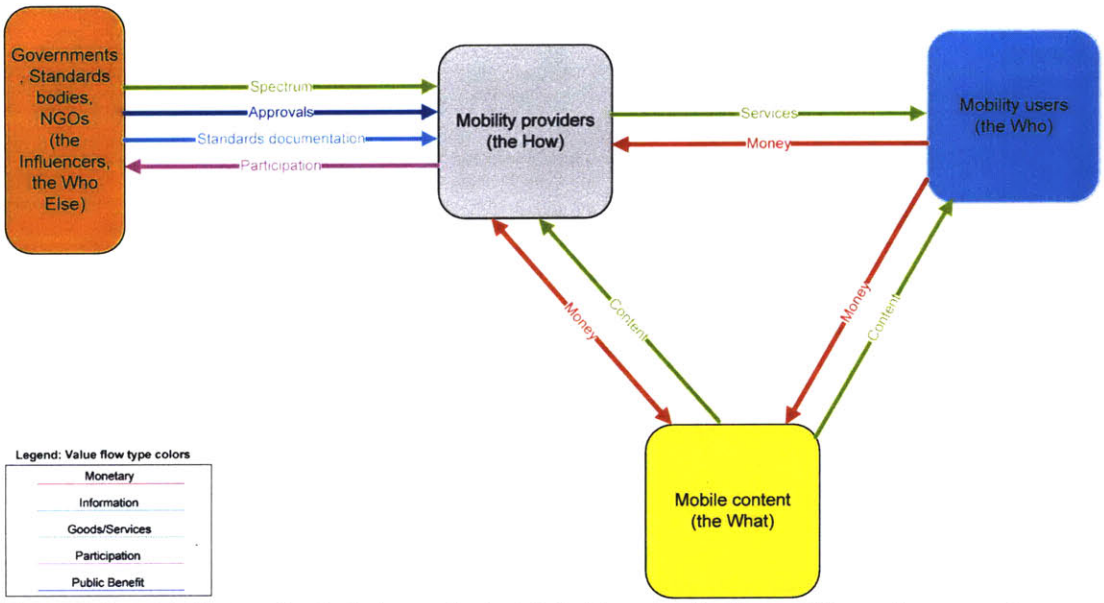


Figure 3 Level-0 (highest level of abstraction) stakeholder map for the mobile services ecosystem grouped as the Who, the What, the How and the How Else

The general value flow for products/services flows in this figure shows content flowing from the Mobile content group to the Mobility users group and also in some cases to the Mobility providers group (in cases where mobile operators get into the content business). Services (as in subscription plans) flow from the Mobility providers group to the Mobility users group and spectrum flows from the governments and standards bodies/forums group. The general monetary value flow comprises money being paid for mobile services and content by the Mobility users group. Money is also exchanged between the Mobility providers group and the Mobile content group depending on the types of relationships forged between entities in these two groups. The level-2 view resulted in the following stakeholder details as shown in Figure 4 below.

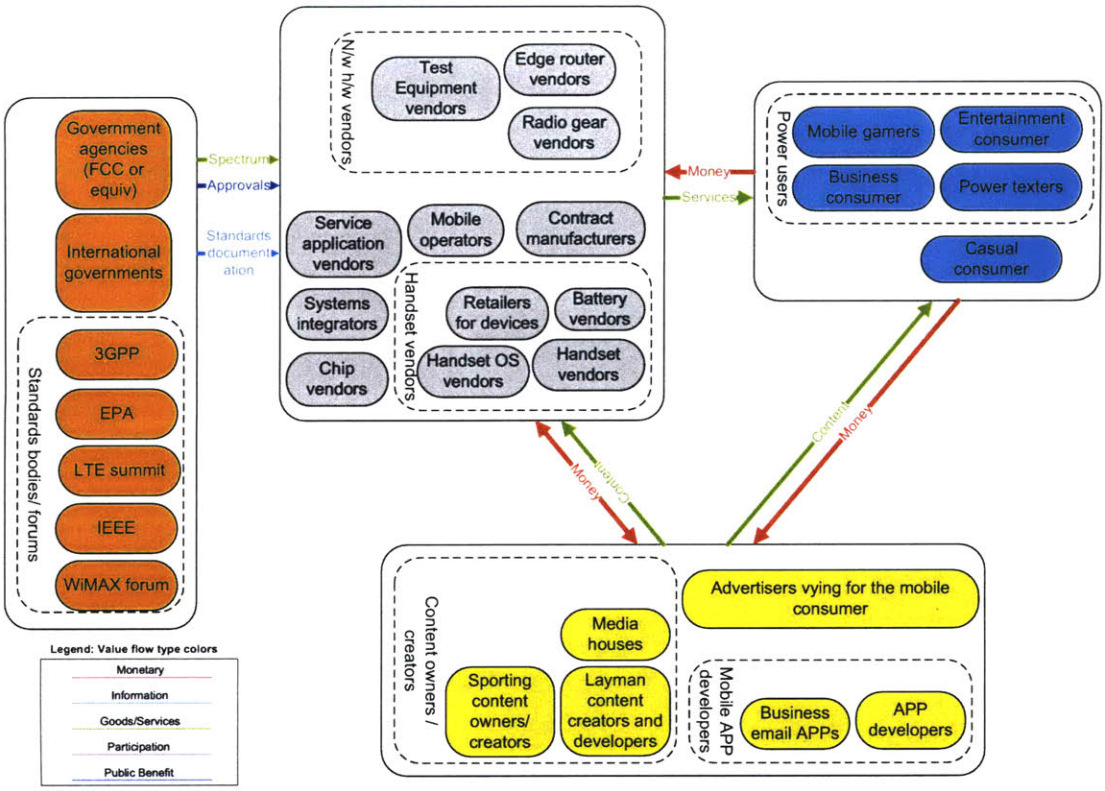


Figure 4 Level-2 stakeholder map for the mobile services ecosystem, breaks down stakeholders from Figure 1 into further detail as indicated by the dotted lines

This diagram shows finer detail within some level-1 stakeholder groups including Network hardware vendors, handset vendors, power users, content owners/creators, mobile application (APP) developers and standards bodies. The reason for not performing the stakeholder analysis at this level was to limit the complexity of the model in this thesis.

2.3 Stakeholder objectives and needs

Once the main stakeholders are identified, the next steps are to identify the role, objectives, needs and inputs (to satisfy these needs) of each of the stakeholders. The process involved consultation with various members of the mobile services ecosystem from different vantage points. The roles are to frame the high level reason for existence

of each stakeholder in the ecosystem. The objectives are a set of goals that each of the stakeholders strives to achieve to be a successful member of the ecosystem. The specific needs and inputs that satisfy these needs are then formulated as the beginning of the process that will eventually define value flows. The focus is only on the inputs because it is intuitively much easier for a stakeholder to identify the inputs needed to satisfy the identified needs. Also, many times there are outputs generated by the stakeholders that are not useful to any of the other stakeholders. It was also felt that there was a greater chance of exaggeration when asked for outputs since there is a human need to either consciously or sub-consciously amplify one's contribution to another and not realize the importance or lack thereof of one's output to another stakeholder.

	Stakeholder: Mobile operators
	Role: Use Spectrum in the various countries in the world to build infrastructure around it to be able to offer mobile services to businesses and consumers
	Objectives: • Build profitable businesses models around mobility • Increase market share in subscribers and revenues • Increase Average Revenue per User (ARPU) numbers • Offer differentiable services to improve subscriber retention
Inputs • Network equipment • User information from services software developers(authentication, quota etc.), power users, casual users, network hardware vendors • Network integration services • Spectrum (from public/govt. auctions) • Software applications • Standards compliance documents • Compensation for information on usage patterns from content providers, Mobile application developers, advertisers • Handset hardware • Support software • Monthly charges for service from power users • Monthly charges for service from casual users	**Specific Needs** • State of the art equipment that will enable flexible and monetizable service offerings with non-linearly scalable capex • Effective services software applications that will tie things together in the network • Efficient systems integration functions that will put solutions together from disparate vendors • Slew of value add software and applications that make network intelligent and enable the flexible and reliable ancillary functions that enable revenue collection • Spectrum to operate services • Handsets to be conduits for service delivery to the end consumer • Revenue flow to enable further investment in infrastructure and sustain business model • Software applications that could be used for selling to end consumer to generate revenue • Monetize wealth of end user information available(available from network hardware vendors, software vendors deployed in network)

	Stakeholder: Network hardware vendors
	Role: Provide state of the art combination of hardware and platforms and software to enable delivery of mobile services. These are the technological enablers to the ecosystem.
	Objectives: • Build profitable businesses around mobility • Increase market share in equipment • Develop state of the art platforms that can serve many different 4G technologies to prevent over niche markets. • Enable flexibility and high performance • Be carrier class in availability and robustness
Inputs • High-performance chipsets • Support software • Specialty manufacturing services • Standards compliance documents • Info (requirements from mobile operators, usage data from casual and power users) • Compensation from mobile operators for products	**Specific Needs** • State of the art chip vendors • Partners to offer supplementary services not developed by self to make a complete solution delivery and value-add software and applications that make network more intelligent • Compensation to validate business model and ensure survivability • Documentation from standards bodies to ensure interoperability • Users to use mobile operator services that will result in generated usage data • Requirements for networks from mobile operators

	Stakeholder: Contract manufacturers
	Role: Provide specialized manufacturing services for the ecosystem members. They have the expensive equipment which benefits from scale.
	Objectives: • Increase breadth in penetration in the ecosystem • Develop ability to service many different technology types. • Make very small MTTF numbers • Reduce instances of bad design and/or bad manufacturing processes.
Inputs • Design specs from network hardware vendors and handset vendors • Chips from chip vendors • Compensation from network hardware vendors • Compensation from handset vendors • Compensation from mobile operators for logistics/repair services	**Specific Needs** • Compensation for services offered to make possible capex investments (from network hardware vendors, handset vendors and mobile operators) • Accurate design specifications from both network hardware vendors and handset vendors • Chips from chipset vendors to be able to manufacture as per specifications

	Stakeholder: Services software developers
	Role: Develop applications that enable the tying together of hardware and embedded software and services into a unified system that is focused on the delivery of value from and within the ecosystem.
	Objectives: • Build profitable businesses around mobility • Develop applications that have use in mobile or landline applications • Span across different types of 4G technologies • Partner with other components of the ecosystem to maximize market penetration • Leverage platforms across product families to maximize software reuse • Effective standards activities to make universal software for like functions possible
Inputs • Service requirements from mobile operators, network hardware vendors, • Policy implementation data (from network hardware vendors) • Usage data (from casual and power users) • Standards specs from forums • Monetary compensation from mobile operators • Monetary compensation from network hardware vendors	**Specific Needs** • Accurate requirements specs from mobile operators and network hardware vendors • Accurate usage data from network hardware vendors for policy implementation • Money for services offered to both mobile operators and network hardware vendors • Standards specs to code to • Usage data from casual and power users to be able to do Deep Packet Inspection (DPI)

	Stakeholder: Handset vendors
	Role: Provide the crucial interface between what the mobile consumer wants and what content and services there are to provide to them.
	Objectives: • Build devices that consumers want and/or need • Analyze the market end consumer needs and appropriately segment the market • Maximize profit margin • Carve out a better slice of the pie for themselves
Inputs • Cost effective chips from silicon vendors • Contract manufacturing services • Mobile applications from applications developers • Indirect money from mobile operators as purchasing agreements • Money from casual users • Money from power users • Money for application approvals • Standards compliance specs • Lead user data (casual and power users)	**Specific Needs** • Cost effective and high performing chipsets and displays • Money from users(direct) / mobile operators(indirect) • Standards specifications • Need validation from lead users on the accuracy of market needs satisfaction • Application vendors to create applications for approval on handsets • Contract manufacturing services to bring down costs

	Stakeholder: Casual users
	Role: These types of mobile users are the recreational users with potentially large numbers in subscriptions and more evening and weekend usage than business day usage
	Objectives: • Enjoy mobile information • Focus on search and entertainment • Could be more responsive to relevant advertising
Inputs • Network and customer service from mobile operators • Cool devices from handset manufacturers • Useful content from creators/owners • Discounts on advertised products via mobile channels • Applications from application developers • Deals from advertisers	**Specific Needs** • Affordable prices for services • Flexibility of usage plans • Simplicity of billing options • Reasonable customer service in case of problems • Choice and variety in content • Relevant advertising for useful products while minimizing intrusive and irrelevant ads

	Stakeholder: Power users
	Role: These types of users are the volume users during work hours or otherwise for business communications. They could also be very service sensitive and access sensitive for reasons of contractual commitments with their customers
	Objectives: • High performing mobility access with less emphasis on cost • Improve productivity while increasing flexibility of how and where business gets done • Maintaining high availability for critical customers via the effective use of mobility
Inputs • Smartphone handsets • State-of-the-art network and customer service • Applications from software vendors • Useful content from creators/owners • Advertised deals via mobile channels • Discounts for advertised products on mobile channels	**Specific Needs** • Powerful devices to use for mobility • Comprehensive and wide-coverage services from mobile operators • Applications to satisfy advanced mobile applications to emulate a mobile office • Ability to completely turn off advertisements delivery • 24x7 integrated customer service in case of service interruption

	Stakeholder: Governments and agencies
	Role: Assigning spectrum in public interest and improving information infrastructure to facilitate commerce and general public good
	Objectives: • Enable economic growth infrastructure • Assign spectrum to highest bidders keeping public access and good in mind • Incentivize a broader spread to sparsely populated regions • Prevent monopolistic tendencies among stakeholders
Inputs • Handset and network hardware vendors approval documentation • Compensation for spectrum • Growth data from mobile operators • Under-served population access	**Specific Needs** • Bids for spectrum • Information on equipment design to evaluate compliance with spectrum/emission regulations • Plans for spectrum use • Growth indicators related to infrastructure decisions made

	Stakeholder: Technical forums and standards bodies
	Role: To coordinate the actions of disparate countries and communications companies to ensure interoperability of technologies so seamless communications can be achieved. Forums to align stakeholder interests towards a common end.
	Objectives: • Global communications are seamless • Technologies are developed cost effectively • Scale and grow technologies organically
Inputs • All stakeholders participation	**Specific Needs** • Plans for interoperability • Divided groups for discussion of various technical aspects of mobility

	Stakeholder: Content owners/creators
	Role: These are the people who have something of value to share with the mobile community. They need to have a way to monetize their property by providing it to those who are willing to pay for it.
	Objectives: • Create successful businesses by creating content valuable to mobile users • Stay ahead of the curve in terms of consumer trends • Find ways to monetize content • Create a large user base of the content which is turn lead to options to monetize
Inputs • Customer data from Mobile operators • Money from users(power and casual) for content provided • Money from advertisers to ride on content • Applications that support content delivery	**Specific Needs** • Data for market research for trends • Content that can be monetized • Advertisers willing to spend money to get to mobile eyeballs • Market surveys on content viewing patterns to be used for advertisement pricing • DRM support from handset vendors • Software applications that marry ads with content for potential revenue realization.

	Stakeholder: Advertisers
	Role: These are the stakeholder set that wants to take advantage of the needs of mobile consumer needing mobile content thereby contributing to the value chain.
	Objectives: • Maximize returns from advertising budget • Increase eyeballs viewing the advertisement • Improving the percentages of actual sales among people viewing the ads • Reduce cost factor of advertisement slots • Improve the variety of mediums depending on market segment
Inputs • Money from casual users • Money from power users • Information from content owners/creators and mobile operators on value of advertising • Applications enabling advertisement delivery • Permission(conduits) to run advertisements on top of content	**Specific Needs** • Cost effective ad slots and abilities • Market survey on eyeballs that can be targeted (internally generated) • Getting data on sales numbers per 1000 eyeballs • Options for conduits for advertisement dissemination that are relevant, non-intrusive and high speed • Customer location, demographic and presence history data (data from mobile operators)

	Stakeholder: Mobile applications developers
	Role: These are the people who write software programs that could add value to the mobile consumer. They need to have a way to monetize their property by providing it to those who are willing to pay for it.
	Objectives: • Create successful businesses by creating applications valuable to any or many of mobile users, mobile operators, handset vendors • Stay ahead of the curve in terms of consumer trends • Find ways to monetize content • Create a large user base of the content which in turn leads to options to monetize
Inputs • Compensation from handset vendors • Compensation from casual users for content provided • Compensation from power users for content provided • Compensation from advertisers when applications help them ride on content • Compensation from content creators/owners • Funding from mobile operators looking for that killer applications • Information on what sells from handset vendors	**Specific Needs** • Market research for trends • Ability to monetize for created applications • Advertisers willing to spend money to get to mobile eyeballs • Market surveys on content viewing patterns to be used for advertisement pricing • Need DRM support from handset vendors • Need support from mobile operators to seed projects

	Stakeholder: Chip vendors
	Role: To supply state-of-the-art chips and ASICs to members of the ecosystem.
	Objectives: • Profits • Intellectual property gathering • Anticipate and research future technologies
Inputs • Compensation from handset vendors, network hardware vendors and contract manufacturers • Requirements (from handset vendors, network hardware vendors and contract manufacturers)	**Specific Needs** • Money from stakeholders to fund research and development costs • Accurate requirements and specifications from the stakeholders that need these products

	Stakeholder: Systems integrators
	Role: To coordinate the actions of disparate vendors to make sure the mobile operators needs are satisfied.
	Objectives: • Expand reach into as many operators as possible • Exhibit independence from other arms of the company to avoid conflicts of interests and to be able to work with various vendors
Inputs • Money from mobile operators for services • Information from all necessary stakeholders • Requirements from mobile operators for what needs to be achieved	**Specific Needs** • Information from all stakeholders that are being integrated • Standards based implementations • Monetary compensation • Requirements specifications for needed services

2.4 Stakeholder value flows

The stakeholder value flows were drawn up on the Stakeholder map for visualization purposes. The resulting diagram is as shown in Figure 5 below: Different colors have been employed to indicate the different types of flows in the system. It was found however that the dominant types of flows were products and services flows, monetary flows, and Information flows. There were few participation flows (primarily to Standards bodies from participants) and very few public-benefit flows. This was rationalized to be acceptable since this was a pure business ecosystem that was being analyzed and did not have much government and federal agencies that were part of the ecosystem except for the minimal activity of granting spectrum and requiring some basic rural access to broadband. Standards bodies elicited participation from mostly the infrastructure group of the ecosystem and generating documents which are used for technical work and compliance by the members. This is visually evident from the only incoming flows to the Technical forums and standards bodies stakeholder as the participation flows. The only outgoing flows from the Technical forums and standards bodies stakeholder are information flows to various stakeholders in the "gray" group (infrastructure group)
The diagram in Figure 5 below was also broken into separate diagrams for each of the major type of flows to get a better picture of the special characteristics of these different types of flows. This process in fact produced changes to the model because it made a few misses in the model obvious. The diagram in Figure 5 now has the updated and corrected model. Figure 6 shows the monetary flows, Figure 7 shows the product and service flows and Figure 8 shows the information, public benefit and participation flows.

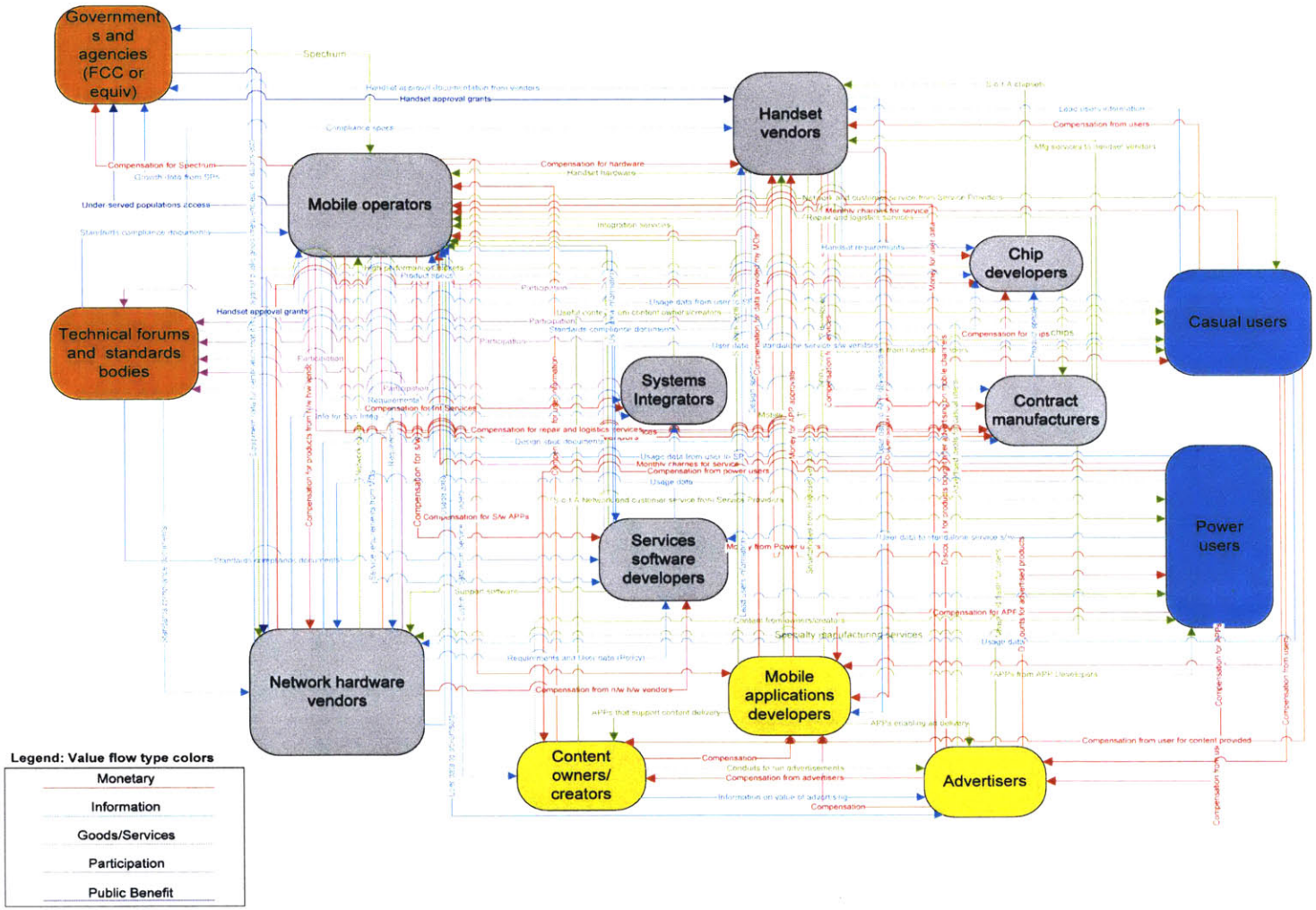


Figure 5 Stakeholder value flow visualization showing monetary (red), products/services (green), information (cyan), participation (magenta) and public benefit (blue) value flows connecting between and within the infrastructure group (gray), content group (yellow), user group (cyan) and government/standards bodies group (orange) of Figure 1

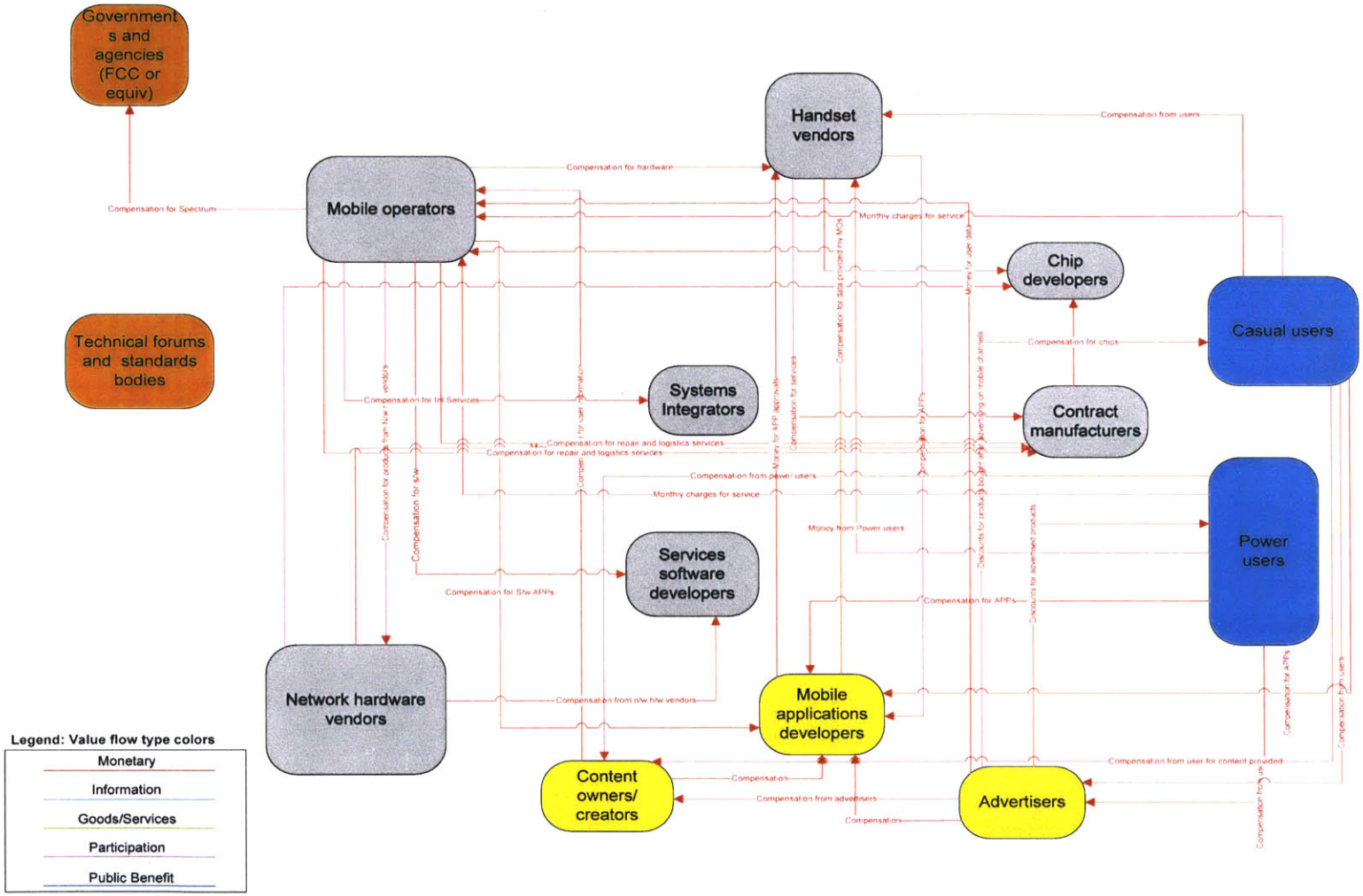


Figure 6 Stakeholder value flow visualization showing only monetary (red) value flows, connecting between and within the infrastructure group (gray), content group (yellow), user group (cyan) and government/standards bodies group (orange) of Figure 1

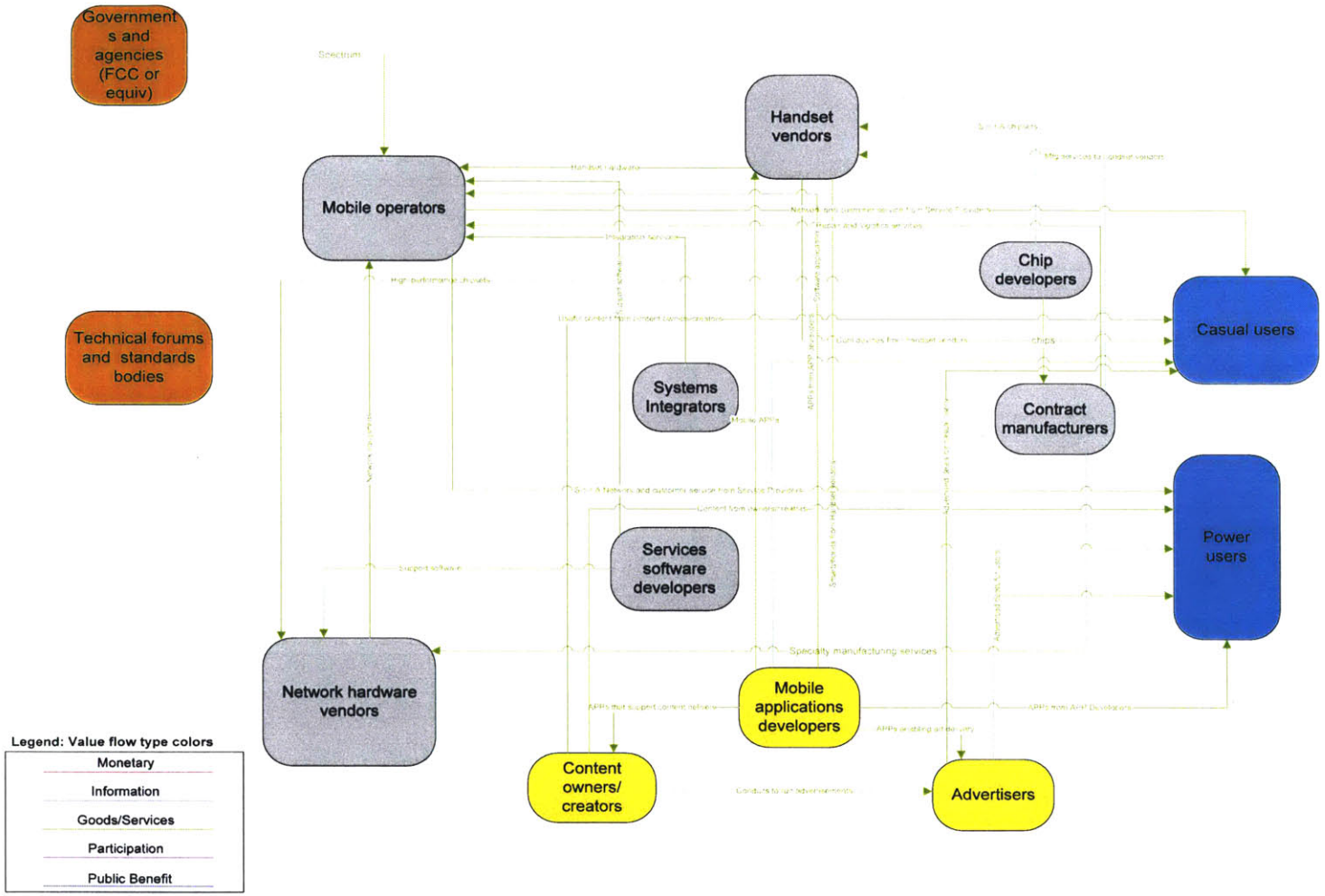


Figure 7 Stakeholder value flow visualization showing products/services (green) value flows connecting between and within the infrastructure group (gray), content group (yellow), user group (cyan) and government/standards bodies group (orange) of Figure 1

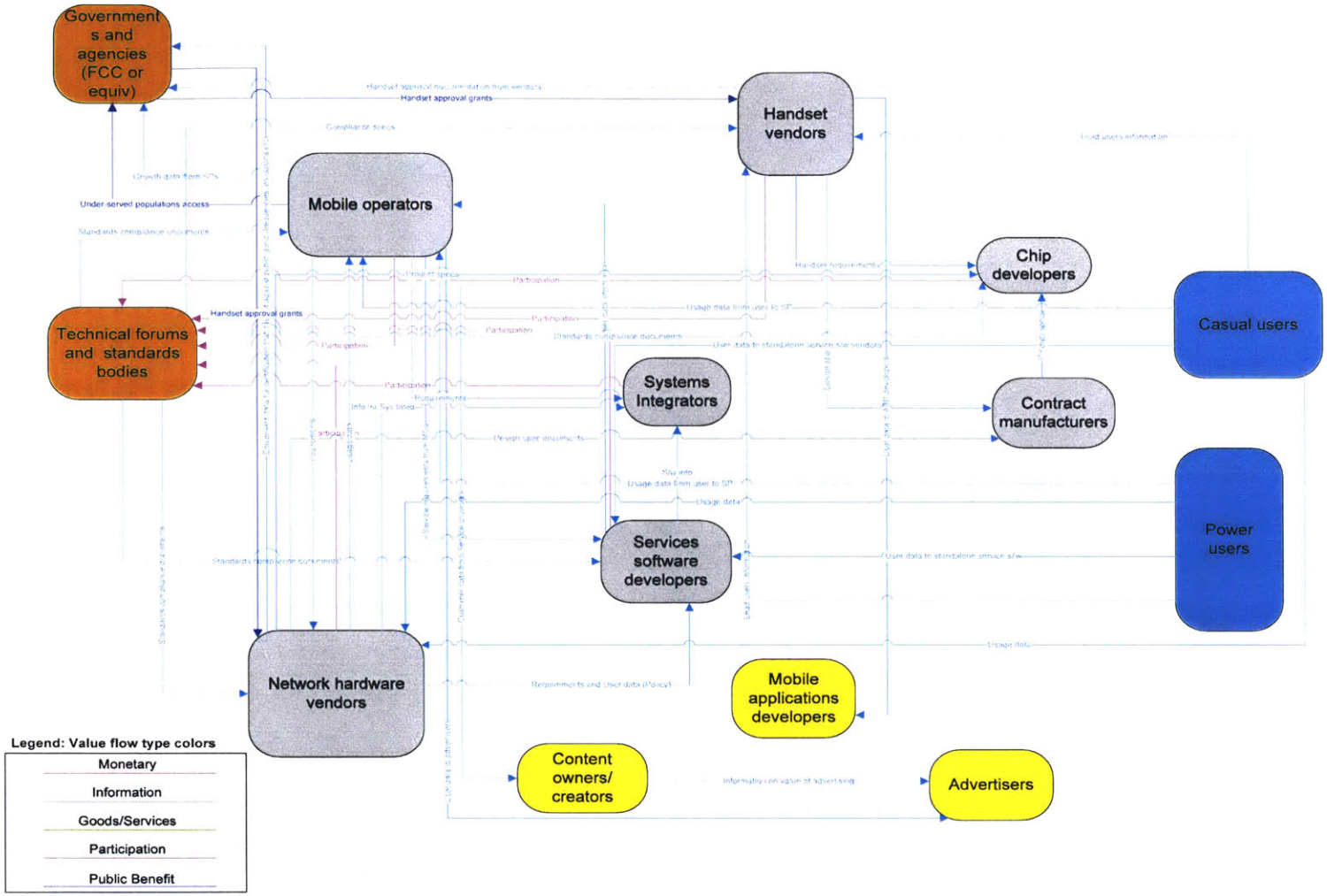


Figure 8 Stakeholder value flow visualization showing information, participation and public benefit (cyan, magenta and blue) value flows connecting between and within the infrastructure group (gray), content group (yellow), user group (cyan) and government/standards bodies group (orange) of Figure 1

2.5 Characterize needs and value flows

The final qualitative aspect of the model for the network is characterizing each of the needs of each of the stakeholders. The fundamental concept here is for each of the needs, there needs to be a relative prioritization with respect to other needs for a given stakeholder. The questionnaire for grading the needs has been directly borrowed from Tim Sutherland's work on the NASA/NOAA model. The questionnaire comprises five grades as described in Figure 9. The regret factor is the same in choices D and E because in these two choices, the dominant factor is how necessary the presence of the need is. The choices A, B and C are same in the satisfaction on the presence but vary the intensity of the regret factor on the absence. Once the intensity of the need is established, then the source that satisfies this need is analyzed in the Source importance determination questionnaire. This has been modified from previous work in Sutherland's thesis to include the aspect of competition within a stakeholder group that is satisfying the need. This has been done to capture the fact that when there is more competition in the stakeholder group satisfying a particular need, the power of the stakeholder group getting its need fulfilled increases because there is more choice and therefore more room for negotiating the terms of the transaction more favorably. An example to illustrate this point would be the need for handset hardware to be part of the ecosystem is very intense because without a handset no one can interface with the end user. At the same time, since there is so much competition within the handset vendor stakeholder group, the mobile operators can negotiate favorable prices for handsets. This would not be true to the same extent for network hardware vendors' relationship with the mobile operators as there are a lot fewer network hardware vendors as compared with handset vendors in the

market. This general rule of course has to be subject to the scrutiny of how popular the handset is with the users (iPhone case). If users have a greater preference for that particular handset, the power of that particular handset vendor (Apple in the iPhone example) increases and therefore we see the clout Apple enjoys with AT&T.

Need intensity categorization questionnaire

How would you characterize the presence or absence of fulfillment of this need?

A. I would be satisfied by its presence, but I would not regret its absence
B. I would be satisfied by its presence, and I would somewhat regret its absence
C. I would be satisfied by its presence, and I would regret its absence
D. Its presence is necessary, and I would regret its absence
E. Its presence is absolutely essential, and I would regret its absence

Source importance determination questionnaire

If this need were to be fulfilled, how important would this source be in fulfilling the need?

1. Not important, item is commodity, can be procured from anywhere
2. Important and many to choose from in this stakeholder group (>2 players)
3. Important and virtual monopoly limited competition(<=2 players)
4. Extremely important and many to choose from(>2 players)
5. Extremely important and virtual monopoly / limited competition(<=2 players)

Figure 9 Modified Kano satisfaction/regret questionnaire for categorizing the intensity of each specific need and source importance determination questionnaire

The survey responses grading the needs and designating the source importance were validated with informal interviews with engineers and managers in the industry to get different perspectives from different vantage points within the industry. The two surveys were administered independently in order to prevent the confusion of the need characterization with the source importance. The results of the surveys are presented in Appendix A: Need characterization / Source importance table

3 Quantitative model

The previous chapter developed the qualitative model by identifying, grouping and mapping the stakeholders. Then the process of specifying the roles, objectives, specific needs and need-satisfying inputs was undertaken. Once the needs and inputs to each stakeholder were determined, the final step of the qualitative modeling tabulated the intensity of the needs and importance of the source(s) satisfying the needs. This chapter will next begin with the quantitative aspects of the model which involves assigning numerical scores to each of the value flows into each of the stakeholders. The chapter will further go on to construct a value flow diagram per stakeholder to clearly elucidate what comes in and what goes out of each stakeholder, to manually list all possible causal value flow loops and thus lay the groundwork for the interpretation that follows in chapter 4.

3.1 Stakeholder value flows

It is very useful to break up the value flows in and out of a stakeholder group and draw them out separately to enable a clearer analysis of an individual stakeholder group. The following diagrams called the stakeholder input/output diagrams were generated for the various stakeholder groups in the stakeholder map from Figure 1. The numbers to the left of each of the inputs are the value scores assigned to each of the value flows. The method by which these numbers are obtained are by assigning value according to the rubric shown in Figure 10 below based on the Needs characterization(A-E) / Source importance(1-5) tuple (from Appendix A: Need characterization / Source importance table). The maximum value of 0.98 (and not 1.0) was chosen in both dimensions so as to be able to distinguish between value loops of different lengths (since 0.98 x 0.98 x 0.98 <

1.0 x 1.0 x 1.0) because of the clear increase in difficulty in capturing equal value as the number of segments via which this value traverses increases.

Source importance		Need characterization (satisfaction/regret)				
		A	B	C	D	E
		0.11	0.19	0.33	0.57	0.98
1	0.11	0.01	0.02	0.04	0.06	0.11
2	0.33	0.04	0.06	0.11	0.19	0.32
3	0.55	0.06	0.10	0.18	0.31	0.54
4	0.78	0.09	0.15	0.26	0.44	0.76
5	0.98	0.11	0.19	0.32	0.56	0.96

Figure 10 Value flow rubric for quantitative score assignment

The stakeholder input/output diagrams follow the same color conventions as all the diagrams in this document. The color of the stakeholder itself is consistent with whether it belongs to the infrastructure (gray), content (yellow), government and standards bodies/forums (orange) or user (cyan) groups. The incoming and outgoing flows are also consistent with the color scheme used throughout the document for flows which is shown in Figure 2 as before. The additional point to be made in these set of diagrams is that if there is a flow coming from or going to the bottom of a set of stakeholder boxes, this is to be interpreted as this flow coming from all the stakeholders stacked above. If a flow only originates from or terminates to a single stakeholder, this would be shown as going to the center of the stakeholder box.

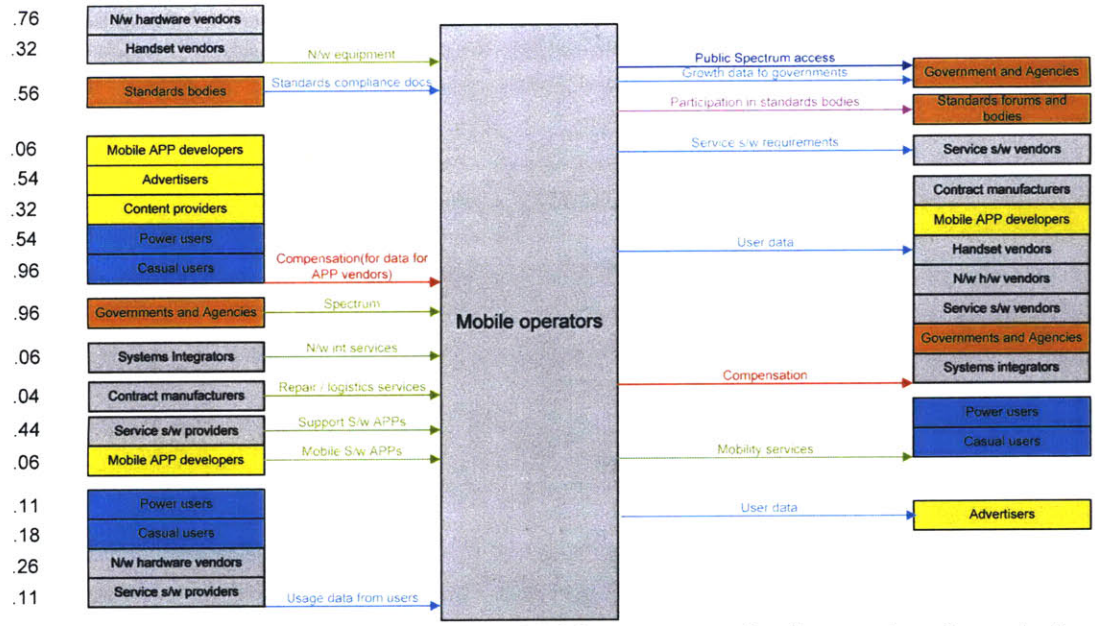


Figure 11 Stakeholder value flow visualization – Mobile operators, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

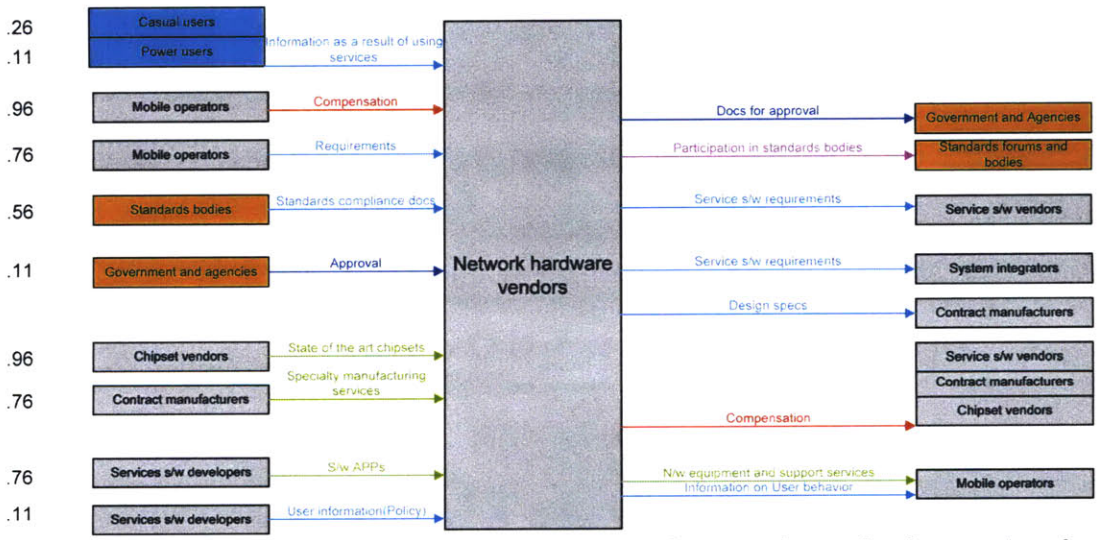


Figure 12 Stakeholder value flow visualization – Network hardware vendors, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

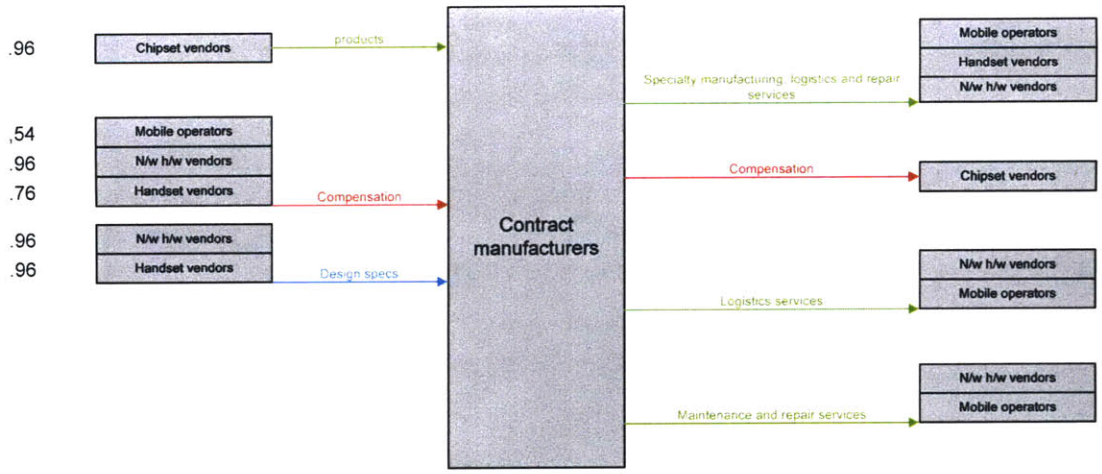


Figure 13 Stakeholder value flow visualization – Contract manufacturers, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

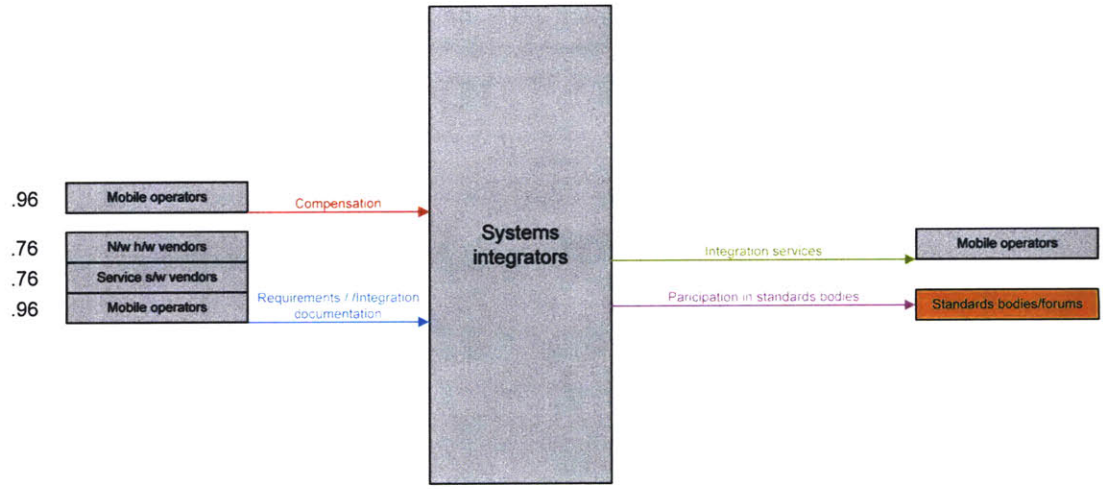


Figure 14 Stakeholder value flow visualization – Systems integrators, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

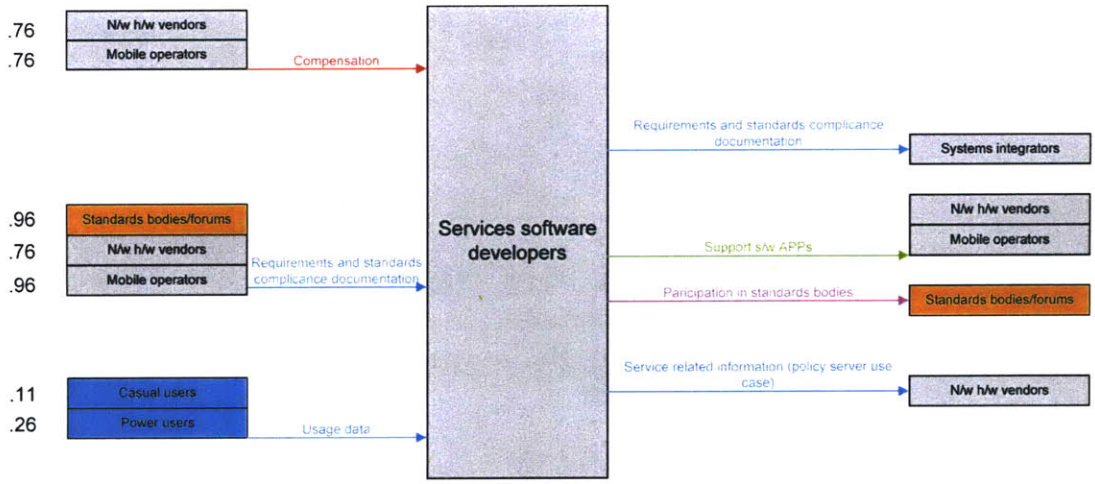


Figure 15 Stakeholder value flow visualization – Services support software developers, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

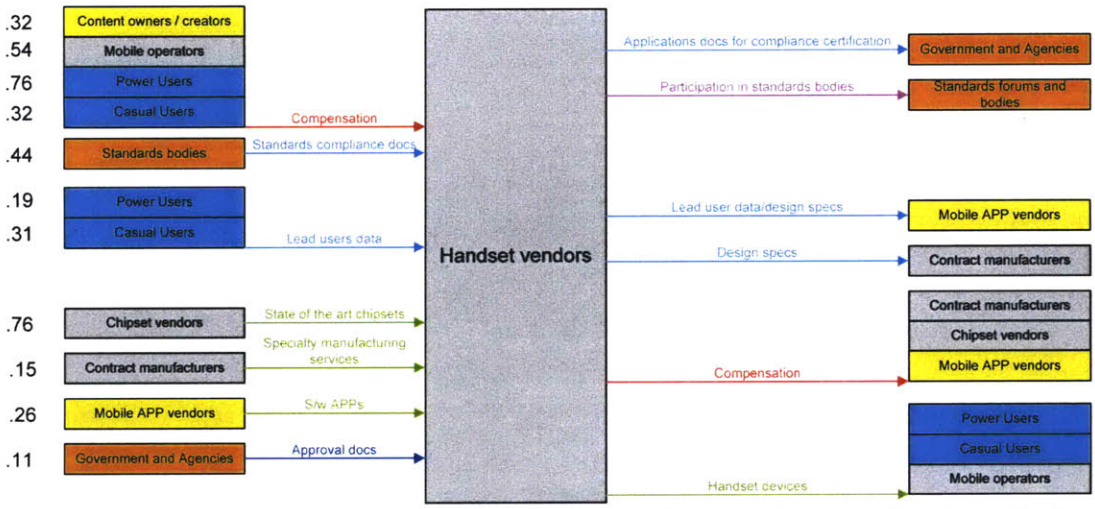


Figure 16 Stakeholder value flow visualization – Handset vendors, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

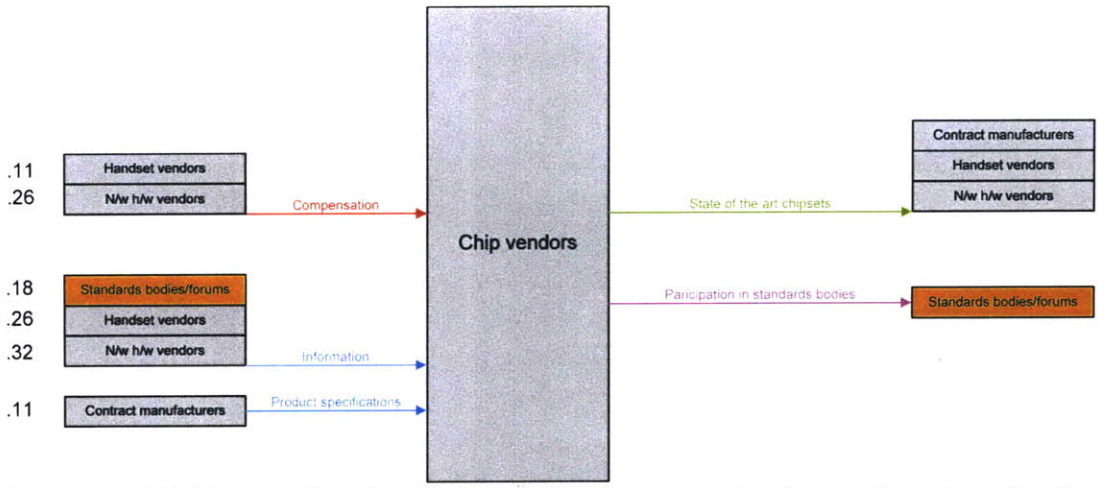


Figure 17 Stakeholder value flow visualization – Chipset vendors, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

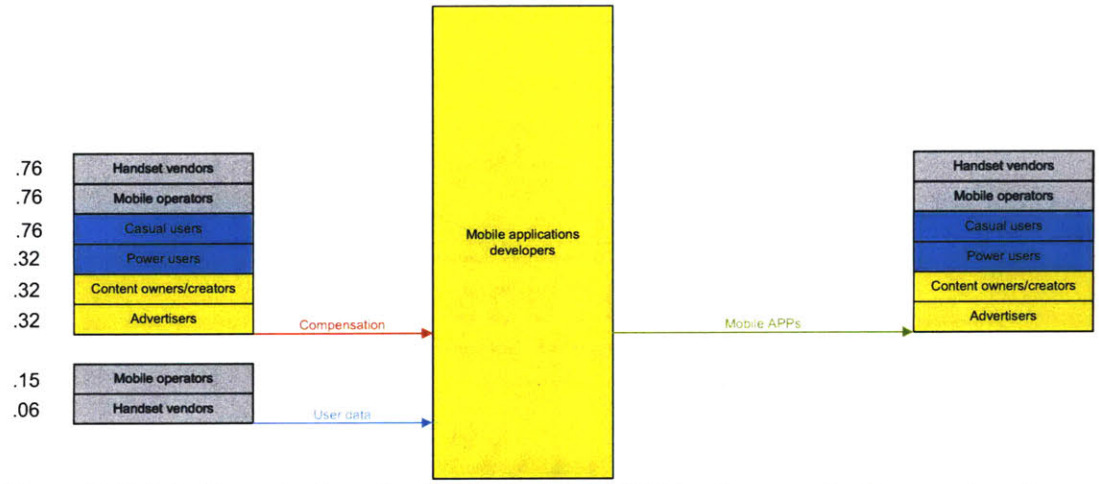


Figure 18 Stakeholder value flow visualization – Mobile APP developers, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

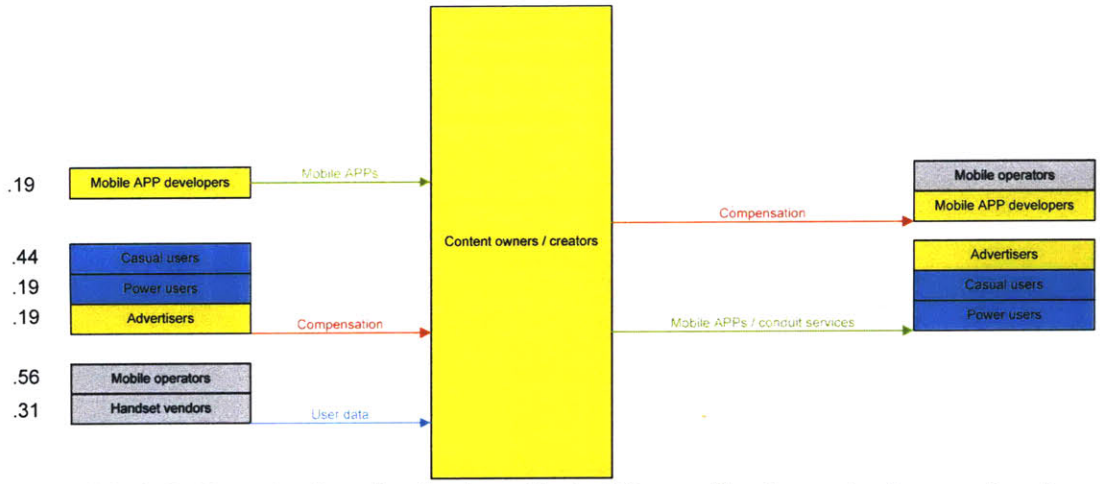


Figure 19 Stakeholder value flow visualization – Content Owners/Creators, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

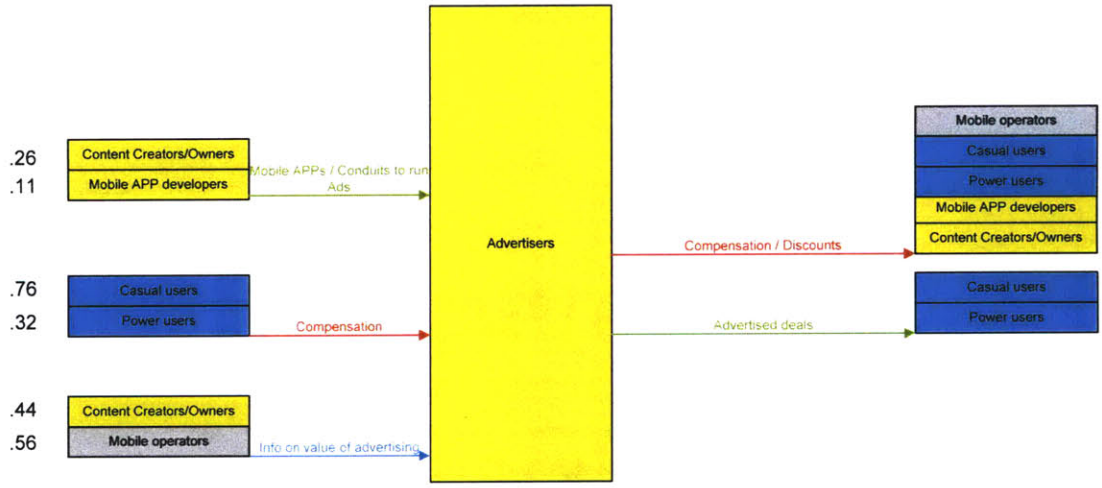


Figure 20 Stakeholder value flow visualization – Advertisers, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

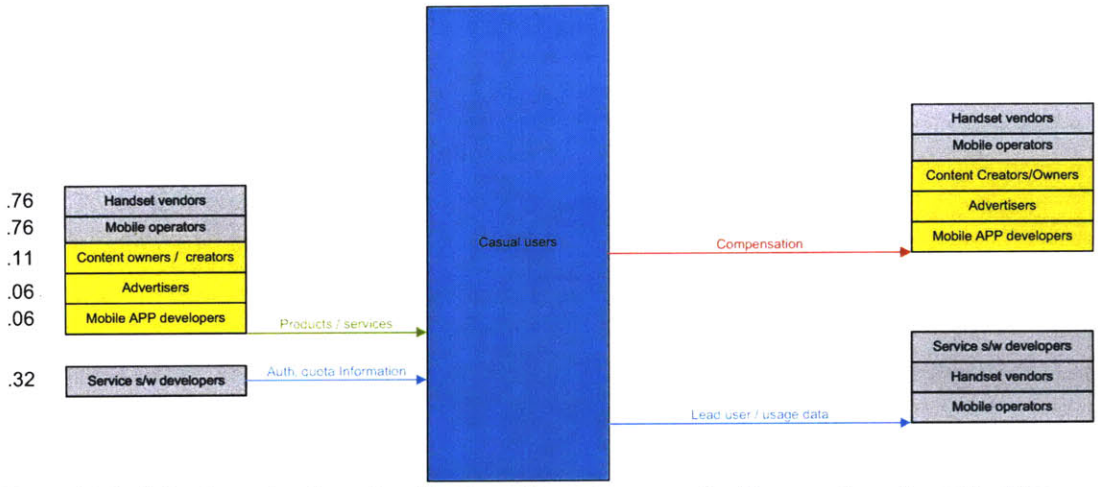


Figure 21 Stakeholder value flow visualization – Casual users, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

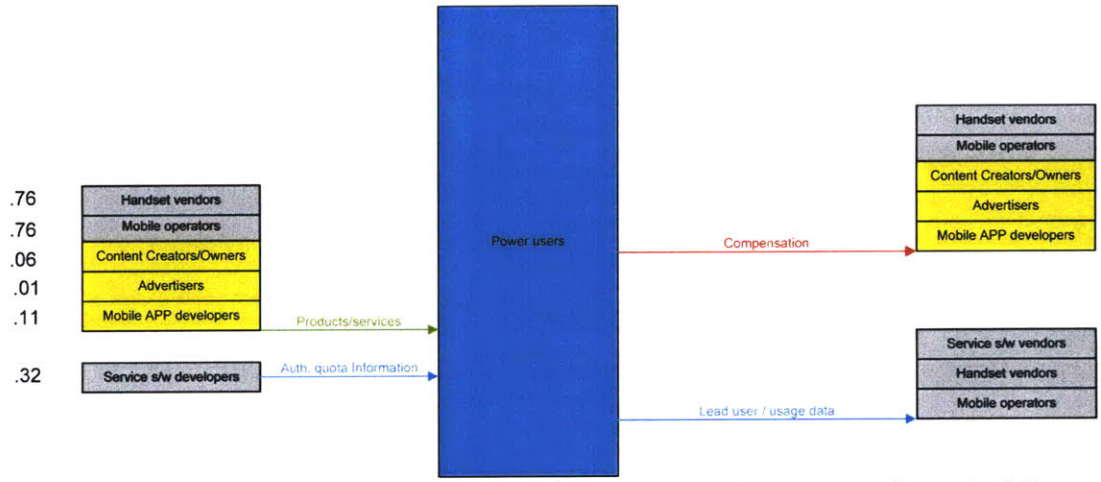


Figure 22 Stakeholder value flow visualization – Power users, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

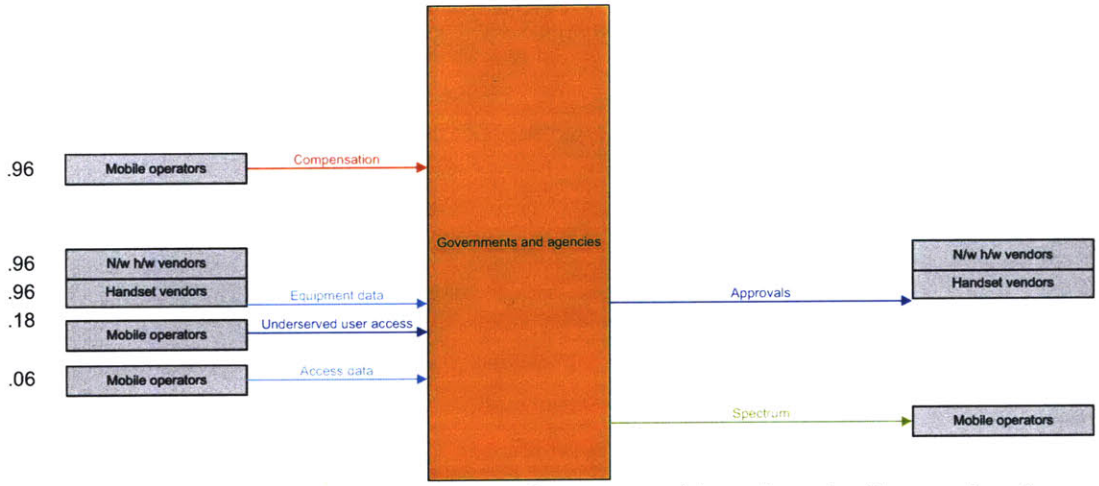


Figure 23 Stakeholder value flow visualization – Governments / Agencies, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

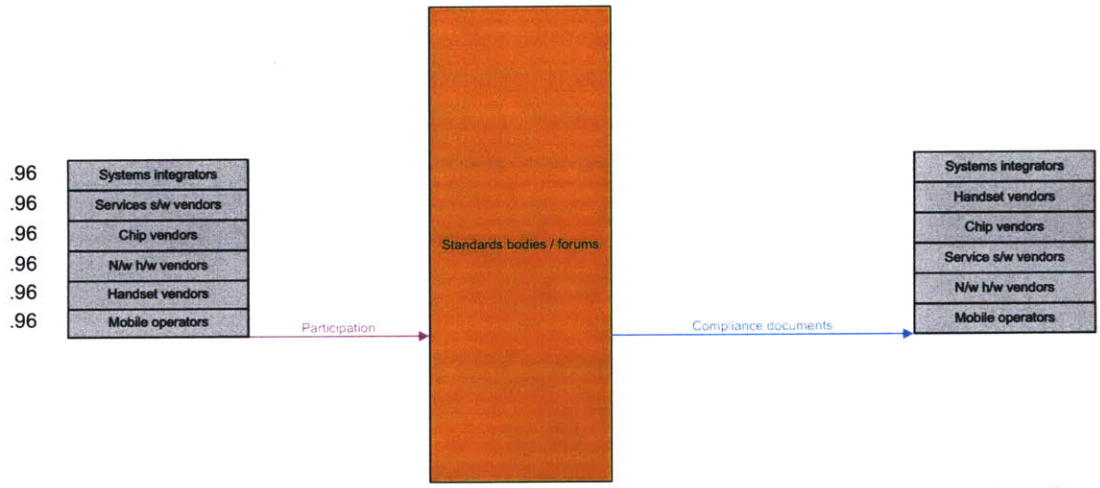


Figure 24 Stakeholder value flow visualization – Standards bodies / forums, value flow numbers for each of the input flows shown to the left, value flow arrows follow color scheme in Figure 2 and a stack of boxes with a single arrow implies flows from all of the boxes in the stack

3.2 Value loop calculation

A value loop is a string of value flows that start and end in the same stakeholder. The calculation of the numerical value of a value loop is nothing but the product of the individual value flow scores (called the ABC method). For this stakeholder system, it was decided to list out the value loops manually instead of using a software program like OPN primarily due to familiarity and time constraints. Another reason for this was that

the time needed to weed out the value loops that do not make sense would take as much time as listing them out manually anyway. The value loop listing was performed for all the stakeholders in the mobile services ecosystem. A major difference in this process (as compared with previous work by Sutherland) was that the listing was first done for all members of the ecosystem and not from any particular stakeholder perspective. Another major difference was that this thesis truly treats loops as circular entities irrespective of which stakeholder the loop originated from. For example a loop A→B→C→A is treated as a duplicate of the loop B→C→A→B. The direct value loops (those with exactly two stakeholder groups exchanging value) were listed first for all the stakeholders and then the larger value loops were listed. The format used for this process was in MS Excel as shown in Appendix B: Value loop listings. The number of direct value loops (two unique stakeholders) and indirect value loops were listed and plotted separately. This was to be able to independently look at the two types of value loops given the fact that the direct value loops are more intuitive and naturally higher scoring because of the quid-pro-quo relationships that usually characterize these types of value exchanges. Listing of most of these value loops needed some amount of domain knowledge to make sense of what constitutes loops that are causal vs. those that are not. The total number of loops after duplicates were discarded turned out to be 101. 55 of these loops were direct loops and 46 were indirect loops. The value loop score distributions of direct and indirect loops are shown in Figure 25. This does show some dominance of the direct loops but at the same time there are at least 15-20 loop scores that are comparable to at least some of the lower scoring direct value loops. The details of the top scoring value loops of both types and their value loop scores are shown later in Figure 32 and Figure 33.

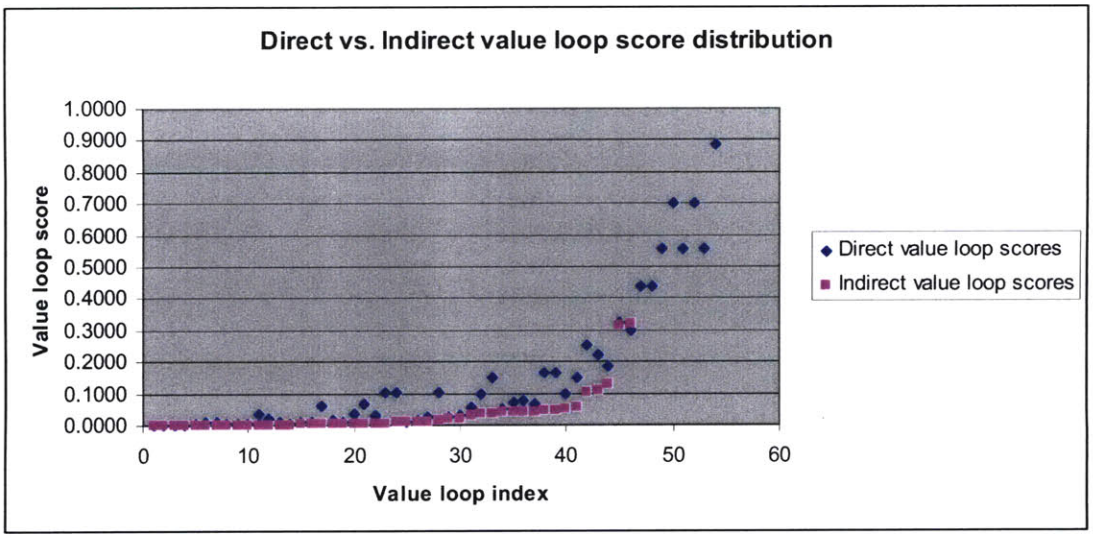


Figure 25 Direct vs. indirect value loop score distribution (46 indirect and 55 direct scores are plotted)

4 Value loop results interpretation

Chapter 3 built on the qualitative model developed in Chapter 2 and developed the quantitative aspects of the model which involved assigning numerical scores to each of the value flows into each of the stakeholders. This lay the groundwork to present the diagrams to experts in the various aspects of the ecosystem to receive feedback on the accuracy of the model. The chapter further constructed value flow diagrams per stakeholder, manually listed all possible causal value flow loops and organized value flow loops in the order of directness. The relative importance between direct and indirect value flow loops was shown. Chapter 4 will now take these value flow loops and compute a system-wide stakeholder importance chart. Then a methodology will be presented to analyze relative importance of other stakeholders from the perspective of any given stakeholder. Furthermore, value loop rankings will be created and views of the entire system will be presented when only top few direct or top few indirect loops are considered and observations will be made along the way as to the insights gained about the ecosystem as a result of each of these analyses. This will lead into Chapter 5 which will summarize both the methodology and the conclusions.

4.1 Stakeholder relative importance for ecosystem

First, the most important stakeholders are identified and a relative importance graph of these stakeholders is created. The importance is defined as those stakeholders that add the most value to the ecosystem. This is computed by taking the weighted average of the value loop scores of the value loops in which each stakeholder appears (using the entire set of value loops without any pre-filtering on stakeholders). After performing the value loop analysis a relative importance chart of the level 1 stakeholders was generated by

calculating a weighted stakeholder occurrence by adding value loop scores of the loops that the stakeholder was a part of and normalizing it to the total sum of all value loop scores. The result of this analysis is shown in Figure 26.

Observation 1: It is illuminating to note the difference between the score of the most important stakeholder (mobile operators) and the second most important stakeholder (network hardware vendors). The mobile operators truly hold a commanding lead on this front and are almost twice as important as the next most important stakeholder.

This is reflected in the evidence on the ground as well in terms of the power they hold on the other stakeholders with reference to negotiating terms and deals.

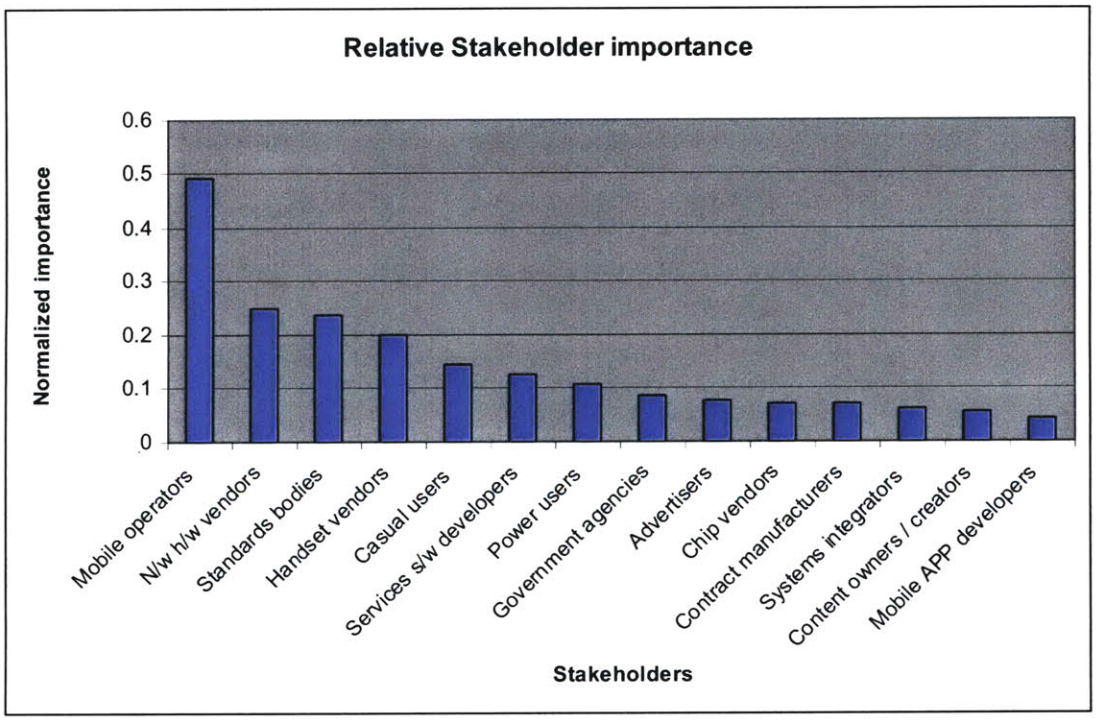


Figure 26 Relative stakeholder importance (weighted occurrence method) when the entire set of value flows are used for the analysis

Observation 2: There is a reasonably steep drop in relative importance after Handset vendors, this is likely due to a few strong handset vendors (iPhone, Blackberry) skewing the data in their industry's favor.

Observation 3: The entire content group (yellow group in Figure 1) is fairly down the importance chain, but among them the advertisers are at the top of the list. This is likely due to the fact that advertisers are directly and indirectly involved with the Mobile operators in many loops as compared with other content group members. This will be looked at again when analyzing the ecosystem from the mobile operators' point of view.

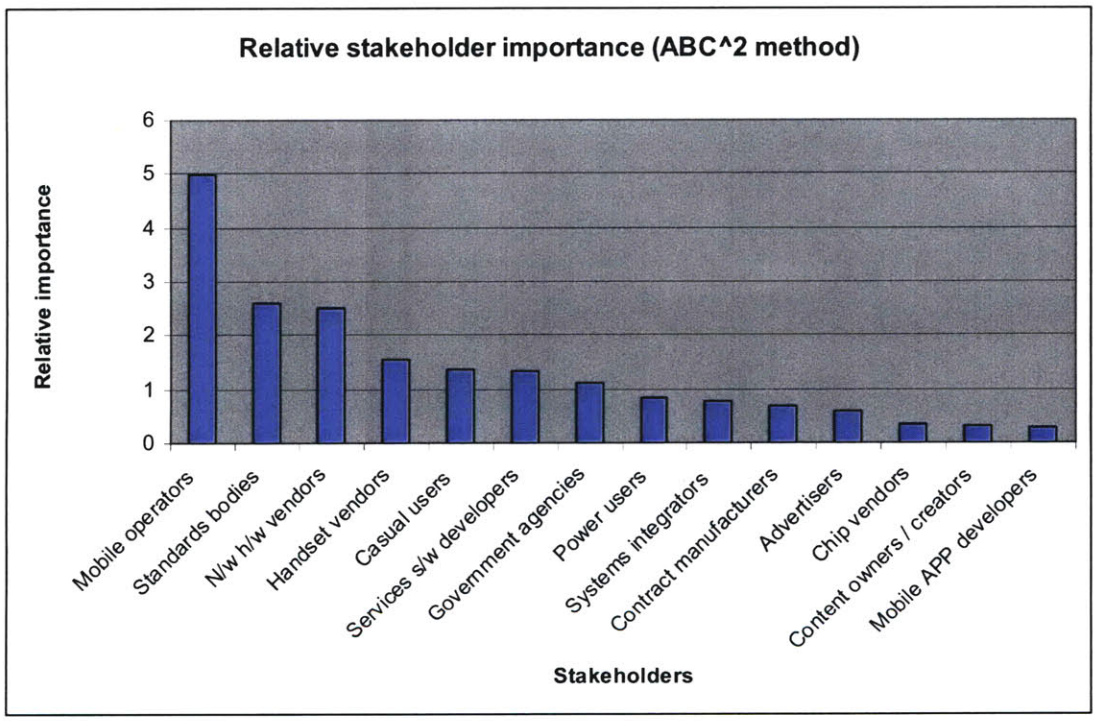


Figure 27 Relative stakeholder importance (ABC^2 method)

Some research done in the System architecture group at MIT has shown that a calculation based on ABC^2 rather than ABC method is a closer approximation of reality when calculating value loop scores from value flow scores. The chart in Figure 27 shows a

very minor readjustment of priorities, so the rest of the thesis has continued using the ABC method.

Another metric which is useful in some cases is the relative importance of the stakeholders further normalized to the number of value loops they appear in. This helps determine whether the importance of the stakeholder is indeed because it is present in a select few high value loops or whether it is present in many value loops. This metric generates the chart in Figure 28 which shows a complete reversal for the mobile operators (as compared with chart in Figure 26) which indicates that the power the mobile operators stakeholder holds is due to the fact that it is present in many value loops rather than just in a select few high value loops.

Observation 4: The mobile operators gain their importance as a result of being in the center of all action rather than being part of a few high value interactions. This is intuitive since they are the owners of the medium which is responsible for the transmission of traffic. This analysis has not yet shown the power of content over medium.

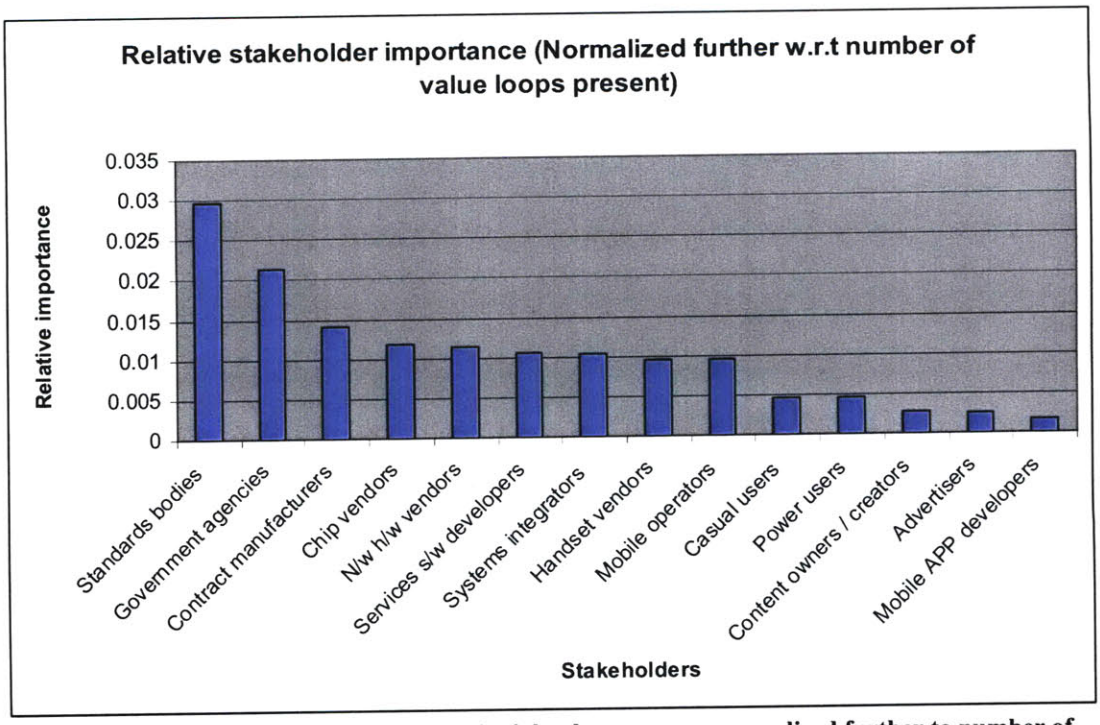


Figure 28 Relative stakeholder importance (weighted occurrence normalized further to number of occurrences in value loops) – shows mobile operators below the middle of the pack

4.2 Stakeholder importance to a given stakeholder

Another useful perspective is the relative importance of all other stakeholders to a given stakeholder. This data is extracted from the value loop score data by performing the analysis done above but by restricting it to only the value loops that contain the stakeholder under question. For the case of the network hardware vendors, this chart is shown in Figure 29 below. It would be a reasonable statement to make that the most relevant stakeholders to the network hardware vendors are mobile operators, service software developers, contract manufacturers and chip vendors and standards bodies and forums. The network hardware vendor stakeholder group has very little interaction with the rest of the ecosystem. Knowing this and also knowing how to change this reality by looking at different ways to increase the value of the other value loops may be a key component to making strategic decisions in the industry. This is especially true since the

power and influence of the important stakeholders in this ecosystem seem to stem more from the fact that they are part of more value loops than others rather than being part of a small number of important value loops.

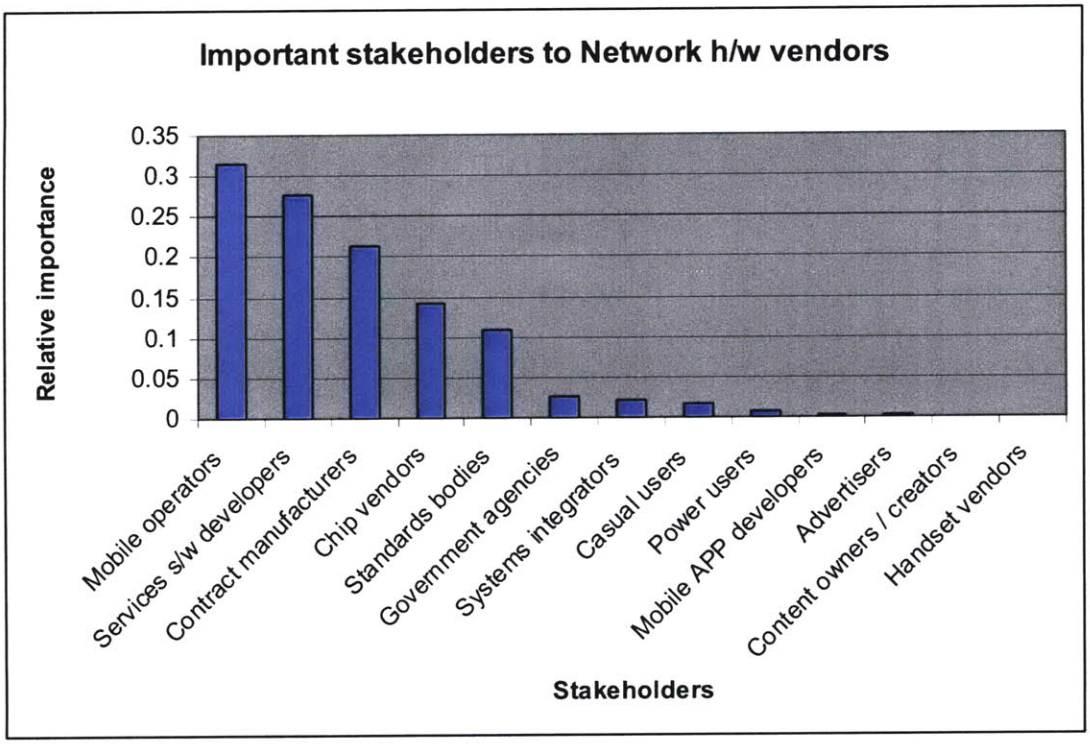


Figure 29 Relative stakeholder importance for the Network hardware vendors stakeholder

A subsequent analysis was performed to see how important the network hardware vendors stakeholder was to the mobile operators. This type of analysis would show how symmetrical the relationship is between any two stakeholders in general. The chart in Figure 30 below shows that the casual users stakeholder is more important to the mobile operators than are the network hardware vendors. This makes intuitive sense since the casual users are the primary revenue source for the mobile operators. From the network hardware vendors point of view, this should be kept in mind whenever there is a strategic conflict, it should be expected that the mobile operators will have to make sure that the casual users stakeholders have to be satisfied more than anyone else. Such an analysis

can be made for every stakeholder in the system from a vantage point of any other stakeholder to provide a framework for symmetry in the respective relationships.

Observation 5: This analysis of stakeholder importance from both mobile operators' and network hardware vendors' perspectives shows that the relationship is not exactly symmetrical. More importantly, if the network hardware vendors can generate ways for the mobile operators can serve the casual users better (the most important stakeholder from the operator's perspective), it is more likely that the relationship between the mobile operators and network hardware vendors will be strengthened (Serve the most important stakeholder of your most important stakeholder).

Observation 6: The pronounced asymmetry is shown by the fact that when only looking at the relative importance chart from one's own perspective, the network hardware vendor might have completely chosen to ignore the casual user, but Observation 5 above suggests to exactly do the opposite.

There are many such analyses that can be done to find out the top few important stakeholders from one's own perspective and then find the top few stakeholders (one step removed) from their perspectives so the strategic position of the stakeholder in question in the ecosystem might be enhanced.

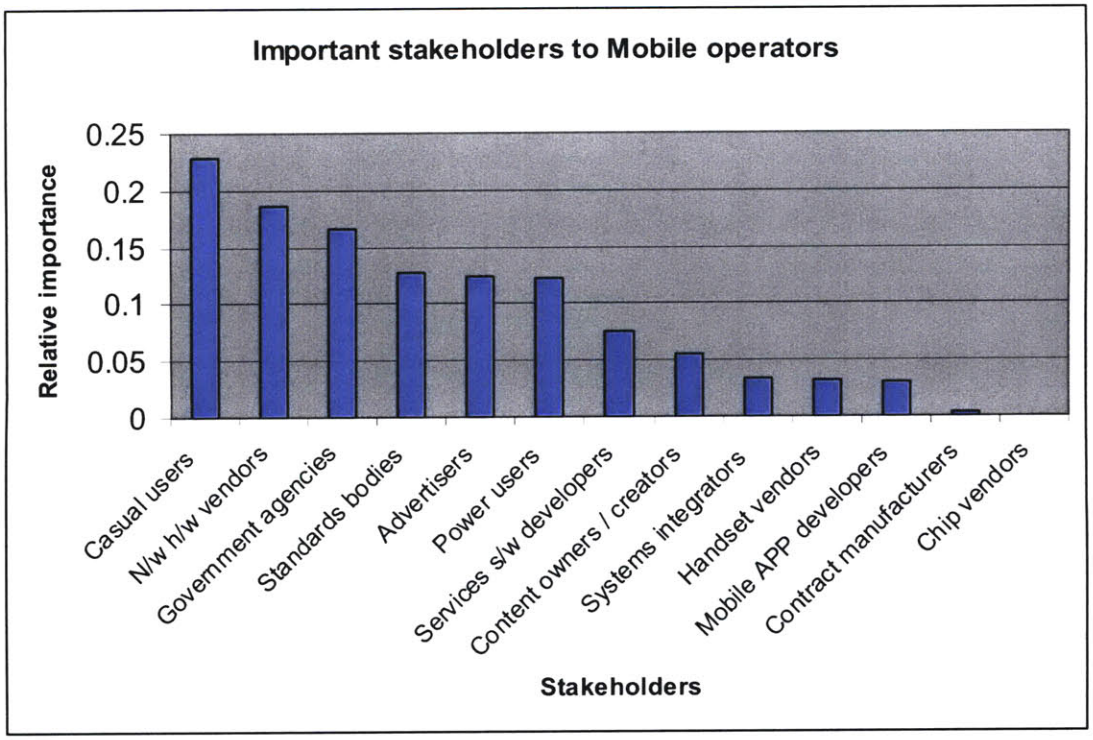


Figure 30 Relative stakeholder importance for the mobile operators stakeholder, casual users are the most important, followed by network hardware vendors

4.3 Stakeholder importance based on types of value loops

The other important metric is the enumeration of the value loops in both the direct and indirect value loops and analyze the data for trends. The most important stakeholders in the ecosystem when only the direct value loops are considered are shown in Figure 31

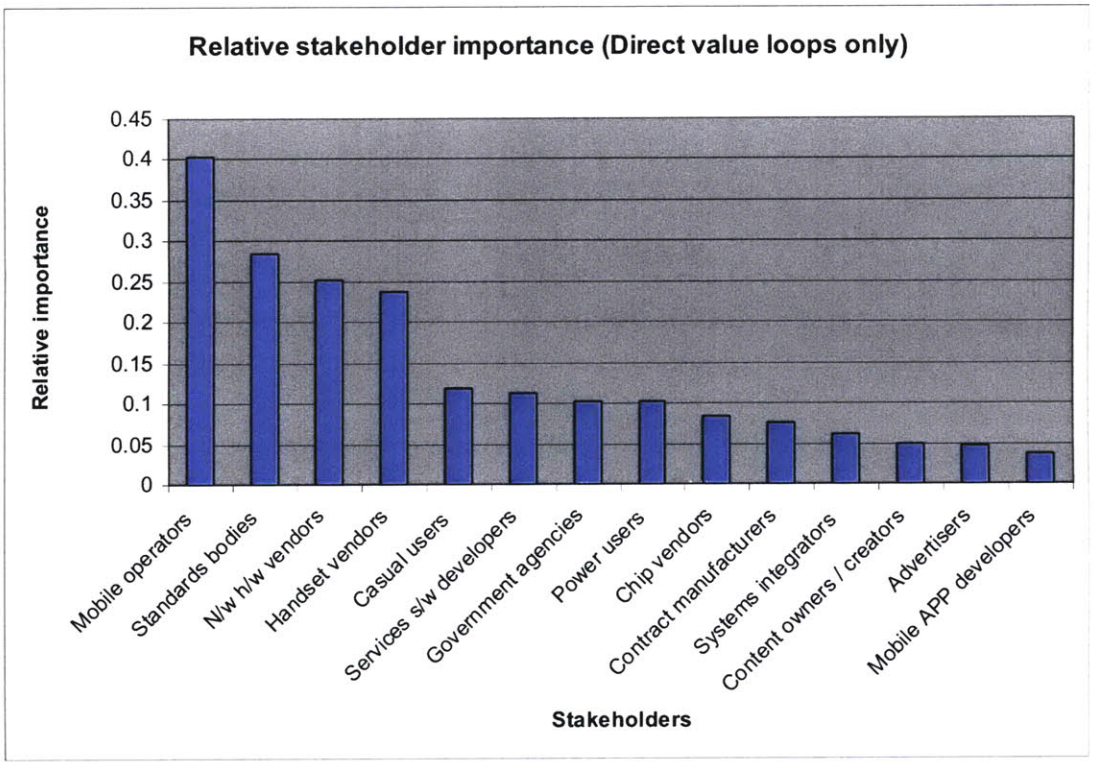


Figure 31 Relative stakeholder importance when only considering direct value loops

The general ranking of stakeholders in the ecosystem when compared between considering all value loops (Figure 26) as against only direct value loops (Figure 31) is similar with a few stakeholders moving in rankings as show in the table in Appendix C: Stakeholder ranking changes between all value loops and direct value loops The most and least important stakeholders have maintained their positions with the most significant movement in rankings reflecting in the systems integrators, advertisers and chip vendors. The advertisers' movement is the illustrative one as that is the main stakeholder to gain from indirect relationships than any other in the ecosystem. The resultant loser in the rankings is the systems integrators stakeholder as that is the one more focused predominantly on the hub and spoke type relationship with other stakeholders.

4.4 Value loop ranking

The most important (highest value producing) direct value and indirect value loops are shown in Figure 32 and Figure 33 below. It is interesting to note that there are no value loops greater than 3 unique stakeholders. A somewhat arbitrary value of a value loop score of 0.3 was chosen as a threshold value. The dominant stakeholders involved in these highest value loops were the mobile operators, standards bodies and network hardware vendors followed behind by handset vendors, power users and services software vendors. This represents the place where the industry has come from where the mobile service itself was a novelty and the subscribers were taking in new service at increasing rates and the operators were being measured by how many subscribers they could sign on and retain. The equipment these operators needed to keep the network operational had to be scaled up as a result of adding subscribers and this led to the increased importance of the network hardware vendors in the industry. The experience in the mobile services ecosystem emerging in the more data-centric world where voice services are increasingly becoming commoditized and an ever decreasing component of ARPU growth and newer players in the internet domain are claiming their place in the industry

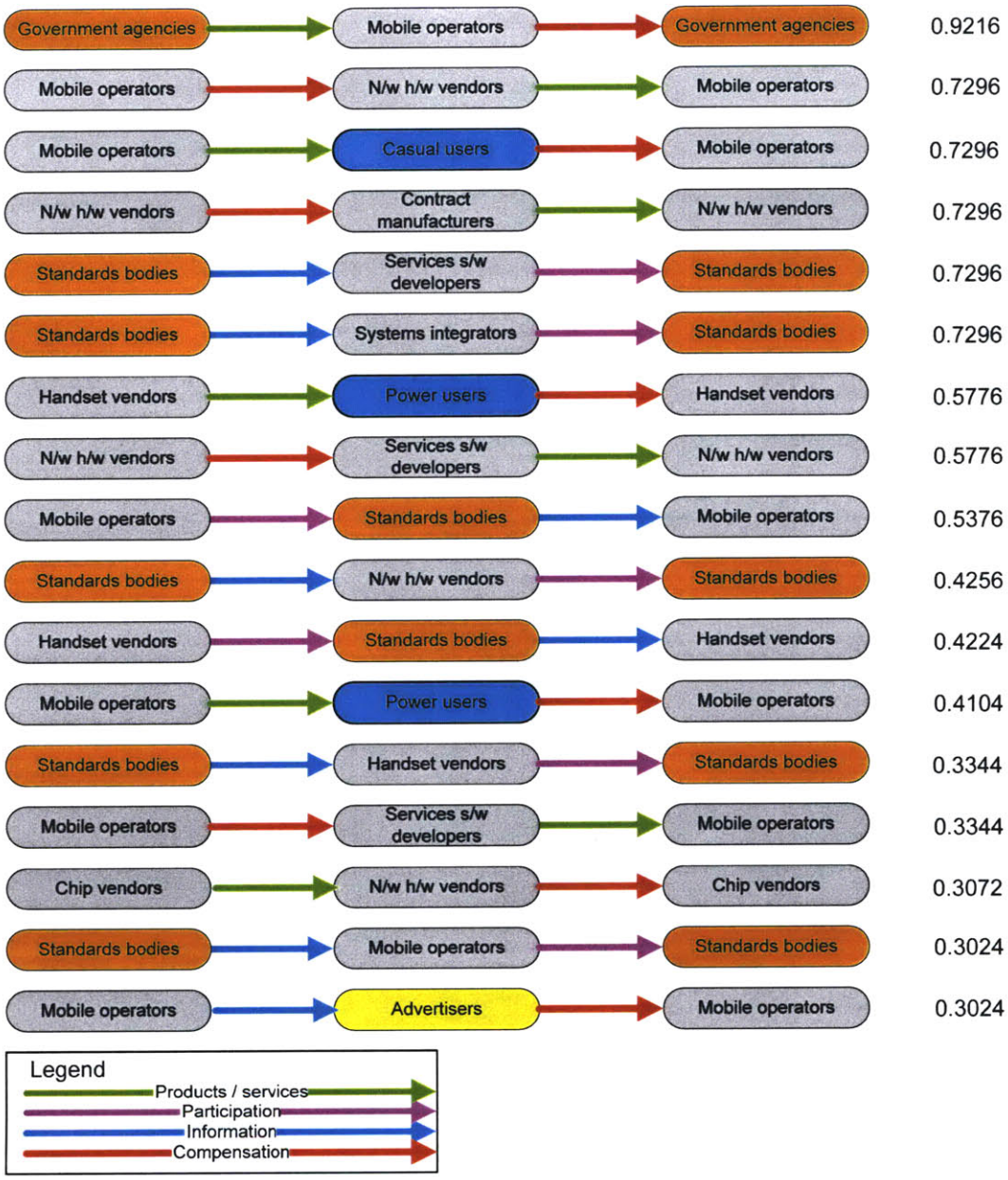


Figure 32 Top scoring direct value loops with value flows indicated by legend and value loop scores indicated on the right

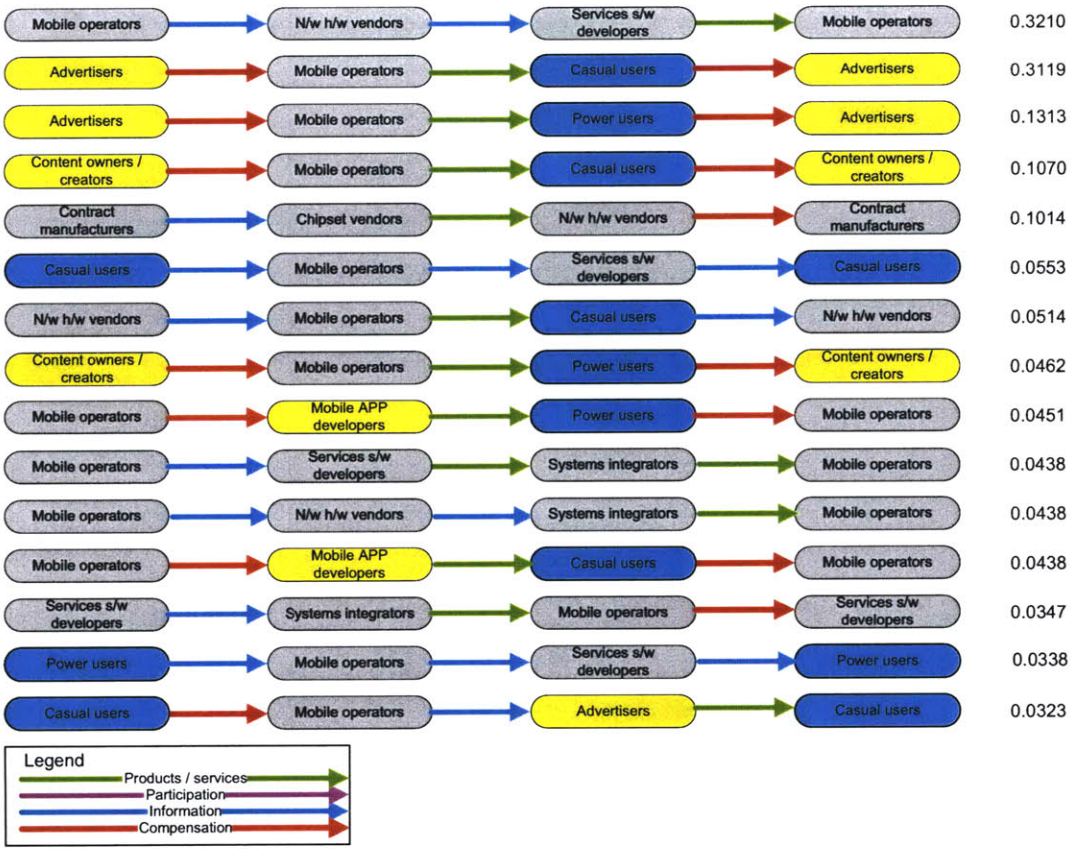


Figure 33 Top scoring indirect value loops with value flows indicated by legend and value loop scores indicated on the right

4.5 Simplified stakeholder map

Based on the analysis using top scoring direct value loops alone, the stakeholder list is reduced to the one shown in Figure 34. The cutoff value loop score used in this case was 0.1 (all stakeholders with a value score of 0.1 or below in the top few value loops were discarded). This fails to capture many important aspects of the ecosystem including the main revenue engines (the casual users). Casual users, by previous analysis (Figure 26 and Figure 30) actually were the most important stakeholder to the most important stakeholder of the ecosystem (mobile operators). The analysis with only top scoring indirect value loops gets us the reduced stakeholder set as shown in Figure 35 below. The cutoff value loop score used in this case was 0.1 (all stakeholders with a value score

of 0.1 or below in the top few value loops were discarded). This captures the casual users but misses the standards bodies/forums which were 3rd ranked in importance in Figure 26. The analysis above shows what parts of the ecosystem are direct-loop heavy and what parts are indirect-loop heavy.

Observation 7: The point of including both types of value flow loops is therefore underscored in developing a richer and more accurate model of the industry which neither of the flow types by themselves are able to do.

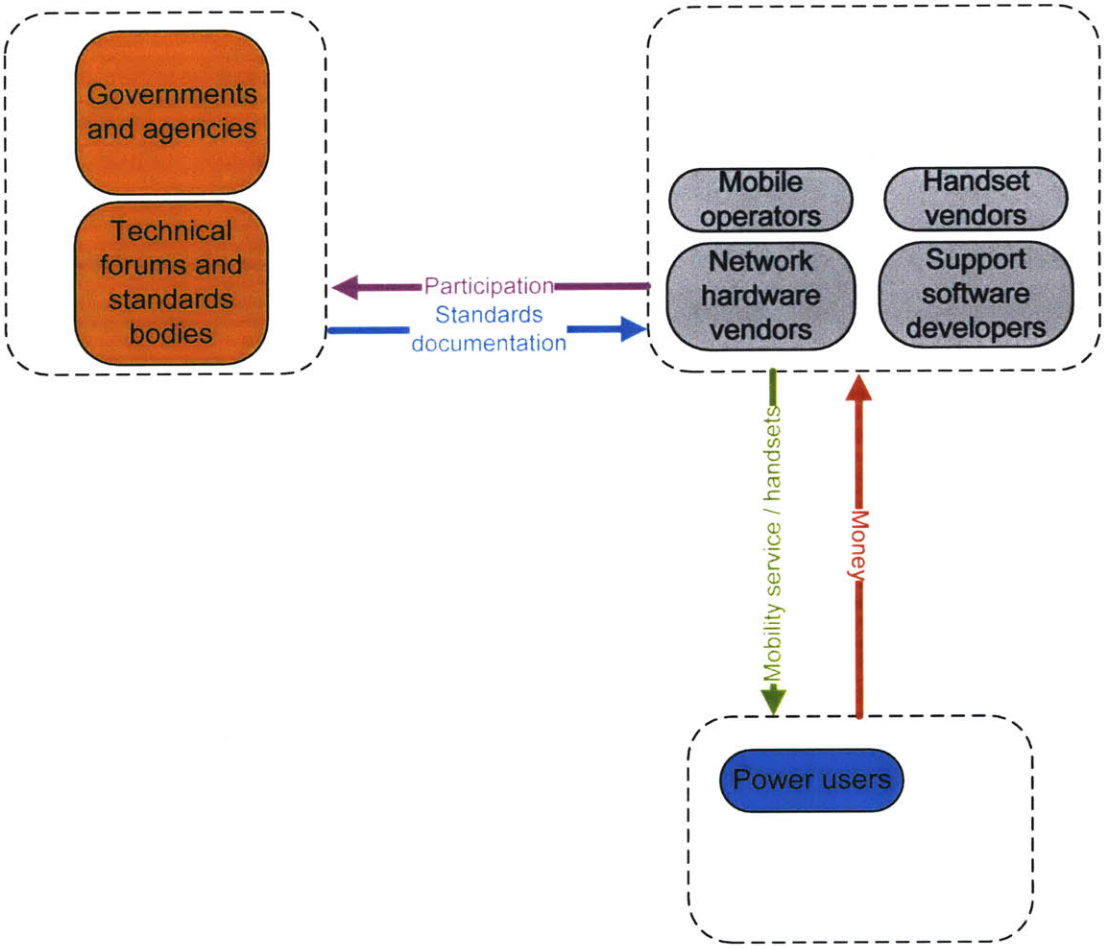


Figure 34 Reduced stakeholder set based on purely top scoring direct value loops, power users makes it due to relationship to both handset vendors and mobile operators

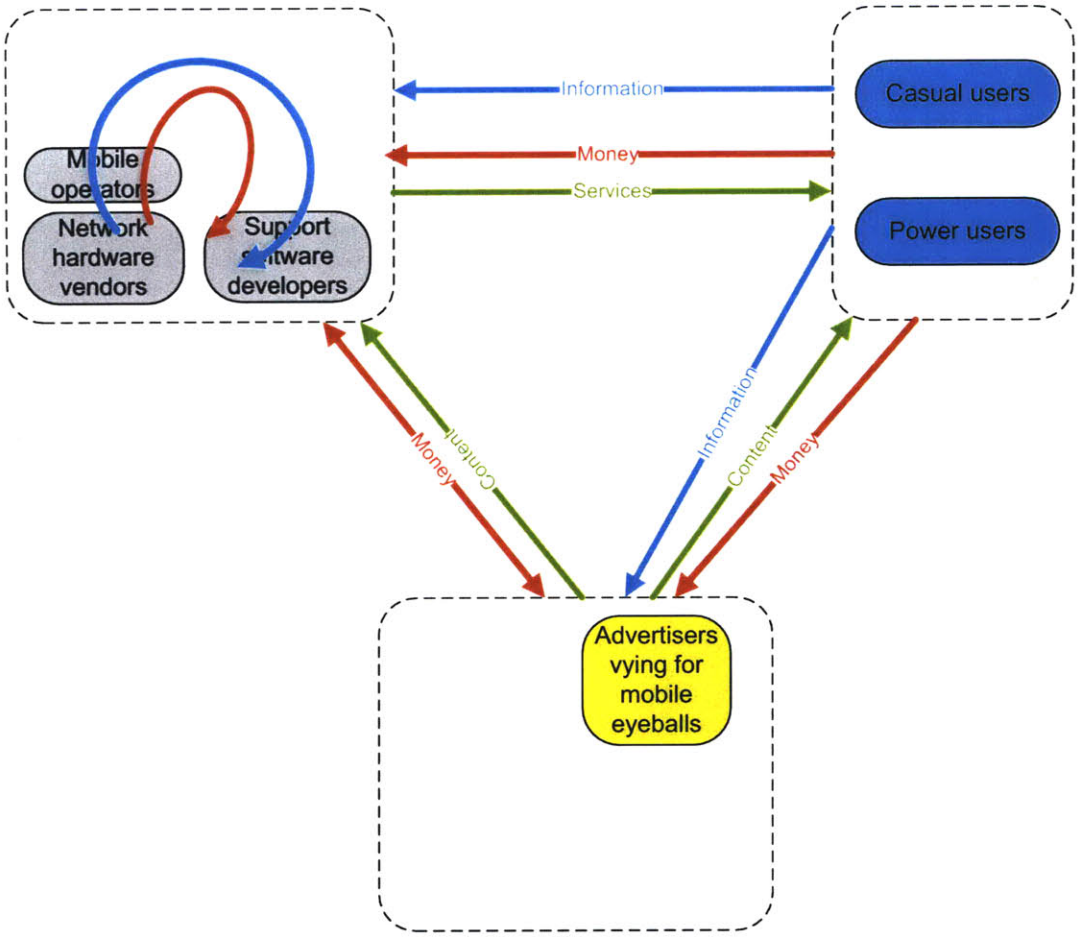


Figure 35 Reduced stakeholder set based on purely top scoring indirect value loops, content owners / creators, advertisers and casual users get included in this analysis and so do some richer information flows

A further verification of the model is in the fact that if only the very important flows are considered and the model simplified, it should resemble familiar connections between the most important stakeholders. This process was performed on the most important value flow loops (both direct and indirect) and a simplified stakeholder map was drawn with the sizes of the arrows proportional to the number of times a particular value flow was used. This elimination process eliminated stakeholders that were deemed not as

important by both top scoring direct loop analysis and top scoring indirect loop analysis. This is shown in Figure 36 below.

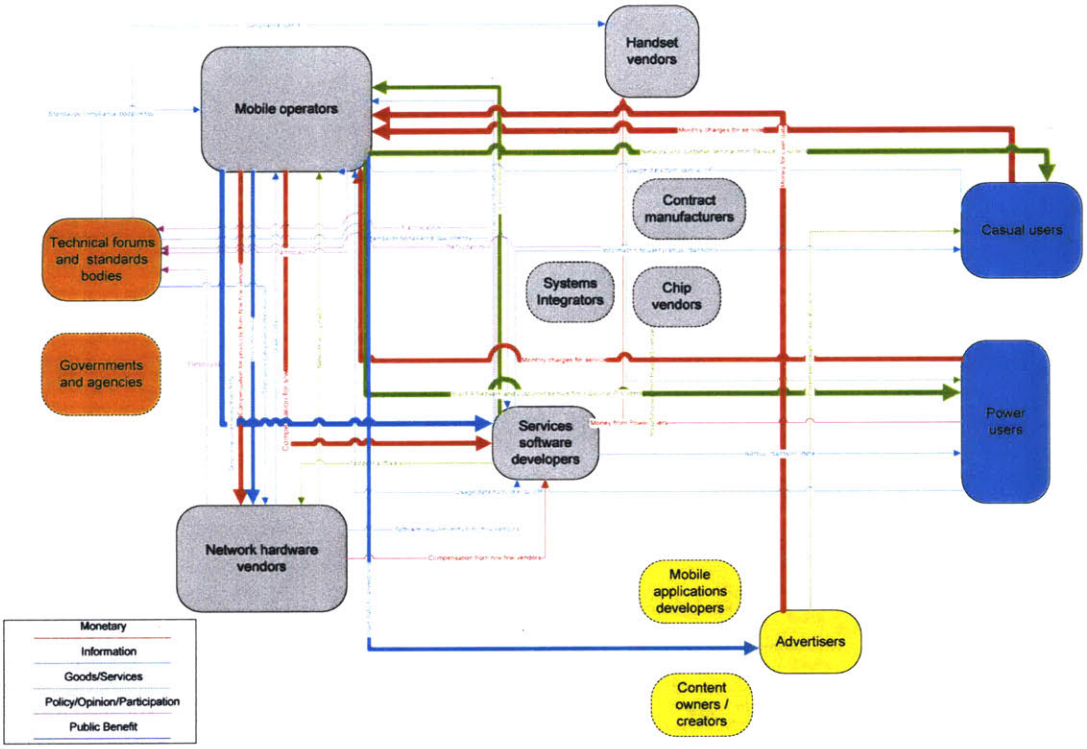


Figure 36 Simplified stakeholder map based on most important direct and indirect value loops, with dropped stakeholder shown in dotted lines

This takes us back to the familiar concepts of money flowing into the mobile operators from casual users, power users and advertisers, this money disbursed by the mobile operators among the network hardware vendors and services software developers. Goods / services flows are mainly emanating out of the mobile operators towards the casual users and power users stakeholders. Information flows mainly flow from the mobile operators to the advertisers and towards the services software developers stakeholder for implementation of various network related services. Standards are primarily involved in making sure that the different stakeholders in the infrastructure (gray) group work sufficiently with each other so that a seamless service is made possible from the mobile

operator point of view and they are not restricted in their purchasing options to go with certain firms due to lack of standard interoperability. A final check of consistency is that the stakeholders dropped off in this analysis were the exact last five in the system-wide analysis of relative stakeholder importance in Figure 26.

Observation 8: The system-wide analysis of relative stakeholder importance to the ecosystem and the consensus between top scoring direct loop and top scoring indirect loop analysis ended up picking the exact 5 stakeholders to be dropped.

5 Summary and conclusions

This chapter briefly summarizes the methodology used to conduct the analysis in this thesis, draws some conclusions about the mobile services ecosystem based on the results of the analysis, identifies some contributions made to further the body of work in the stakeholder analysis area and identifies some areas of future work that could be pursued.

5.1 Summary

To summarize, this thesis took the mobile services ecosystem and

1. Identified the various stakeholders in the ecosystem
2. Spelt out their roles and objectives
3. Characterized their needs
4. Identified the possible sources of satisfying these needs
5. Prioritized the importance of the sources that could satisfy the needs
6. Classified flows into any stakeholder into money, goods/services, information, participation and public benefit flows and quantified the value flows into each stakeholder
7. Listed all possible causal value flow loops (defined as any circular sequence of flows that starts and ends with the same stakeholder) and scored these loops
8. Ranked the loops by order of most value producing for the ecosystem.
9. Determined the most important stakeholders and most value producing interactions between them by analyzing the top scoring direct value loops and the top scoring indirect value loops separately and then classifying the stakeholders based on consensus between the two analyses.

5.2 Conclusions

Using these techniques summarized above, the ensuing analysis led to the following conclusions:

- The mobile operators are almost twice as important to the ecosystem as the next stakeholder (network hardware vendors)
- The content group of stakeholders are not important (yet at least) to the ecosystem but advertisers are the most important among them.
- The mobile operators' importance in the ecosystem stems from being part of many value loops and not from being part of a view high value loops
- The relationship between mobile operators and network hardware vendors is not symmetrical with casual users being the most important stakeholder to the mobile operator although the mobile operators are the most important stakeholder to the network hardware vendors
- Given the above, there will be indirect ways for network hardware vendors to increase their importance in the ecosystem by enabling their most important stakeholder (mobile operators) to serve their most important stakeholder (casual users)
- An analysis using both direct and indirect value loops produces a richer and more representative model of the ecosystem
- In a business ecosystem analysis, like the one done in this thesis, value loops longer than three stakeholders did not come out as important.

5.3 Contributions

This thesis has drawn heavily from previous work done at MIT on the subject of stakeholder analysis. The works of Sutherland, Cameron, Baron and the methodology of Crawley and the stakeholder analysis methods pioneered by Freeman have played a central role in the development of this material. Along the way there are a few things that this thesis also contributed to the body of work to further the cause of maturing the discipline. Some of these are listed below

- Applying stakeholder value network analysis techniques to the mobile services ecosystem in particular was first attempted.
- Performing a stakeholder analysis on the entire ecosystem first before narrowing down to the perspective of a single stakeholder was introduced
- Looking for stakeholder relationship symmetry by analyzing the value flow network from different stakeholder perspectives was developed as well

5.4 Future Work

It is expected that to be more relevant to a particular company, similar analysis as performed in this thesis be done with the specific company as the focus of attention (rather than the entire industry group). This is because there is significant variation even within the network hardware vendor stakeholder depending on whether they supply radio equipment, network core equipment or base stations or towers etc. Relative importance charts become very significant when this is done at that level of abstraction in getting to understand stakeholder actions and priorities. The analysis in this thesis has

been based on the strongest members in a particular stakeholder group (for example, the iPhone in the handset vendors group drove some of the numbers associated with that stakeholder group). It would be useful to take this analysis down a greater level detail of looking at classes of stakeholders within the stakeholder groups and analyze the ecosystem at a higher level of granularity.

Appendix A: Need characterization / Source importance table

To	Value Flow	Need Characterization	Source of Flow	Source Importance (1 2 3 4 5)
Mobile operators	Network equipment	E	Network hardware vendors	4
			Handset vendors	2
	Network equipment information for integration	E	Network hardware vendors	4
	Network integration services	B	System integrators	2
	Spectrum (from public/govt. auctions)	E	Governments	5
	Software applications	B	Mobile applications developers	2
	Standards compliance documents	D	Standards bodies	5
	Compensation (for mobile service and for information on usage patterns from content providers)	E	Casual users	5
			Power users	3
			Content providers	2
			Advertisers	3

		B	Mobile APP developers	2
	Support software	D	Service s/w providers	4
	Repair and logistics services	A	Contract manufacturers	2
	Usage data about users	C	Power users	2
			Casual users	3
			N/w h/w vendors	4
			Service s/w developers	2
N/w h/w	Requirements	E	Mobile operators	4
vendors	Support software	E	Service s/w vendors	4
	Specialty manufacturing services	E	Contract manufacturers	4
	Standards compliance documents	D	Standards bodies	5
	Compensation from Mobile operators for products	E	Mobile operators	5
	Chipsets	E	Chipset vendors	5
	User information (e.g. for Policy server implementation, DPI etc.	C	Service s/w vendors	2
			Casual users	4
			Power users	2
	Approval for gear	E	Government and agencies	1
Contract manufacturers	Design specs from n/w h/w vendors	E	N/w h/w vendors	5
			Handset vendors	5
	Compensation	E	N/w h/w vendors	5

			Handset vendors	4
			Mobile operators	3
	Chip products	E	Chipset vendors	5
Service s/w providers	Requirements and compliance docs from (Mobile operators and H/w vendors, Standards bodies)	E	Mobile operators	5
			N/w h/w vendors	4
			Standards bodies	5
	Monetary compensation from Mobile operators, Network h/w vendors	E	Mobile operators	4
			N/w h/w vendors	4
	Usage data (Users)	C	Power users	4
			Casual users	2
Handset vendors	Contract manufacturing services	B	Contract manufacturers	4
	Mobile APPs	C	Mobile APP vendors	4
	Data about lead user behavior	D	Power users	2
			Casual users	3
	Standards compliance docs	D	Standards bodies	4
	Cost effective Chips from silicon vendors	E	Chip vendors	4
	Money (from Mobile operators, CUs, Pus)	E	Mobile operators	3
			Casual users	2
			Power users	4
			Content owners / creators	2
	Approval docs	E	Government and	1

			agencies	
Systems Integrators	Compensation	E	Mobile operators	5
	Documentation	E	N/w h/w vendors	4
			Service s/w vendors	4
			Mobile operators	5
Chipset vendors	Compensation	D	Handset vendors	2
			N/w h/w vendors	4
	Information	C	Handset vendors	4
			N/w h/w vendors	5
			Standards bodies/forums	3
			Contract manufacturers	2
Casual users	Network and customer service (from Mobile operators)	E	Mobile operators	4
	Cool devices from Handset manufacturers	E	Handset vendors	4
	Useful content from creators/owners	C	Content creators/owners	2
	Discounts on advertised products via mobile channels	B	Advertisers	2
	APPs from APP developers	B	Mobile APP developers	2
	Information regarding prepaid/auth etc	C	Service s/w providers(5 because they cannot choose the SSW developers)	5

Power users	Smartphone Handsets	E	Handset vendors	4
	State-of-the-art network and customer service	E	Mobile operators	4
	Applications from Software vendors	C	Mobile APP developers	2
	Useful content from creators/owners	B	Content creators/developers	2
	Advertised deals via mobile channels	A	Advertisers	1
	Discounts for advertised products on mobile channels	A	Advertisers	1
	Information regarding prepaid/auth etc	C	Service s/w providers(5 because they cannot choose the SSW developers)	5
Government and agencies	Handset approval documentation from vendors	E	Handset vendors	5
			N/w h/w vendors	5
	Compensation for spectrum	E	Mobile operators	5
	Growth data from Mobile operators	C	Mobile operators	3
	Under-served population access	C	Mobile operators	3
	Access data	B	Mobile operators	2
Technical standards bodies	All stakeholders participation	E	Systems integrators	3
			Service S/w vendors	5
			Chip vendors	5
			N/w h/w vendors	5
			Handset vendors	3

			Mobile operators	5
Content owners/creators	Customer data from Mobile operators and Handset vendors	D	Mobile operators	5
			Handset vendors	3
	Money (from users for content provided and from advertisers to ride on content)	D	Casual users	4
			Power users	2
			Advertisers	2
	APPs that support content delivery	D	Mobile APP developers	2
Advertisers	Money(from casual users and from power users)	E	Casual users	4
			Power users	2
	Information on user behavior	D	Content owners/creators	4
			Mobile operators	5
	APPs enabling advertisement delivery	C	Mobile APP developers	2
	Conduits to run advertisements	C	Content creators/developers	4
Mobile APP developers	Compensation (from casual users for content provided and power users for content provided and advertisers when APPs help them ride on content and content creators/owners)	E	Casual users	4
			Power users	2
			Advertisers	2
			Content owners/creators	2
			Mobile operators	4
			Handset vendors	4
	Information (about users or platforms)	B	Handset vendors	2

	Mobile operators	4

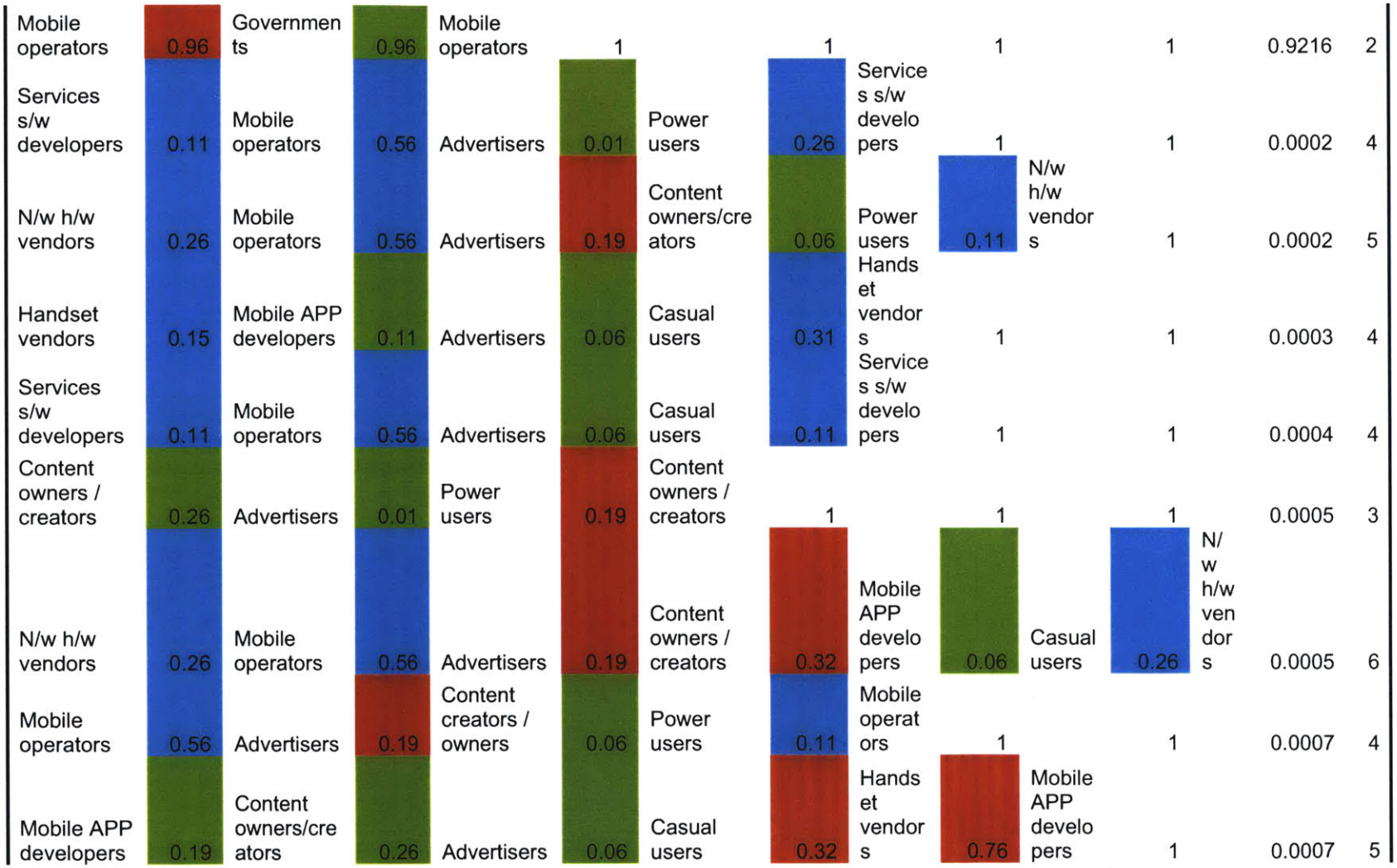
Appendix B: Value loop listings

Stakeholder	Value	Stakeholder	Value	Stakeholder	Value	Stakeholder	Value	Stakeholder	Value	Stakeholder	Value	Total value score	Value segments
Advertisers	0.01	Power users	0.32	Advertisers	1		1		1		1	0.0032	2
Mobile APP developers	0.06	Mobile operators	0.15	Mobile APP developers	1		1		1		1	0.0090	2
Content owners / creators	0.06	Power users	0.19	Content owners / creators	1		1		1		1	0.0114	2
Mobile operators	0.54	Contract manufacturers	0.04	Mobile operators	1		1		1		1	0.0216	2
Advertisers	0.32	Mobile APP developers	0.11	Advertisers	1		1		1		1	0.0352	2
Casual users	0.11	Services s/w developers	0.32	Casual users	1		1		1		1	0.0352	2
Mobile APP developers	0.11	Power users	0.32	Mobile APP developers	1		1		1		1	0.0352	2
Power users	0.32	Mobile APP developers	0.11	Power users	1		1		1		1	0.0352	2
Advertisers	0.06	Casual users	0.76	Advertisers	1		1		1		1	0.0456	2
Casual users	0.76	Mobile APP developers	0.06	Casual users	1		1		1		1	0.0456	2

Mobile operators	0.76	Mobile APP developers	0.06	Mobile operators	1	1	1	1	0.0456	2
Content owners / creators	0.11	Casual users	0.44	Content owners / creators	1	1	1	1	0.0484	2
Advertisers	0.19	Content owners / creators	0.26	Advertisers	1	1	1	1	0.0494	2
Mobile operators	0.96	Systems integrators	0.06	Mobile operators	1	1	1	1	0.0576	2
Content owners / creators	0.32	Mobile APP developers	0.19	Content owners / creators	1	1	1	1	0.0608	2
Advertisers	0.19	Content owners / creators	0.44	Advertisers	1	1	1	1	0.0836	2
Chip vendors	0.76	Handset vendors	0.11	Chip vendors	1	1	1	1	0.0836	2
Content owners / creators	0.44	Advertisers	0.19	Content owners / creators	1	1	1	1	0.0836	2
Handset vendors	0.11	Chipset vendors	0.76	Handset vendors	1	1	1	1	0.0836	2
Mobile operators	0.76	Power users	0.11	Mobile operators	1	1	1	1	0.0836	2
Services s/w developers	0.12	N/w h/w vendors	0.76	Services s/w developers	1	1	1	1	0.0912	2
Content owners / creators	0.32	Handset vendors	0.31	Content owners / creators	1	1	1	1	0.0992	2
Chip vendors	0.96	Contract manufacturers	0.11	Chip vendors	1	1	1	1	0.1056	2

Governmen t agencies	0.11	Handset vendors	0.96	Governmen t agencies	1	1	1	1	0.1056	2
Governmen t agencies	0.11	N/w h/w vendors	0.96	Governmen t agencies	1	1	1	1	0.1056	2
Handset vendors	0.76	Contract manufactur ers	0.15	Handset vendors	1	1	1	1	0.1140	2
Mobile operators	0.76	Casual users	0.18	Mobile operators	1	1	1	1	0.1368	2
Standards bodies	0.18	Chip vendors	0.76	Standards bodies	1	1	1	1	0.1368	2
Handset vendors	0.76	Power users	0.19	Handset vendors	1	1	1	1	0.1444	2
Governmen t agencies	0.96	Mobile operators	0.18	Governmen t agencies	1	1	1	1	0.1728	2
Mobile operators	0.54	Handset vendors	0.32	Mobile operators	1	1	1	1	0.1728	2
Content owners / creators	0.32	Mobile operators	0.56	Content owners / creators	1	1	1	1	0.1792	2
Chip vendors	0.76	Handset vendors	0.26	Chip vendors	1	1	1	1	0.1976	2
Mobile APP developers	0.26	Handset vendors	0.76	Mobile APP developers	1	1	1	1	0.1976	2
Handset vendors	0.76	Casual users	0.31	Handset vendors	1	1	1	1	0.2356	2
Handset vendors	0.76	Casual users	0.32	Handset vendors	1	1	1	1	0.2432	2
Chip vendors	0.96	N/w h/w vendors	0.26	Chip vendors	1	1	1	1	0.2496	2
Mobile operators	0.56	Advertisers	0.54	Mobile operators	1	1	1	1	0.3024	2
Standards bodies	0.56	Mobile operators	0.54	Standards bodies	1	1	1	1	0.3024	2

Chip vendors	0.96	N/w h/w vendors	0.32	Chip vendors	1	1	1	1	0.3072	2
Mobile operators	0.76	Services s/w vendors	0.44	Mobile operators	1	1	1	1	0.3344	2
Standards bodies	0.44	Handset vendors	0.76	Standards bodies	1	1	1	1	0.3344	2
Mobile operators	0.76	Power users	0.54	Mobile operators	1	1	1	1	0.4104	2
Handset vendors	0.96	Standards bodies	0.44	Handset vendors	1	1	1	1	0.4224	2
Standards bodies	0.56	N/w h/w vendors	0.76	Standards bodies	1	1	1	1	0.4256	2
Mobile operators	0.96	Standards bodies	0.56	Mobile operators	1	1	1	1	0.5376	2
Handset vendors	0.76	Power users	0.76	Handset vendors	1	1	1	1	0.5776	2
N/w h/w vendors	0.76	Services s/w developers	0.76	N/w h/w vendors	1	1	1	1	0.5776	2
Mobile operators	0.96	N/w h/w vendors	0.76	Mobile operators	1	1	1	1	0.7296	2
Mobile operators	0.76	Casual users	0.96	Mobile operators	1	1	1	1	0.7296	2
N/w h/w vendors	0.96	Contract manufacturers	0.76	N/w h/w vendors	1	1	1	1	0.7296	2
Standards bodies	0.96	Services s/w developers	0.76	Standards bodies	1	1	1	1	0.7296	2
Standards bodies	0.76	Systems integrators	0.96	Standards bodies	1	1	1	1	0.7296	2
Governmen t agencies	0.96	Mobile operators	0.96	Governmen t agencies	1	1	1	1	0.9216	2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Content owners/creators 0.06
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Advertisers 0.06
Casual users 0.31
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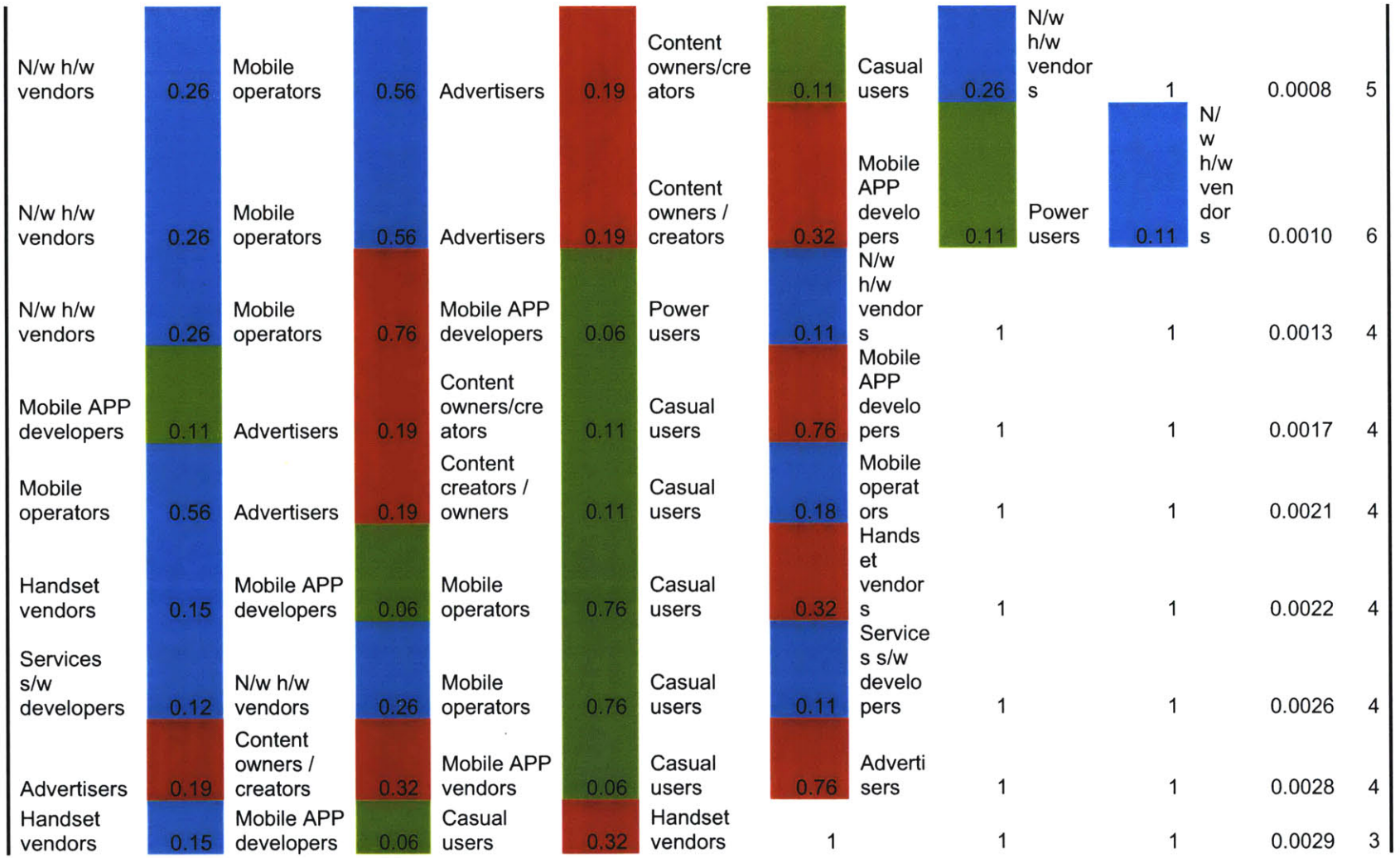
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Mobile operators 0.76
Casual users 0.11
Services s/w developers 1 1 0.0026 4
Advertisers 0.19
Content owners / creators 0.32
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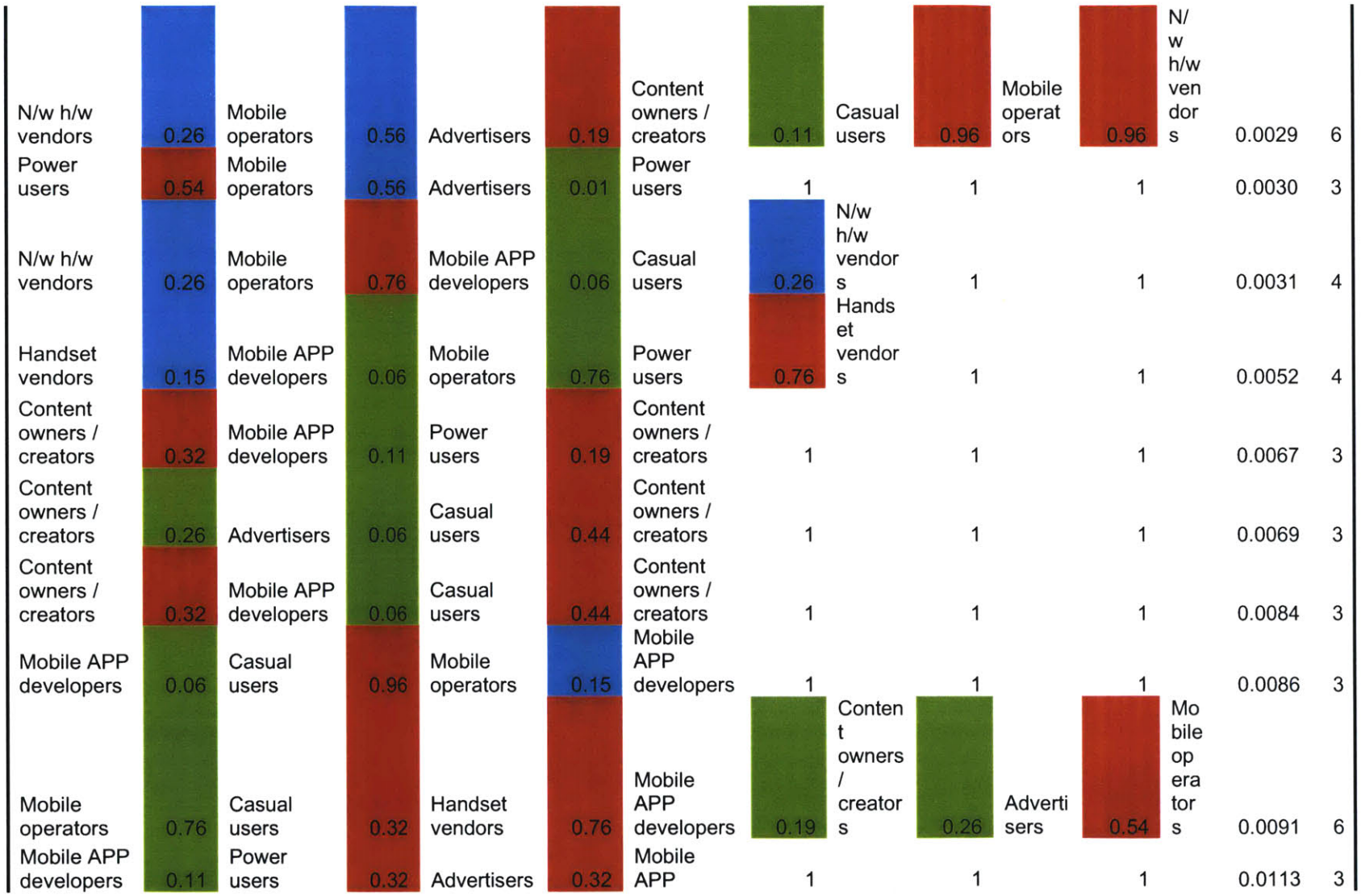
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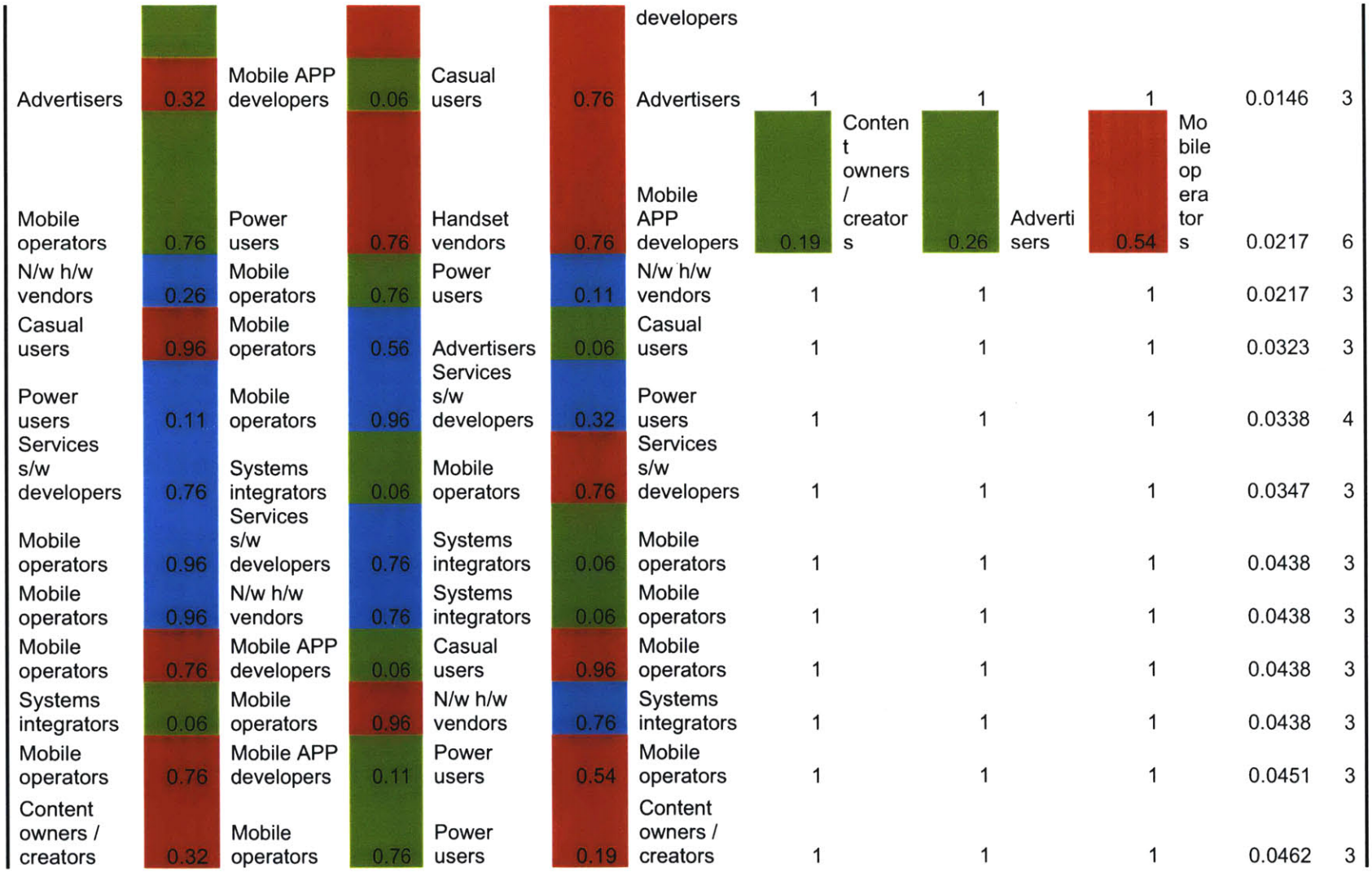
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Systems integrators 0.06 Mobile operators 0.96 N/w h/w vendors 0.76 Systems integrators 1 1 1 0.0438 3
Mobile operators 0.76 Mobile APP developers 0.11 Power users 0.54 Mobile operators 1 1 1 0.0451 3
Content owners / creators 0.32 Mobile operators 0.76 Power users 0.19 Content owners / creators 1 1 1 0.0462 3

N/w h/w vendors	0.26	Mobile operators	0.76	Casual users	0.26	N/w h/w vendors	1	1	1	0.0514	3
Casual users	0.18	Mobile operators	0.96	Services s/w developers	0.32	Casual users	1	1	1	0.0553	4
Contract manufacturers	0.11	Chipset vendors	0.96	N/w h/w vendors	0.96	Contract manufacturers	1	1	1	0.1014	3
Content owners / creators	0.32	Mobile operators	0.76	Casual users	0.44	Content owners / creators	1	1	1	0.1070	3
Advertisers	0.54	Mobile operators	0.76	Power users	0.32	Advertisers	1	1	1	0.1313	3
Advertisers	0.54	Mobile operators	0.76	Casual users	0.76	Advertisers	1	1	1	0.3119	3
Mobile operators	0.96	N/w h/w vendors	0.76	Services s/w developers	0.44	Mobile operators	1	1	1	0.3210	3

Appendix C: Stakeholder ranking changes between all value loops and direct value loops

Rank Change (+ better - worse)	Rank	All loops	Direct Loops	Rank
NC	1	Mobile operators	Mobile operators	1
+1	2	N/w h/w vendors	Standards bodies	2
-1	3	Standards bodies	N/w h/w vendors	3
NC	4	Handset vendors	Handset vendors	4
NC	5	Casual users	Casual users	5
NC	6	Services s/w developers	Services s/w developers	6
+1	7	Power users	Government agencies	7
-1	8	Government agencies	Power users	8
+2	9	Advertisers	Systems integrators	9

+2	10	Chip vendors	Contract manufacturers	10
-1	11	Contract manufacturers	Advertisers	11
-3	12	Systems integrators	Chip vendors	12
NC	13	Content owners/creators	Content owners/creators	13
NC	14	Mobile APP developers	Mobile APP developers	14

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