OPENTRADECLOUD:
REGULATING THE NEXT GENERATION OF THE NATIONAL MARKET SYSTEM

(Summarized and abridged version)

Carlos Mauricio S. Mirandola
Columbia Law School
csm2134@columbia.edu

1st Draft: April 21st, 2010
Comments appreciated

This is a summarized and abridged version of some of the arguments made in the report "OpenTradeCloud: Regulating the Next Generation of the National Market System" [Summary Report], that is part of my doctorate research at Columbia Law School. It is still very rough and preliminary, and it is only intended as a contribution to the debate about the structure of equity markets being promoted by the SEC. The full report [Full Report], still incomplete and in its beta version 0.5, and can be downloaded at www.cmmirandola.org.

I am extremely grateful to Larry Glosten and Merritt Fox for suggestions, comments and discussions. Without their contribution, this project would not have progressed. Special thanks to Katharina Pistor, Craig Pirrong, Eric Sirri, Edward Greene, Jeff Gordon and [more to come] for discussions, ideas and very helpful comments. Credit should also be given to the participants of the workshop "Law and Economics of Capital Markets" at Columbia Law School, where many aspects of the project were discussed, directly and indirectly. The views expressed herein are my own and do not necessarily reflect any research institution or government body I may be associated with.

OPENTRADECLOUD:
REGULATING THE NEXT GENERATION OF THE NATIONAL MARKET SYSTEM

Carlos Mauricio S. Mirandola
Columbia Law School
csm2134@columbia.edu

OpenTradeCloud: Regulating the next generation of the National Market System

Carlos Mauricio Mirandola
JSD Candidate, Columbia Law School
csm2134@columbia.ed

I. Introduction

As a contribution to the debate on the structure of equity markets that the SEC has initiated, I would like to present some ideas I have been developing in the course of my doctorate studies at Columbia Law School. Since 2007 I have been researching topics on microstructure, macrostructre, industrial organization and business models for trading in securities and exchanges. For the purposes of the present exposition, I am deliberately simplifying many of the arguments. For a more thorough discussion on the regulation of the National Market System, and for all the complete references and citations, please find the incoplete, draft full version of this report at www.cmmirandola.org [Full Report].

The current market structure is based on the promotion of closed trading systems connected by linkages built by regulatory intervention. In its latest version, introduced in 2005 by Regulation NMS, there are three main linkages connecting the markets: (i) the order protection rule, which establishes an automated and integrated execution system that routes orders to the markets displaying the national best bid and offer (NBBO); (ii) the consolidated quotation and tape systems, which consolidate and disseminate data about quotes and transactions; and (iii) the network of routing services provided by independent broker routing systems, which were made possible by the market access rules.

However, in spite of a notable improvement in the quality of the markets, under this regulatory model, tensions amongst market players are building up, incentives are misaligned, and the dominant business model for infrastructure and data providers has proven unbalanced. Symptomatically, investors and traders have been complaining about issues such as fairness and asymmetric access to technologies (co-location, trading center data feeds, added value data services), and the supposed advantageous treatment certain traders using strategies based on high frequency and algorithmic trading are getting.

The report sees no easy solution for the tensions in the current structure of the National Market System for securities. As a consequence, it proposes a shift in the regulatory paradigm. The approach to be advocated, which will be called the “OpenTradeCloud model”, is arguably more in tune with the original intent of Congress when it passed the 1975 Amendments to the Exchange Act than the path taken by Regulation NMS. The reasons are the following: (i) it relies heavily on the adoption of an updated technological framework for the system’s infrastructure; (ii) it presents a more elegant and less unbalanced solution for the tension between fragmentation and competition in markets; (iii) it aims at improving the efficiency of the markets while reducing strains caused by the structure stemming from the RegNMS. What this text will thus do is to discuss the Regulation NMS regulatory framework, comparing it with the proposed OpenTradeCloud approach.

II. Equities markets as today.

A. Market structure under Regulation NMS.

The fundamental structure of equity market is defined by its regulatory and technological determinants.

1. Regulatory aspects.

In 2005, after a long, controversial (and perhaps overheated) debate about how to modernize the way securities are traded,[1] the Securities and Exchange Commission (SEC) resolved a crucial issue on the structure of securities markets in the US: Regulation NMS.[2] The regulatory model set is in fact a variation on the same framework in force since 1979.[3] The following elements characterize the current structure of the market:

(1) multiple, heterogeneous and disintegrated market centers (trading venues);

(2) each market center operates its own, independent trading system, which is proprietary;[4]

In order to avoid fragmentation and promote the creation of the national market system, the regulatory framework induced the formation of the following linkages between the many trading centers:

(3) an inter-venue routing and execution system that redirects orders placed in one market place to others in order to provide better execution (the ITS and the trade-through rule);

---

[1] See the full report for a short recapitulation of how the National Market System evolved and about the discussions that led to the adoption of the current Regulation NMS.
[2] [Cite regNMS]
[3] See the former incarnation of the data rules 11Aa3-111 (the "Transaction Reporting Rule"), 11Ac1-115 (the "Quote Rule"), 11Ac1-218 (the "Display Rule"). Rule 11Aa3-221 sets forth the procedures for the filing and SEC approval of national market system plans and plan amendments and The ITS trade-through rule was approved in Securities Exchange Act Release No. 17703 (April 9, 1981).
[4] The term "proprietary technology" denotes technologies whose owner adopts policies that restrict its availability, use, study, modification and redistribution. By "policies" one is referring to legal measures (for example, restrictive licensing, restrictive enforcement of patents or copyrights), or technical measures (for example, restrictions to physical access, interoperability, compatibility, interconnection and interface for equipments, encryption, retention of the source-code and compilation for software).

(4) an inter-venue linkage system for the consolidation and dissemination of information about quotes and trades (the joint industry plans);

(5) broker routing services that provide routing services before an order is placed in any market;

Lastly, three sets of rules determine the governance of monopoly-like structures the regulatory framework induces, introducing competition in the fringes of the market:

(6) a set of rules determining interconnection and access obligations in order to allow the operation of independent routing systems and restrain abuses of monopoly power in execution (the access rule);

(7) a set of rules for the inter-venue consolidation systems that provide for governance and sharing of revenues earned in data dissemination that relies primarily on private arrangements between the venues – the so-called "industry plans" (the data rule);

(8) a set of rules authorizing the provision of independent data dissemination (also in the data rule).

2. Technology aspects.

Four breakthroughs in information technology had a strong impact in the structure of the market:

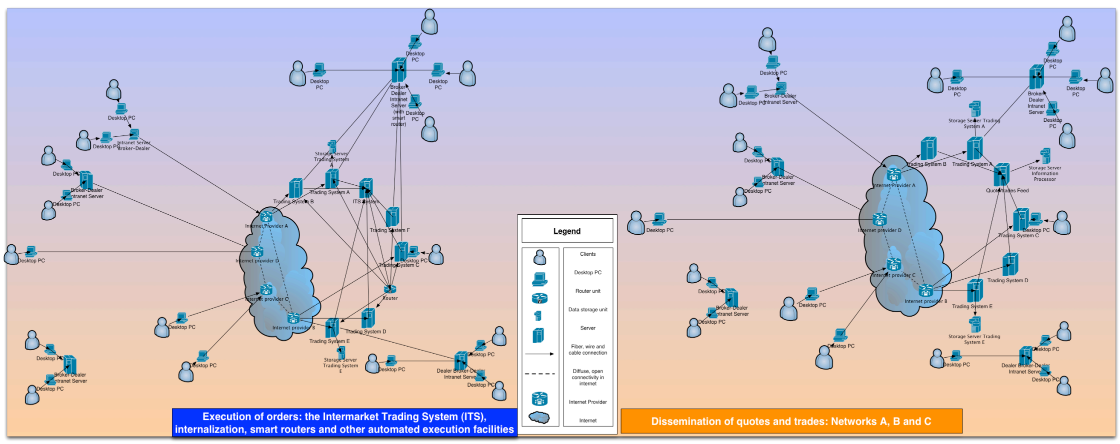
(1) the popularization of microprocessors and the personal computer revolution, which reduced the costs of processing trade information, multiplied the number of instructions and orders that can be placed in a given unit of time, allowed creation of larger databases, and led to the reaction ofincreasingly sophisticated software designed to execute transactions;

(2) the birth of networking computing and the client/server architecture, which allowed for the setup of closed local area networks (LANs) or intranets, with their secure applications platforms, that are the heart of the closed automatic, proprietary trading systems upon which modern exchanges, alternative trading systems, electronic broker-dealers and information services depend;

(3) the development of internetworking and creation of the internet, which allowed for the interconnection of different computer networks, reduction in the costs of communications, increased speed in transmission of data, and flexibility in the delivery of services;

(4) the creation of the World Wide Web, which allowed for improvements in the dissemination of data, distribution of trading services, creation of new services, improvements in marketing channels for trading services, and direct contact with end users, clients and investors.

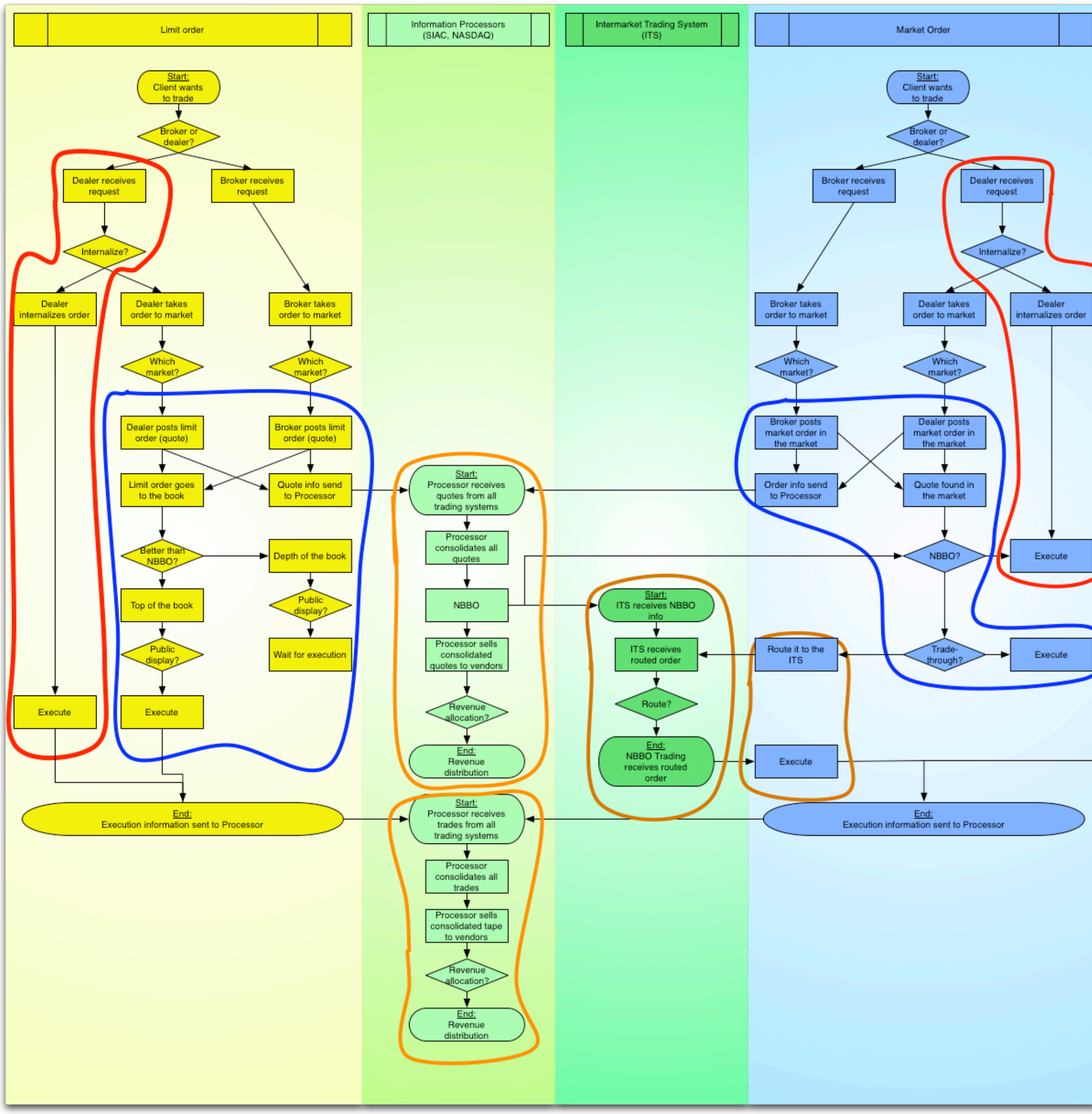
The diagrams below represent the current technological infrastructure of trading in securities:



3. Anatomy of trades.

The flowchart below describes the anatomy of trades as they occur today.

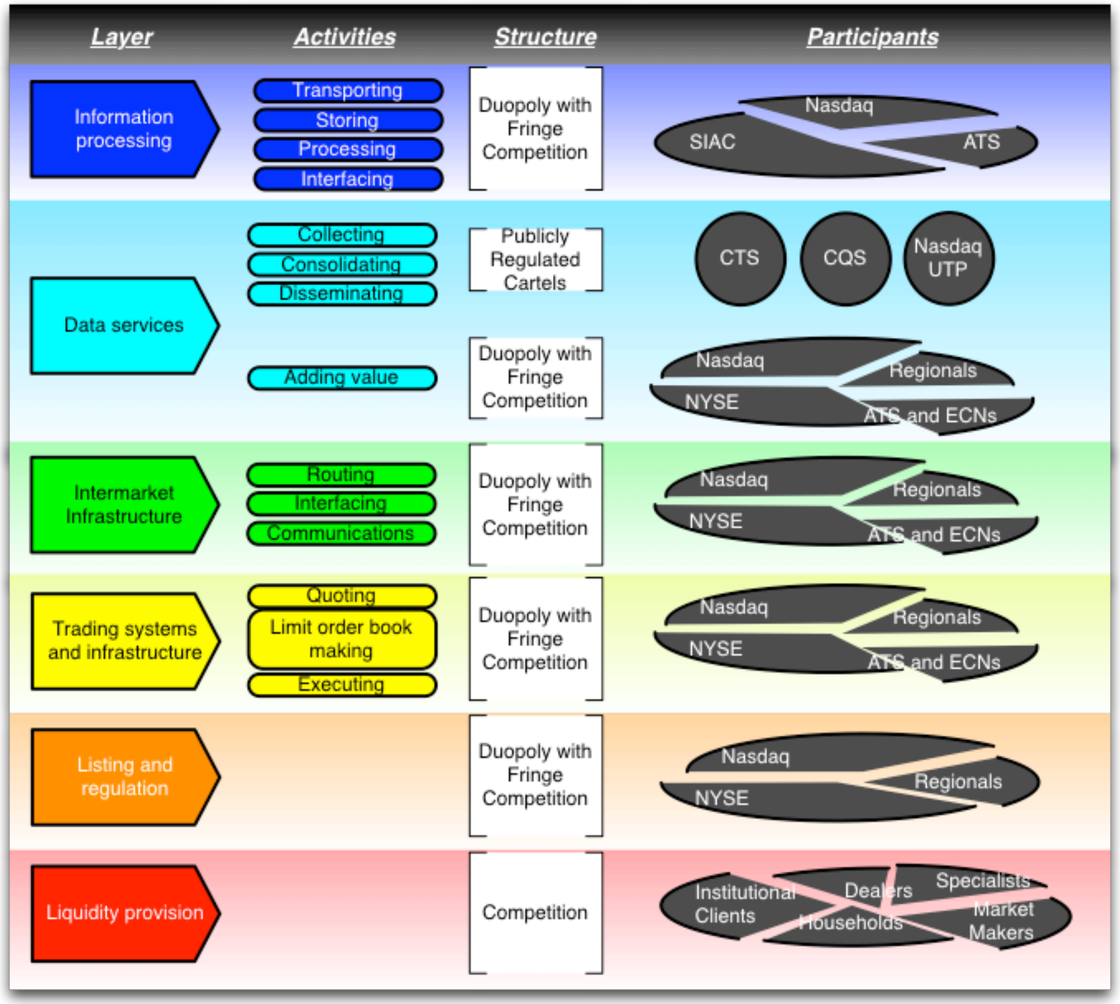
Trade under RegNMS



B. Competing under Regulation NMS.

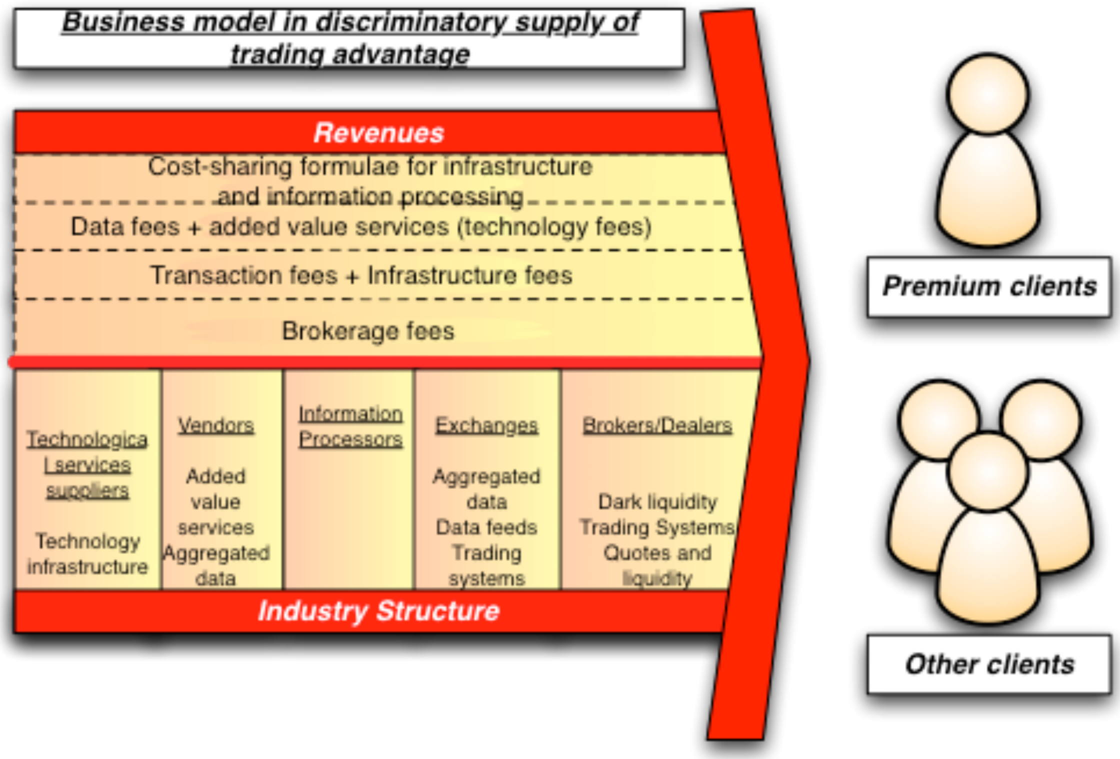
1. Industrial organization: Incumbents and fringe competition.

The regulatory structure and technology innovations created incentives for the development of a fringe competition model of industry organization. Such a model is characterized by the existence of an incumbent, normally a vertically integrated a monopolist, that faces the threat of small but tough competitors, either already operating in the market, or potential entrants. The main objective of the regulatory regime is to use the competitors in the fringes of the market to push incumbents and make them engage more intensively into competing and innovating. In other words, we want to dislodge incumbents in all layers of the industry from their possible passivity to bring more action to the market. The diagram below describes how the industry is organized, its many layers and dominating competition strucuture.

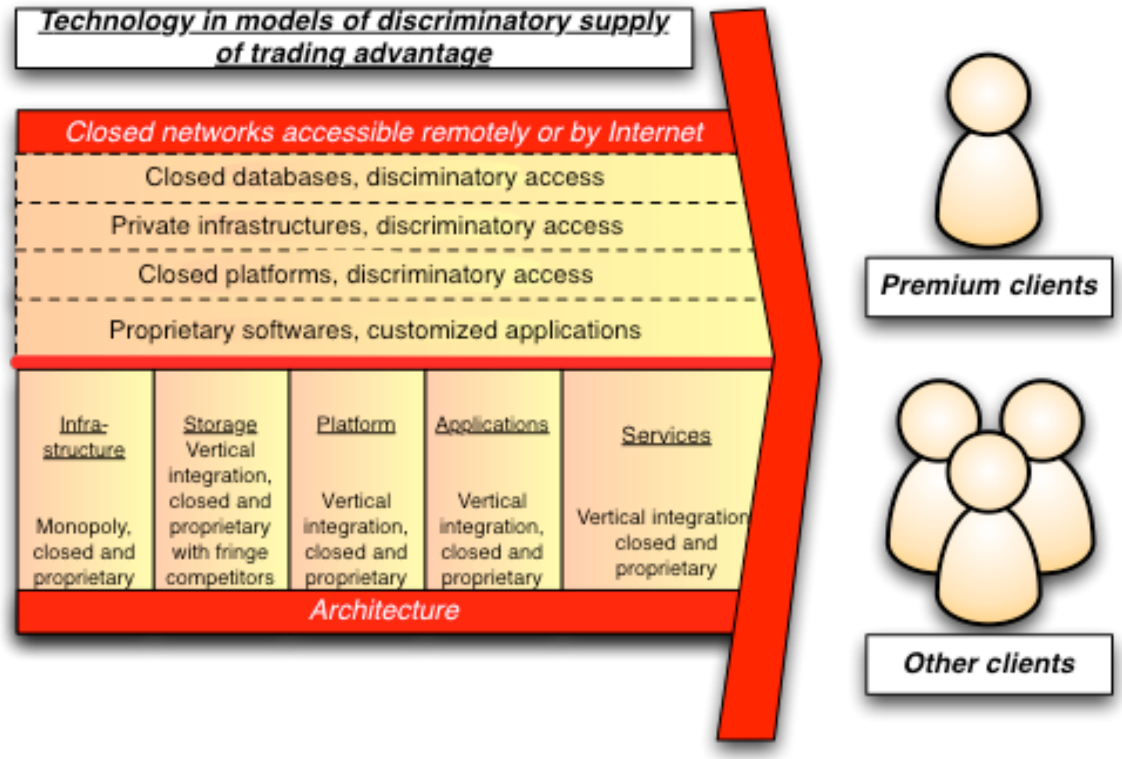


2. Favored business models: Characteristics.

Data and the supply of trading systems and infrastructure are main sources of revenues for the industry. However, because of the regulatory framework and other structural factors such as technology, incentives are great for the adoption, across the industry, of a business model that will be named here "discriminatory supply of trading advantage". As a general pattern, under such a model, suppliers tend to segment the market into two groups of clients: a small group of premium clients, and a larger group of regular clients. The greater the advantage supplied to the premium clients and the more exclusive they are, the greater the capacity of premium traders to earn abnormal returns and capture a bigger share of the bid and ask spread, and the greater the supplier's capacity to extract revenues from its clients. The figure below represents such relationships.



In an abridged version, one could say that such a business environment has three main components, one that is plainly positive, another two that are not so much. On the one hand, (i) it induces firms to innovate and fiercely compete to develop trading advantages, which means investing and deploying solutions that would improve the capacity of traders to find and reach liquidity. On the other hand, it induces firms to (ii) obtain proprietary control over all aspects of their technologies, and (iii) deploy their solutions in a discriminatory fashion competing for the property of standards.



3. Premium clients: Suitability and trading advantage.

The first observation one could make is that some technologies or trading methods are more suitable to certain types of investors in the view of their trading strategy or individual characteristic. Others are even necessary to the operation of a specific group of traders, but not for others. The same happens with databases and information products. It is fair to affirm, thus, that certain investors have stronger preferences for more technological methods and products than others. The table below tries to establish some preference relationships. In the rows, it lists relevant trading strategies and attributes of investors. In the columns, it shows relevant attributes of trading methods and products, as well as kinds of databases and information products. The notation (-), (+), (++) and (+++) indicates how much stronger the preference of a trader with determined characteristic or attribute might likely be in relation to the more technological product as compared to the less technological.

Preferences and Necessities												
			Low-tech / High-tech					Databases				
			Capital turnover Low-frequency / High-frequency	Strategy input Semi-automated / Automated	Order input Standard / Algorithmic	Co-location With co-location / without co-location	Execution speed High-latency / Low-latency	Core data	Historical data	Economic / governance data	Depth of the book data	Textual data
Trading strategies		Fundamental	+	+	+	+	+	+	+	+++	+	+
		Technical	+	+	+	+	+	+	++	+	++	+
		Quantitative	+++	+++	+++	+++	+++	+	+++	+	+++	+++
Investors	Time horizon	Long-term	-	+	+	-	-	+	+	++	-	+
		Short-term (speculative)	++	++	++	++	++	+	+	+	++	++
	Use of rights	Passive	+	-	+	-	+	+	-	-	-	-
		Active	+	-	-	-	-	+	-	+	-	++
	Investor occupation	Professional	++	++	++	-	++	+	-	-	+	+
		Household	+	+	+	-	+	+	-	-	+	+
	Ownership of the capital	Proprietary	-	-	-	-	-	+	-	-	-	-
		Third-party	-	-	-	-	-	+	-	-	-	-
	Nature of the person	Institutional	+	+	++	-	++	+	-	-	-	-
		Personal	+	+	+	-	+	+	-	-	-	-

The table suggests, for example, that it is likely that quantitative traders manifest a strong (+++) preference for products such as high-frequency, automated, algorithm-capable, low-latency execution systems, and co-location services – stronger, indeed, than the preferences fundamental and technical traders would have. So, fundamental traders would be more likely to have stronger preferences in relation to better economic and governance databases and information products. If the attribute was long-term investment, however, it is likely that investors committed to long-term investment strategies should be more neutral (-) to services such as co-location: in the long run, the cost and advantages of a specific execution system are diluted, and the prospects of the investments become relatively more important.

The second observation one could make is that such technologies and products are also poised to give advantages to investors consuming them. However, such advantage is weaker or stronger conforming to the investor's strategy or individual characteristics and attributes. As a result, for example, when one compares the performance of two very similar hypothetical quantitative investors I_1 and I_2, if I_1 has access to high-frequency, automated, algo-capable, lower latency systems, and I_2 does not, it is very likely that the latter's performance should be worse than the former's. The table below tries to establish such relationships, imagining contests between investors that have strategies that are very similar in certain attributes (rows), but differ in that they have asymmetric access to certain products (columns).

Contests											
		Low-tech / High-tech					Databases				
		Capital turnover Lower-frequency v. Higher-frequency	Order input Less-automated v. More automated	Strategy input More standard v. More algo. Capable	Co-location Further v. closer location	Execution speed Higher-latency v. Lower-latency	Core data	Historical data	Economic / governance data	Depth of the book data	Textual data
Trading strategies	Fundamental	+	+	+	+	+	+	+	+++	+	+
	Technical	+	+	+	+	+	+	++	+	++	+
	Quantitative	+++	+++	+++	+++	+++	+	+++	+	+++	+++
Investors: Time horizon	Long-term	-	-	-	-	-	+	+	++	-	+
	Short-term (speculative)	+	+	+	+	+	+	+	+	++	++
Investors: Use of rights	Passive	-	-	-	-	-	+	-	-	-	-
	Active	-	-	-	-	-	+	-	+	-	+
Investors: Investor occupation	Professional	-	-	-	-	-	+	-	-	-	-
	Household	-	-	-	-	-	+	-	-	-	-
Investors: Ownership of the capital	Proprietary	-	-	-	-	-	+	-	-	-	-
	Third-party	-	-	-	-	-	+	-	-	-	-
Investors: Nature of the person	Institutional	-	-	-	-	-	+	-	-	-	-
	Personal	-	-	-	-	-	+	-	-	-	-

The table suggests, for example, that, in a contest between two fundamental traders, co-location is likely to give a good advantage (+) for the investor who has access to it; however, such an advantage is likely to be comparatively much bigger (+++) when the two investors being compared adopted quantitative trading strategies. Likewise, it is likely that more access to information of deeper limit order books makes more difference for quantitative traders (+++) than it does to fundamental traders (+).

The third observation stems from such relationships. In cases where comparative preferences are stronger (+++) and comparative competitive advantages are bigger (+++), it is more likely that the benefitted investors will be willing to pay more for exclusive access to the technology or product. Consequently, when it is technically and legally possible and viable to implement the desired exclusivity, the likelihood that the dominating business model for the suppliers of such technology will be based on more exclusive or restrictive agreements is proportional to the size of the advantage the trader will secure in relation to its competitors. Also, investments in technological development are channeled to the more lucrative premium sector.

In other words, suppliers have incentives to restrict the supply of state-of-art technologies and information products by signing exclusivity deals, for users are likely to pay premiums proportional to the trading advantage received *only if other traders do not receive the same advantage*. Suppliers also invest more in the creation of premium products for such smaller constituency. Clients, thus, are segregated in two categories: those few who pay premiums to have exclusive access to state-of-art products that provide competitive advantages, and those who cannot have access to such technologies.

4. The ladder match: The business model and its incentive problems.

The discriminatory supply of trading advantage model functions as if trading services suppliers profited from seeking to provide trading advantages to their premium clients – in other words, they feed on the creation of market asymmetries. This creates tensions and conflicts between traders in the market. This explanation allows one to understand some fairness problems with which the SEC has been struggling:

(i) Co-location issue: to what extent should market centers be authorized to use the independent dissemination of data clauses in Regulation NMS to offer proprietary, discriminatory physical access to its quotes and trades information.

(ii) The core and non-core trade database regulation issue: should market centers be free to charge fees for trade information that is product of consolidation obligations.

(iii) Dark pool/transparency issue: should all alternative trading venues be obliged to promptly disclose and give access to information about the orders in their system.

(iv) "Flashing" orders issue: should exchanges be allowed to sell services providing for certain traders to have a milliseconds "peek" on incoming orders before other they are publicly displayed.

The most negative aspect of such discriminatory business models is that the advantages supplied do not have to be absolute advantages – they can merely be relative advantages. This means that they do not need to allow investors to be the fastest traders, only to trade faster than their competitors. There are strong incentives, thus, for suppliers to channel their competitive efforts to the creation devices and tools to selectively trick competing traders. Moreover: since such asymmetries are structural – indeed, part of the business model – long-term investors may be discouraged to seek markets to place their savings. With so many sharks in the sea, long term investors may become more adverse to enter the water. Too many resources may be being spent in devices designed to deceive a significant share of the investors.

In the end, the competition in such markets could be compared to a race between firms that are building ladders to climb higher than the others – a ladder match. Under the current structural conditions, firms operating in the market have two crews: the top-of-the-ladder crew and the bottom-of-the-ladder crew. On the top of the ladder, competitors fight for building creative new extensions that would make them reach higher – that is the innovation component. On the bottom of the ladder, however, competitors fight to build devices that would allow them to saw the legs of the opponents' ladders or even kick them off so that they would fall – those are the proprietary and discriminatory components. Every time a firm becomes the proprietor of databases or technologies that are necessary for other companies, they obtain powers to, either saw a piece of the competitors' ladder, or blocking their way up, so that the competitor will have to make a detour, or build their steps on a different fashion. The bottom-of-the-ladder crew, moreover, shouts loud and screams denouncing copiers, enforces their exclusive powers over competitor ladders' steps they think are too similar to their exclusive solutions, and try even to steal steps by appropriating competitors' solutions. They do so because their profits come from charging very high prices to let a small group of exclusive clients use their company's ladder. As a consequence, they do not compete to build the tallest ladder of all, but instead to build a ladder that is just taller than their competitors'. And that includes reliance on bottom-of-the-ladder strategies, which means investing energy in curtailing other competitors' efforts.

III. Equities markets under the OpenTradeCloud model.

A. Market Structure under OpenTradeCloud.

1. Regulatory aspects.

As an alternative to correct such imbalances and incentive problems, the proposal this report sponsors is the creation of what could be named the OpenTradeCloud. The OpenTradeCloud tackles incentive many of the current incentive problems by establishing interoperability requirements, minimal open standards, disclosure rules, technological neutrality obligations, and changing the current governance structure of the National Market System. It heavily relies on the adoption of cloud computing technologies. The following elements would characterize the market structure in the OpenTradeCloud model:

(1) public cloud enabling convenient, on-demand, networked access to a shared pool of virtualized configurable trading resources that can be rapidly and indiscriminately provisioned and released with minimal management effort or service provider interaction;

(2) suppliers interoperate and use open standards to develop their solutions to execute orders and provide data services;

Given its open architecture, the cloud is not subject to fragmentation concerns. The regulatory framework is designed to ensure interoperability, openness, transparency and neutrality:

(3) since the cloud has an open architecture, traders have access to all orders published by any SRO. SROs' role in the industry changes, and part of their business becomes to receive, certify and publish orders; best execution is ensured by the competition of matching engines (systems that locate, reserve, execute and publish a transaction); cross-execution (direct execution of one order published by one SRO against the order published by another SRO) is possible; the concept of routing becomes meaningless;

(4) since the cloud has an open architecture, traders have access to all transaction information published by any SRO; information is gathered by search

engines (systems that index, locate, run queries, retrieve information and return it to users); searching engines are ensured free access to all the data available in the cloud; they may also search proprietary databases in case they grant permission;

(5) trading services (search engines, matching engines, data analysis tools, algorithm builders, general applications, development platforms, infrastructural services) are supplied on a competitive, disaggregated and non-discriminatory basis by traditional trading entities such as SROs, broker-dealers, alternative trading systems, market makers, but also by technology companies;

Lastly, three sets of rules define the governance of the OpenTradeCloud:

(6) a set of rules determining interoperability requirements and open standards for the federation of suppliers, transit of content, and operation of the cloud;

(7) a set of rules determining the composition, functioning and procedures of the technical committees in charge interoperability requirements, open standards, transparency and neutrality;

(8) a set of rules determining benchmarks and evaluation procedures to assess effectiveness and fairness of SROs publishing procedures, as well as to promptly settle conflicts that may arise from order execution.

2. Technological aspects.

i . What is the cloud?

"Cloud" is a state-of-the art term used by specialists[5] to refer to pools of virtualized computer resources that can be summoned at will by suppliers and

[5] *See* I. Sriram & A. Khajeh-Hosseini, *Research Agenda in Cloud Technologies*, ARXIV PREPRINT ARXIV:1001.3259 (2010); M. Litoiu et al., *A Business Driven Cloud Optimization Architecture*, (2010); L. J Zhang & Q. Zhou, *CCOA: Cloud Computing Open Architecture*, *in* PROCEEDINGS OF THE 2009 IEEE INTERNATIONAL CONFERENCE ON WEB SERVICES-VOLUME 00 607–616 (2009); M. Zeller et al., *Open standards and cloud computing: KDD-2009 panel report*, *in* PROCEEDINGS OF THE 15TH ACM SIGKDD INTERNATIONAL CONFERENCE ON KNOWLEDGE DISCOVERY AND DATA MINING 11–18 (2009); Jeffrey Voas & Jia Zhang, *Cloud Computing: New Wine or Just a New Bottle?*, 11 IT PROFESSIONAL 15-17 (2009); Thomas Rings et al., *Grid and Cloud Computing: Opportunities for Integration with the Next Generation Network*, 7 JOURNAL OF GRID COMPUTING 375-393 (2009); Borje Ohlman, Anders Eriksson & Rene Rembarz, *What Networking of Information Can Do for Cloud Computing*, *in* PROCEEDINGS OF THE 2009 18TH IEEE INTERNATIONAL WORKSHOPS ON ENABLING TECHNOLOGIES: INFRASTRUCTURES FOR

costumers. In a working paper commissioned and published in 2009, the US National Institute of Standards and Technology (NIST) provisionally defined cloud computing as “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, serves, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.” The first works referring to clouds came about in 2007; interest for the concept has been mounting ever since.

Conceptually, the cloud-computing model evolved around three other recent innovations: (1) virtualization, (2) grid computing and (3) web-based services.

(1) Virtualization technologies are hardware and software solutions that allow for the creation of simulated computer environments, which the users can remotely access. Processing, storage, memory, databases, networks, desktops, platforms, applications and services can all be virtualized. In such cases, the solutions may access computing resources available in different locations, making the many parts to work as one single computing unit. In fact, the resources may even belong to different owners and entities – it is access to them that matters. In essence, the virtualization technologies are solutions that coordinate the operation of all shared resources, permitting the user and the applications she is using to increase or decrease the usage of resources on demand.

(2) Parallel or grid computing aims to enable resource sharing and coordinated problem solving in dynamic, multi-institutional virtual organizations. Grids are solutions used to integrate existing resources, federating them around a specific project and distributing the tasks to be executed amongst them. In the

---

COLLABORATIVE ENTERPRISES 78-83 (2009), http://portal.acm.org/citation.cfm?id=1591839 (last visited Mar 1, 2010); R. Mikkilineni & V. Sarathy, *Cloud Computing and the Lessons from the Past*, *in* PROCEEDINGS OF THE 2009 18TH IEEE INTERNATIONAL WORKSHOPS ON ENABLING TECHNOLOGIES: INFRASTRUCTURES FOR COLLABORATIVE ENTERPRISES-VOLUME 00 57–62 (2009); D. Hilley, *Cloud Computing: A Taxonomy of Platform and Infrastructure-level Offerings*, (2009); R. L Grossman, *The Case for Cloud Computing*, 11 IT PROFESSIONAL 23–27 (2009); G. Briscoe & A. Marinos, *Digital ecosystems in the clouds: towards community cloud computing*, ARXIV PREPRINT ARXIV:0903.0694 (2009); L. Mei, W. K. Chan & T. H. Tse, *A Tale of Clouds: Paradigm Comparisons and Some Thoughts on Research Issues*, *in* PROCEEDINGS OF 2008 IEEE ASIA-PACIFIC SERVICES COMPUTING CONFERENCE (APSCC 2008) 464–469 (2008).

beginning, they were conceived as cheaper alternatives to supercomputers in once-in-a-lifetime tasks requiring intense computing power. Normally used by an organization with geographically distributed resources, grids may comprise processing, storage and networking resources. Grid solutions define and provide sets of standard protocols, middleware, toolkits and services built on the top of such protocols.

(3) Web-based services are generally application programming interfaces (APIs or web-APIs) that can be accessed over a network or over the internet, and are executed on a remote host or client. They are not resident on the client's computer. When accessed, they may use both the server's and the client's processing capacity, depending on the way they were conceived: some web services are designed to be gateways to the application hosted on the supplier's server – processing happens mostly in the server; some are full-body applications that are momentarily downloaded from the server to the client – processing happens in the client's computer; others are in between. Web services are developed to be directly accessed by users, and, thus, commercialized – they are not solutions designed to run only inside organizations, instead, they are supplied directly to the market.

Clouds, in their turn, congregate many aspects of all three innovations:

(1) Clouds may be similar to web-based services in that they allow for the deployment of applications directly to users remotely located. They go further, though, because not only do they offer application solutions (software as a service, SaaS), but also platforms (platform as a service, PaaS) and infrastructure services (infrastructure as a service, IaaS). Their public is both the end-user (end of the chain) and service supplier (middle of the chain).

(2) Clouds also incorporate grid computing solutions in that they rely on the federation of different resources often geographically separated; they allow for the distribution of tasks amongst the many computing units; they are flexible and capable of summoning impressive computing capacity whenever needed; they make intensive use of standard protocols that help different systems to interoperate. However, they are not limited to a single project and single organization: clouds can

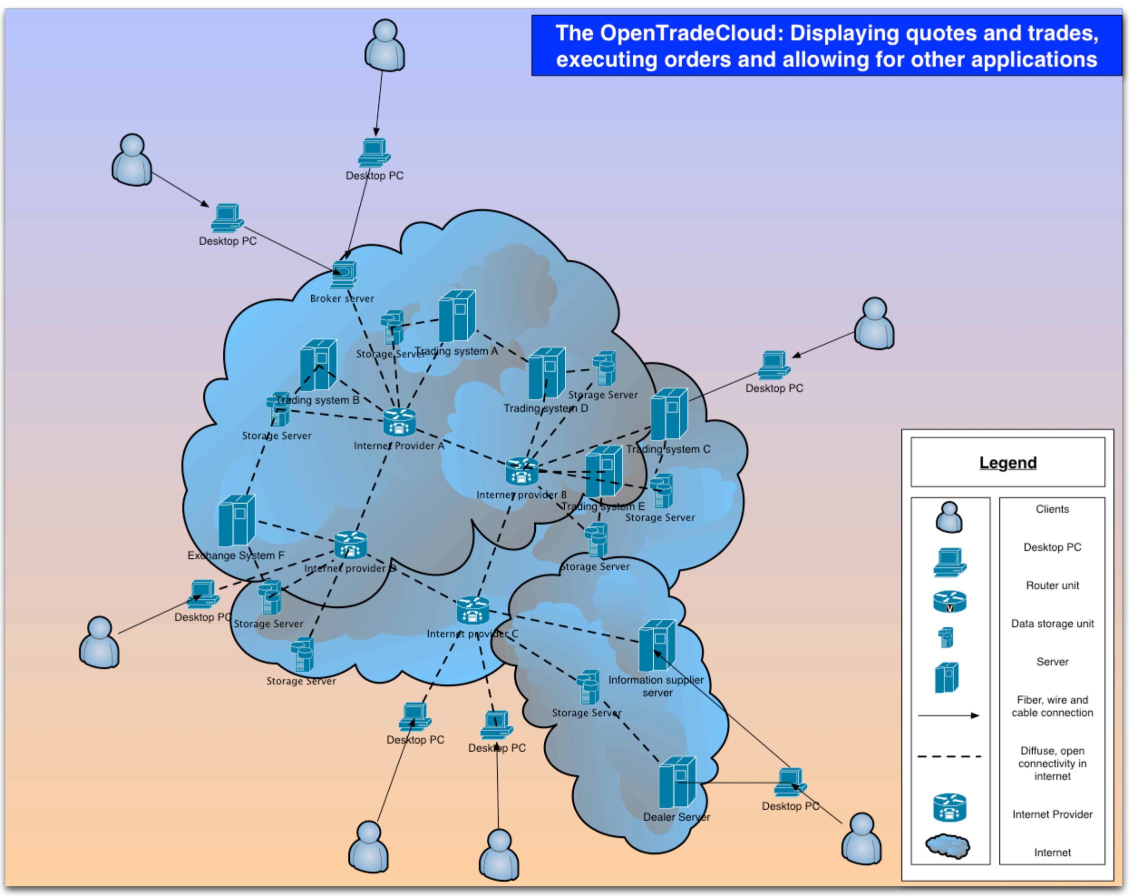
be open to the public, which means that not only do organization insiders access federated resources of clouds to solve their problems, but also outsiders.

(3) Clouds bear similarities with virtual computing solutions in that they allow for resources belonging to different owners to be accessed, unbundled and shared, permitting the creation of single virtual entities; they can be operated by many organizations at the time, and even though resources from one owner may be accessed, used and shared by different users, all is done independently, and there is no conflict or superposition between them; many different virtual machines can exist and share the same resources, even though each one of them are single entities running their own processes with neither knowledge of each other nor outside interference. The operation of clouds cannot be seen as restricted to the supply of virtual processes, nonetheless: clouds in themselves may be used to host and distribute content, which means that end users may access and run applications existing in them. As a consequence, not only can clouds be used to host services and applications for developers and services suppliers, but also they supply services themselves.

To sum up, five characteristics are generally cited in the specialized literature as key to understand clouds:[6] (i) on demand self-service (computing resources – processing power, storage, virtual machines, etc. – can be acquired and used at anytime without the need for human interaction with cloud services providers); (ii) broad network access (the cloud can be indiscriminately accessed by simple devices such as laptops or mobile phones, or more sophisticated networks and powerful computers); (iii) resource pooling (cloud service providers pool their resources, which are then shared by multiple users in a way specialists refer to as multi-tenancy and co-tenancy – one physical server may host several virtual machines belonging to different users, and the same virtual machine may be hosted by different servers); (iv) rapid elasticity (a user can quickly acquire more resources from the cloud by scaling out, and scale back by releasing those resources once they are no longer needed); (v) measured service (resource usage is metered using appropriate metrics such as storage usage, CPU hours, bandwidth usage, etc.).

ii. What is the OpenTradeCloud?

The diagram below offers a representation of how such a technological architecture could be transposed to the current National Market System. The basic idea is that the regulatory framework mentioned above, with its strong interoperability obligations, open standards policies, transparency and neutrality requirements, and the cloud computing technology would help to create the OpenTradeCloud.



In relation to its technological architecture, thus, the OpenTradeCloud would be one large pool of easily usable and virtualized trading resources (software and hardware) such as storage capacity, memory, searching engines, matching engines, development platforms for search and execution algorithms, databases and other services. In the diagram above, there are no separate subsystems for collection, consolidation and dissemination of quotes and trades, no mandatory routing system, and no interfacing or linkage system. The diagram shows trading centers (exchanges, alternative trading systems, broker-dealers, systemic internalizers) virtualizing their activities, moving them to the cloud, and operating in a federated way. The cloud, its interoperability requirements, interconnection protocols, open standards and data, and applications federation policies would allow for trading services suppliers to compete more freely and vigorously. Technological bottlenecks and perverse lock-in incentives would be drastically reduced. The architecture permits that all resources be supplied on a competitive, nondiscriminatory, unbundled basis, which would allow for variable scale, optimum resource utilization, and reduced lock in problems. In short, the cloud model would allow for consolidation without consolidators.

3. Trading mechanics.

What changes, however, in the trading mechanics? How trading in the OpenTradeCloud differs from trading in today's system? First, in the OpenTradeCloud, any investor, individual (or institution), one-time, long term (or high-frequency, algo trader), will be able to search and find a quote (execute an extended query and complex probabilistic analysis) and place an order (write an algorithm and start to stream orders), choosing amongst many visibility options and different kinds of orders created by market places. She will also be able to use proprietary algorithmic strategies developed in third party platforms that are natively built to operate in the cloud. Once the order (or the stream of orders) that the investor placed is received, the market place where they were placed will certify and publish it, making it available to other investors. Publishing means that it will be disclosed to the public cloud, and anyone will be able to see it unless the investor who placed it chose other available publishing option (iceberg orders, for example). The market place can store the information about the order in any place of the cloud, and use the resources of the suppliers it deems to be the best for its present needs.

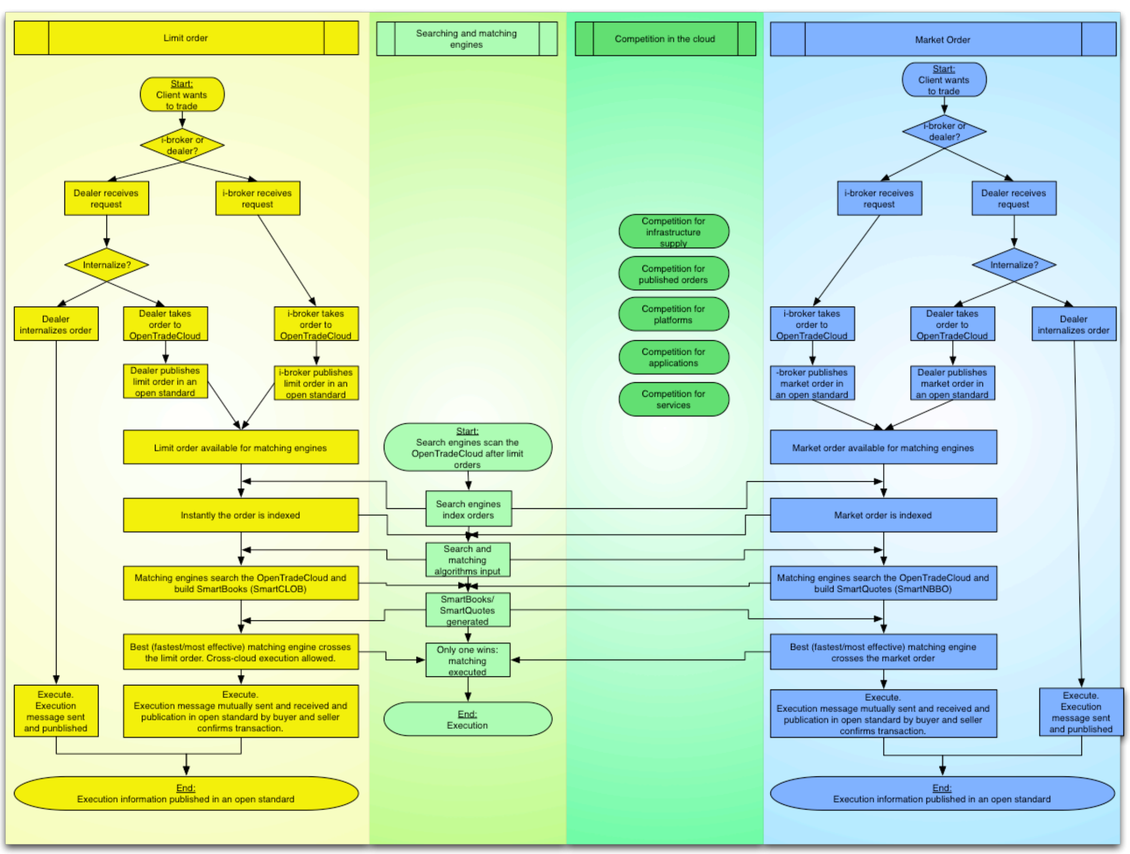
Second, in the cloud, the concept of limit order books also changes. Once certified and published, the order is disclosed and becomes visible, in the terms its placer determined, to all search engines operating in any part of the cloud. It is also accessible to all matching engines. Just like google, bing and yahoo do in the internet, search engines will permanently scan the cloud for orders and index them, following their status. When users input a query in the search engines provided by exchanges, brokers, dealers and other companies, the engines build a list with all orders they could find in the cloud that correspond to the parameters requested. In other words, over potentially the same database (it all depends on how well the search engines perform their indexing and finding tasks), each search engine uses their own algorithm to build their own list. Such lists will be called here SmartBooks. Limit order books are just that – a specific kind of SmartBook, a list built from the answers to a query for a specific kind of order, the limit order. Each exchange and broker-dealer can have its own SmartBook, and it will be as good and deep as the algorithm it uses. They will thus compete for the best algorithms and the best SmartBooks. The information in SmartBooks can then be used in the same way limit order book data is.

Third, execution of orders also changes, and the concept of routing becomes meaningless. In the cloud, orders are executed by matching engines, which are services that may be supplied by exchanges, broker-dealers and other third-party technology firms. What these engines do is to find a corresponding order against which they can execute the order they received, lock and reserve it with the market where it was placed and published, execute the transaction, and publish the record in the cloud. When orders are certified and published, thus, matching engines start to run, finding and reserving orders that can be matched or crossed in all over the cloud. Since any engine can have indiscriminate access to all orders, the better their search and reservation services are, the better the execution provided will be. Moreover, given that all orders are published in the open cloud after the market center certified them, no routing is needed, and cross-market execution is always possible. Matching engines compete for the best algorithms to break orders and find the ideal matches for the execution style that the investor requires. Investors would be able to choose between optimizing speed (breaking the orders and finding the volume needed as fast as possible) and price (breaking the orders and finding the best prices).

4. Anatomy of trades.

The flowchart below describes the anatomy of trades as they would occur in the OpenTradeCloud.

<u>Trade under OpenTradeCloud</u>



B. Competing under the OpenTradeCloud model.

1. Business models in the cloud: General terminology.

In terms of services provided by clouds, the NIST definitional paper and experts normally point out three kinds of service delivery models:

(i) Software as a Service (SaaS): Applications with specific purposes that are offered directly to the end user or client. The consumer uses an application, but does not control the operating system, hardware, or network infrastructure on which it is running. As examples, one could mention email and messaging services (Gmail, Hotmail, Messenger); productivity tools such as text editors, spreadsheets, presentation and forms (Google Docs); data crunchers and management systems (Yahoo Pipes, Google Analytics); search tools (Bing, Google, Yahoo); news aggregators and RSS readers (Google Reader, NewsGator, My Yahoo); business and customer relationship management (CRM) tools (salesforce.com); networking (Facebook, Linkedn); payment systems (PayPal, Amazon Checkout, Google Checkout); information and financial data tools (Financial Times, Reuters, Bloomberg). Some stock trading tools and online brokers could also be mentioned: TD Ameritrade, E*Trade, TradeStation, Fidelity.com. One should consider, however, that such services are still in their infancy: most of them are hybrid trading tools that were conceived, not as purely internet/cloud application, but instead as internet interfaces, portals or access gateways to broker-dealers traditional businesses.

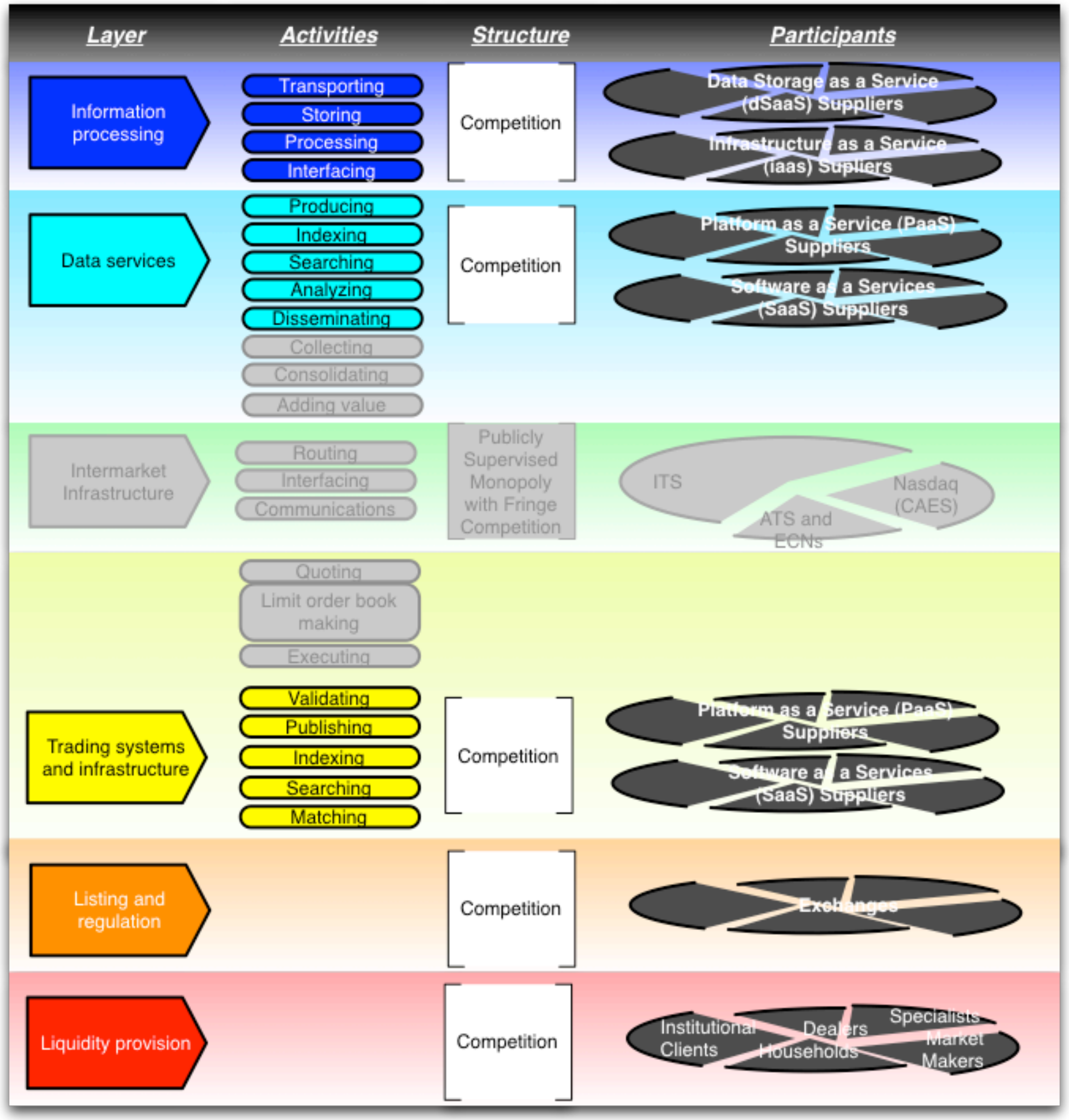
(ii) Platform as a Service (PaaS): environments where applications are developed, with programming language, set of libraries, development tools (application code and runtime environment), frameworks (identity, security, integration, data), forms and templates. The consumer controls the applications that run in the environment (and possibly has some control over it), but does not control the operating system, hardware or network infrastructure on which it is running. As examples, one could mention more general programming tools (Google Apps

Engine, Microsoft Azure Service Platform, Amazon Elastic Cloud Compute, Bungee Connect); client capabilities tools (Google Web Toolkit, Mashup Editor); business development tools (force.com, Long Jump, WaveMaker Enterprise), e-commerce platforms (Amazon StoreFront).

(iii) Infrastructure as a Service (Iaas): Processing power, storage capacity, memory, network components, middleware and bandwidth are amongst the infrastructures that can be supplied as services. The consumer can control the operating system, storage, deployed applications and networking. She may contract the resources on a metered basis, and may scale her use up or down depending on her needs. Examples are general IaaS (Amazon Web Services, ServePath GoGrid, Rackspace Mosso), hosting environment (Amazon Simple Storage Service – S3, GoGrid Cloud Hosting, Rackspace Cloud Server and Cloud Sites), storage (Amazon Elastic Block Storage, GoGrid Cloud Storage, Microsoft SQL Services), e-commerce database and services (Amazon SimpleDB).

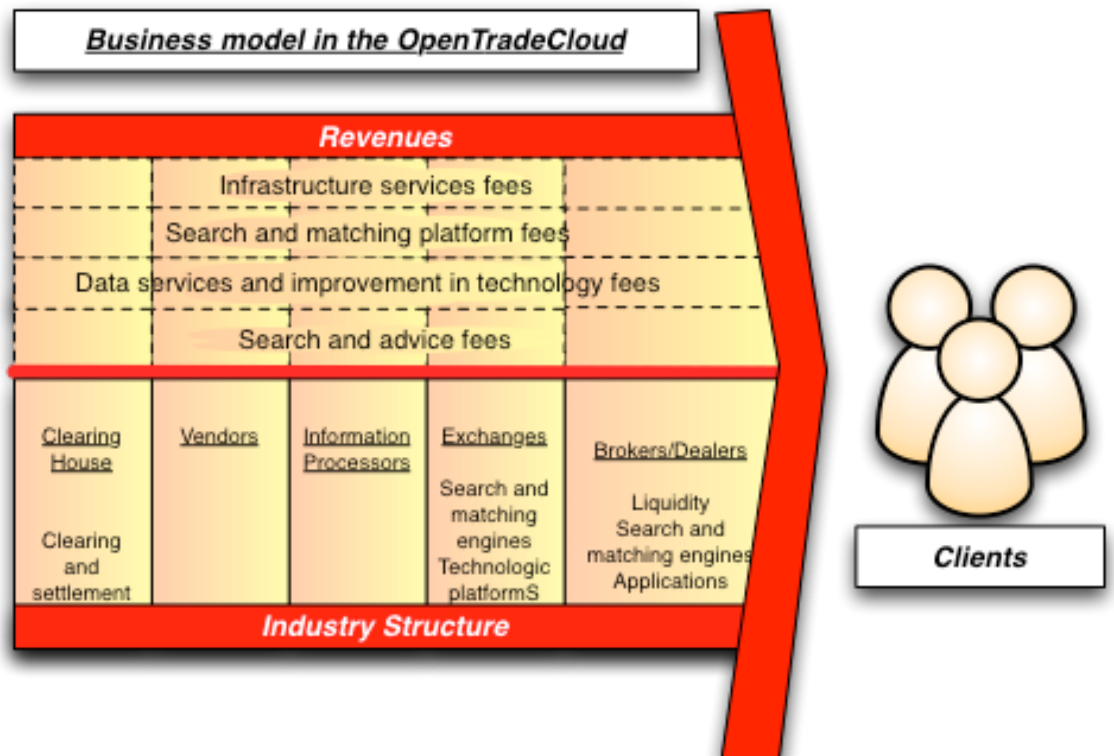
2. Industrial organization: Delivery models and competition.

The cloud allows for a radical unbundling of all services being supplied, including infrastructure and processing. Moreover, the interoperability requirements and open standards reduce lock-in problems and dependency relations, which means that full competition is possible in all layers. The diagram below presents the organization of the industry under the cloud paradigm. The boxes in grey are layers that exist in the Regulation NMS model, but that would disappear under the OpenTradeCloud model.



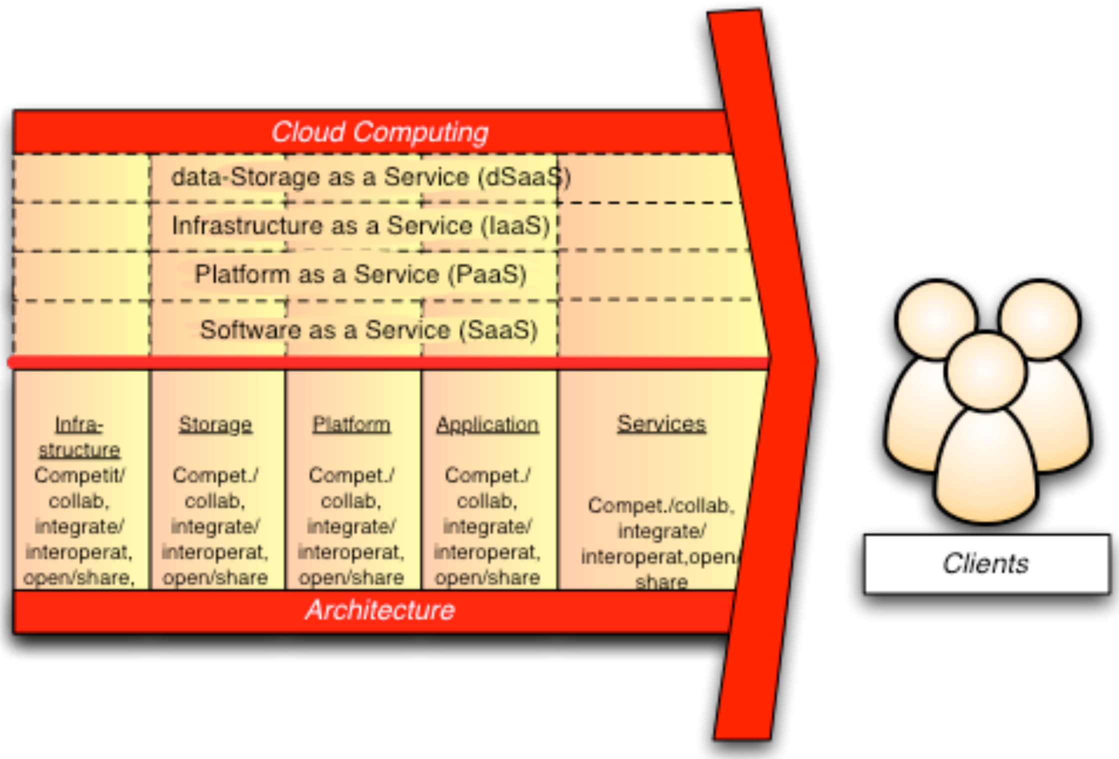
3. Favored business models: Characteristics.

In comparison with the RegNMS model, in the OpenTradeCloud incentives in many layers of the industry are better aligned, and discriminatory behaviors are drastically reduced. First of all the OpenTradeCloud regulatory framework privileges a public cloud model. Public clouds are characterized for making available to their clients third-party services via open connections such as the internet. "Public" should not mean either "for free", "without privacy for clients", or "with unprotected access, unsupervised" – it just means that regulation assures end users have indiscriminate access to all the cloud's resources, that the cloud does not belong to single organization or entity, that suppliers follow minimally common, non-discriminatory procedures, and that there is no hierarchic dominance relationship established amongst providers. The expression is used in opposition to "private" clouds, which are fully controlled by a single entity or organization in a centralized way. To enter private clouds suppliers and clients have to be chosen or allowed, and access is offered on a discriminatory basis. The diagram below indicates the structure of the business models of suppliers operating in the OpenTradeCloud.



Second, roughly speaking one could say that the business model has three very positive components. First, it gives incentives for SROs to publish orders in the cloud. Because, under the new model, SROs certify and publish orders, and because such activities generate revenues, it is likely that they will compete for publishing orders in the cloud. Contrary to the RegNMS model, thus, they are competing to release and free information instead of locking in and hiding it.

Third, the revenues deriving from other activities such as the supply of searching engines and matching engines do not depend on the monopoly of order flow, which undercuts incentives to jeopardize market integration and reduce access. Moreover, the fact that there is cross-execution increases the likelihood that vertically integrated firms will collaborate – restrictions in interoperability may lead to less cross-execution, and thus less revenues. The diagram below represents such relationships.



OpenTradeCloud

Regulating the next generation of the National Market System

Carlos Mauricio Mirandola
Columbia Law School

Objectives of the paper

Two objectives

1. Critically analyze the current regulatory framework for the National Market System
   - Identify:
     - Regulatory goals and history
     - Market structure (technology, ownership and competition patters)
     - Shortcomings and deficiencies
     - Some elements of regulatory and political constraints (path dependency, transition and politics)

Two objectives

2. Propose an alternative regulatory model: the "OpenTradeCloud model"
   - Better fit for the congressional intent
     - Use of technology, more orderly markets (less imbalances), better business models
   - Consolidation without a consolidator
   - Platform competition
   - Elements
     - Open standards and interoperability
     - Incentives for production and disclosure of information
     - Cloud architecture
     - Better business models: platform services

Structure of the paper

PART I:

I. Introduction

II. The competition for the monopoly of order flow

III. Competition for the monopoly of discrimination

PART II:

IV. OpenTradeCloud

V. Comparisons

VI. Transition: Competing for the next generation.

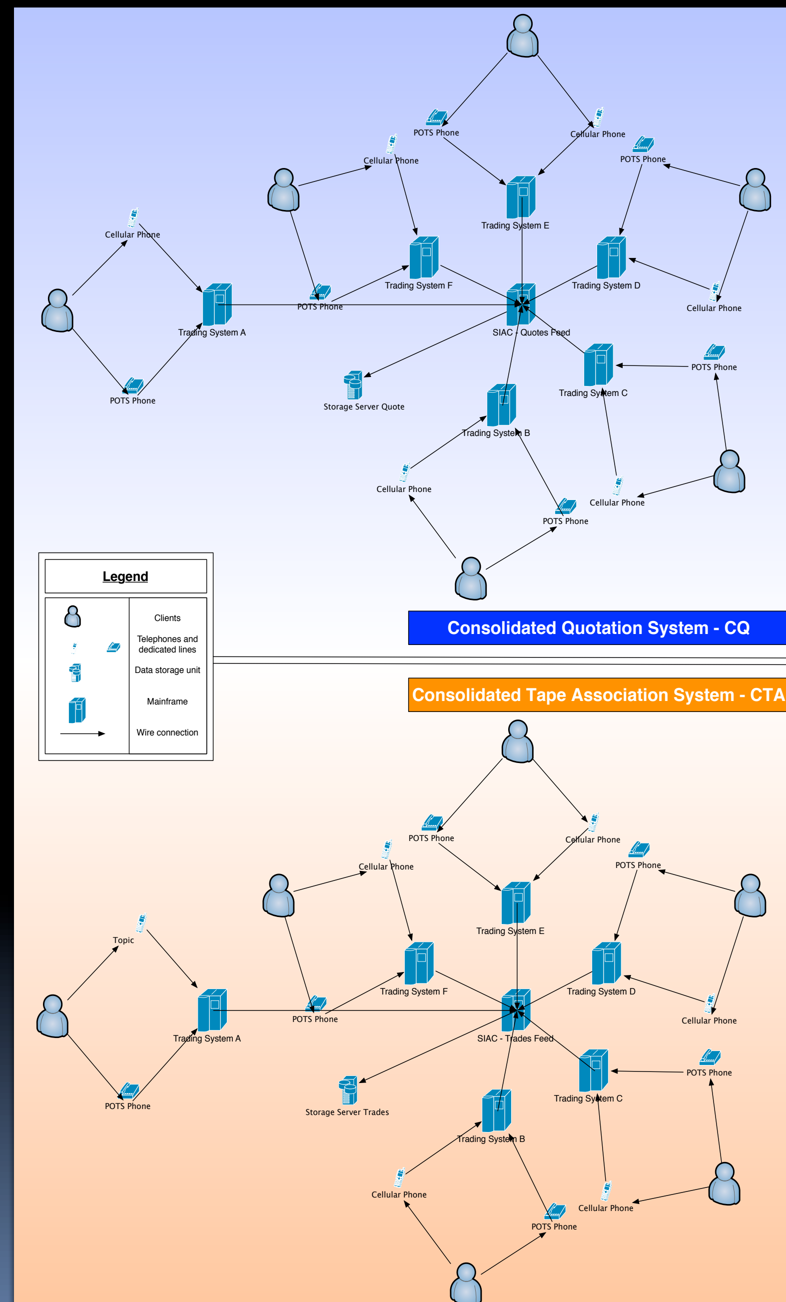
VII. Conclusion

II. Competition for the monopoly of order flow

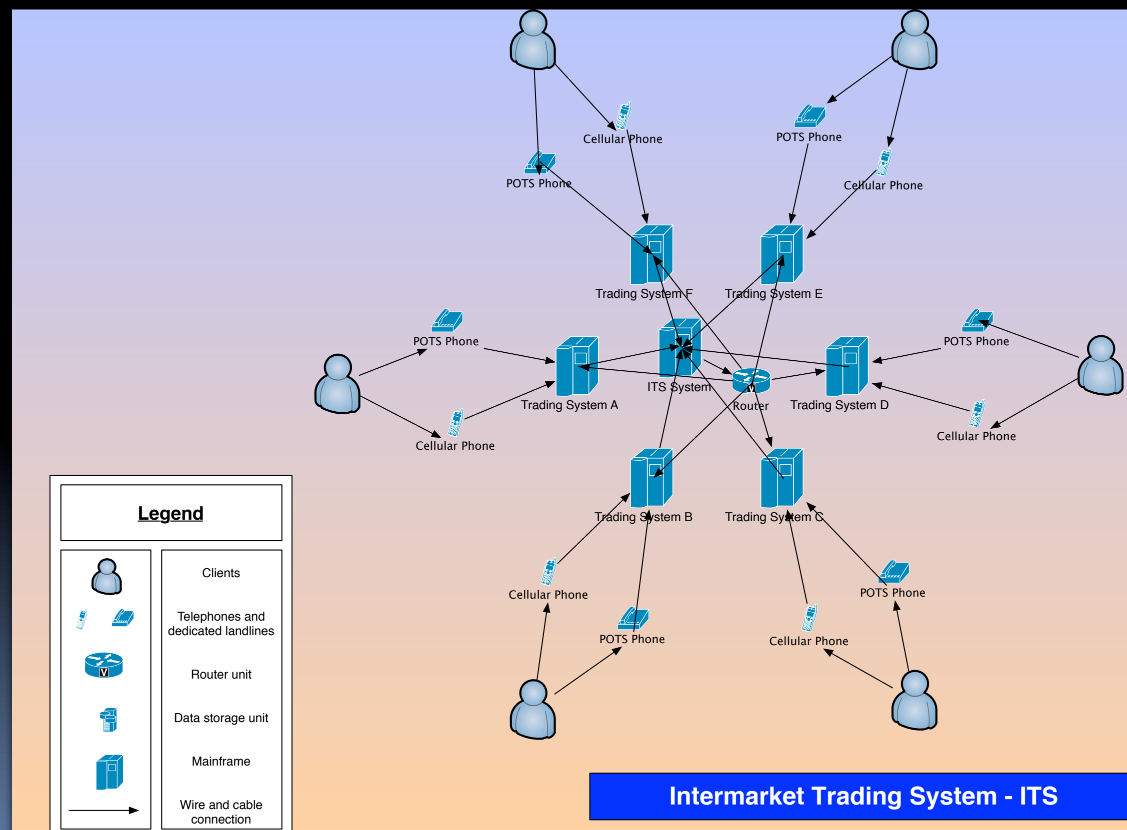
A. Regulatory structure and history

- Inducement: Building linkages between fragmented markets
  - Consolidating quotes and trades information (CTA, CQ and data plans)
  - Routing and ordering (ITS)
  - Private governance
- Direct intervention: Tweaking the market structure structure
  - Fixed commissions rules (ok)
  - Trade-through rules (partial ok)
  - Central Limit Order Book (no)

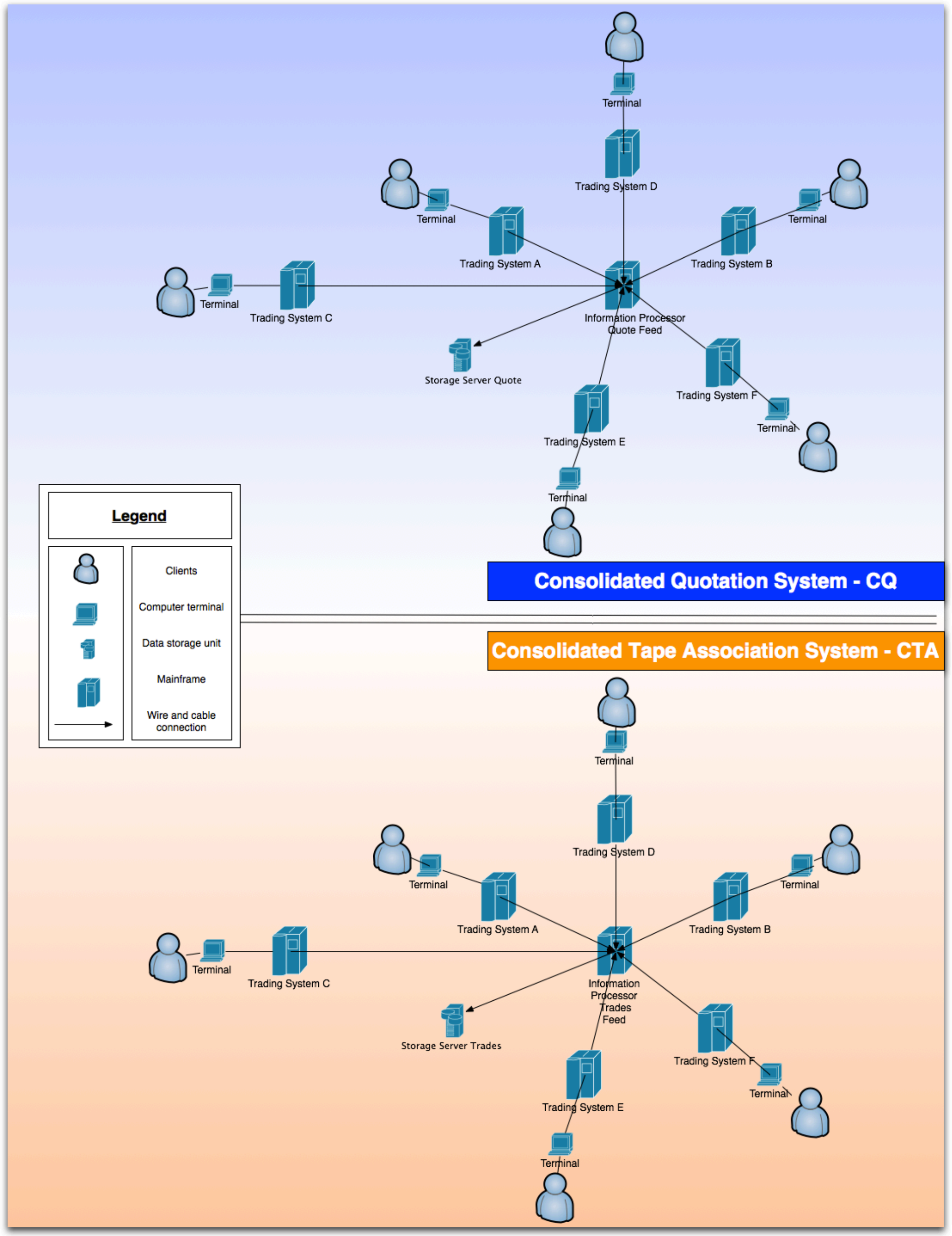
B. Regulation and market structure



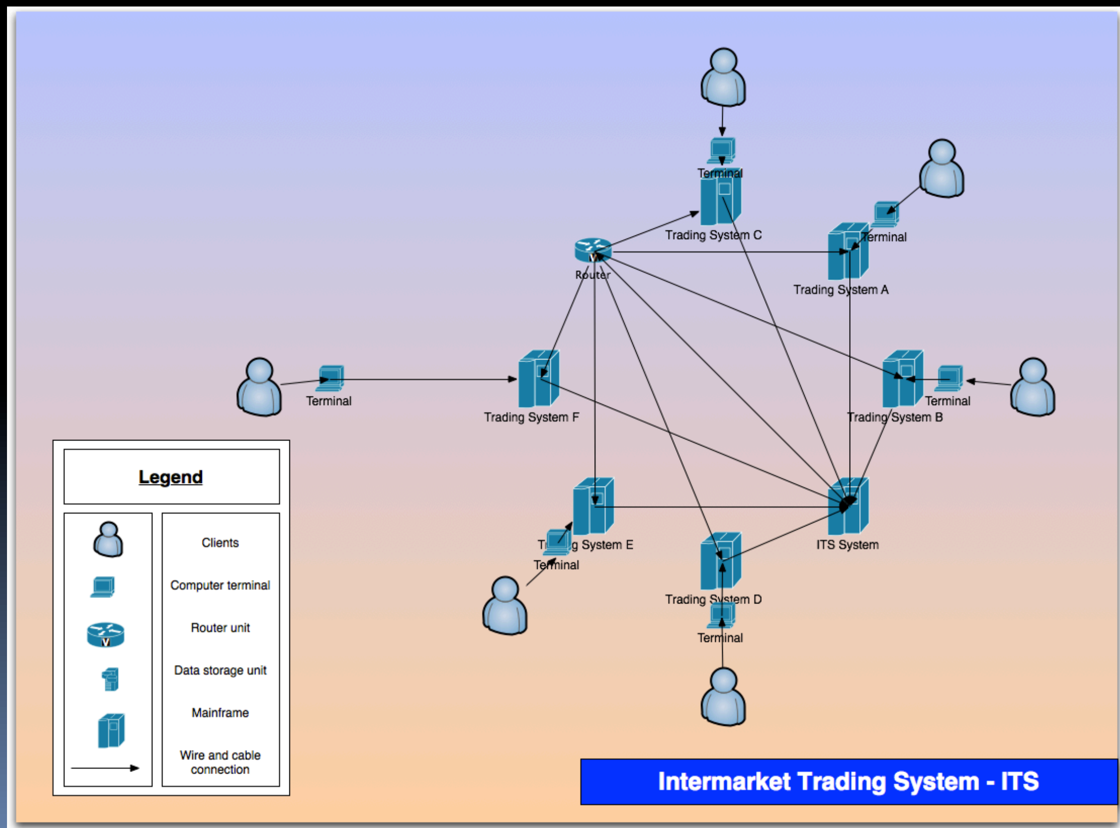
B. Regulation and market structure



B. Regulation and market structure



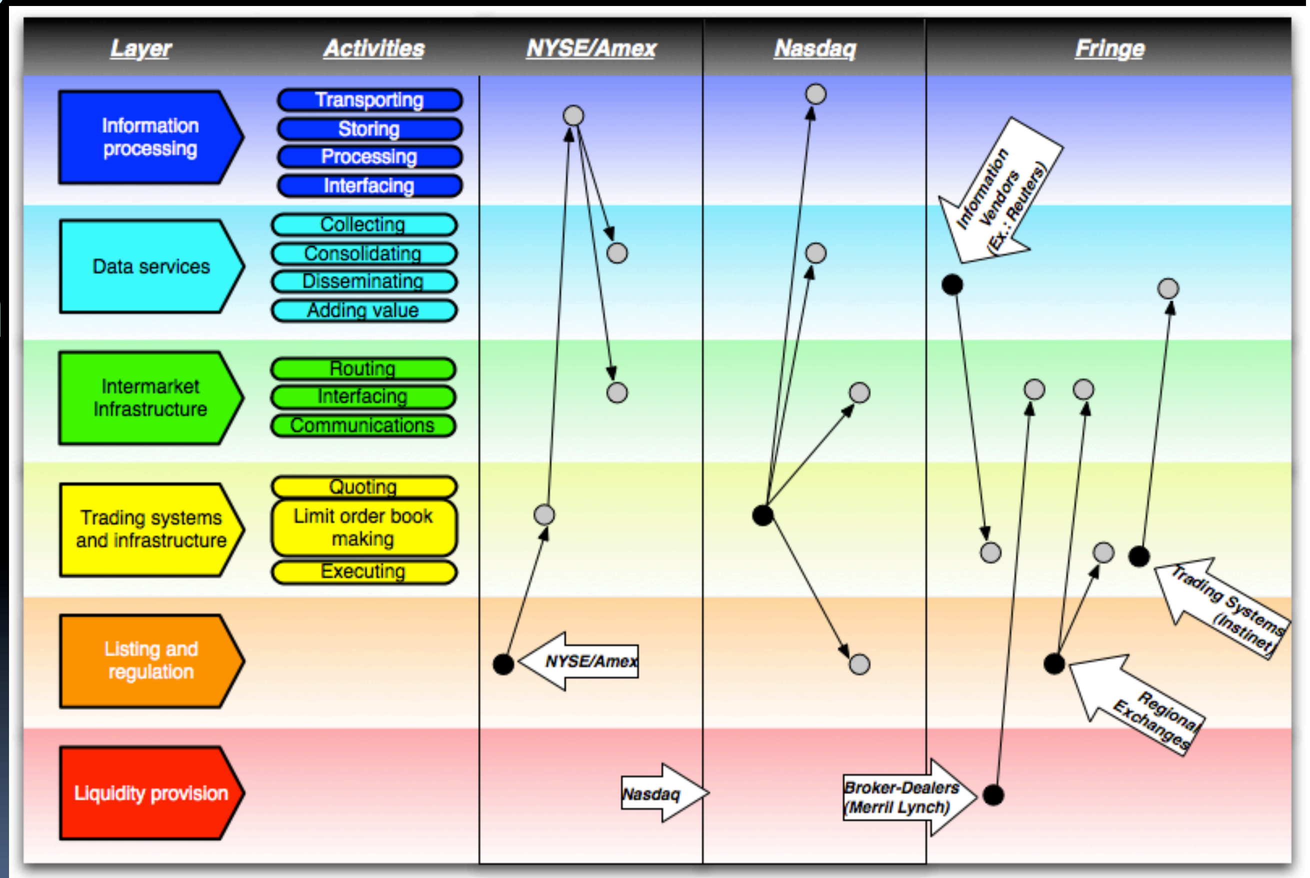
B. Regulation and market structure



Layer	Activities	Structure	Participants
Information processing	Transporting, Storing, Processing, Interfacing	Privately Regulated Monopoly (Duopoly)	Nasdaq, SIAC
Data services	Collecting, Consolidating, Disseminating, Adding value	Publicly Supervised (Regulated) Cartels	CTS, CQS, Nasdaq UTP
Intermarket Infrastructure	Routing, Interfacing, Communications	Publicly Supervised Monopoly with Fringe Competition	ITS, Nasdaq (CAES), ATS and ECNs
Trading systems and infrastructure	Quoting, Limit order book making, Executing	Monopoly (Duopoly) with Fringe Competition	National Exchanges, Nasdaq, Regional Exchanges, ATS and ECN
Listing and regulation		Monopoly (Duopoly) with Fringe Competition	Nasdaq, National Exchanges, Regional Exchanges
Liquidity provision		Competition	Institutional Clients, Dealers, Specialists, Households, Market Makers

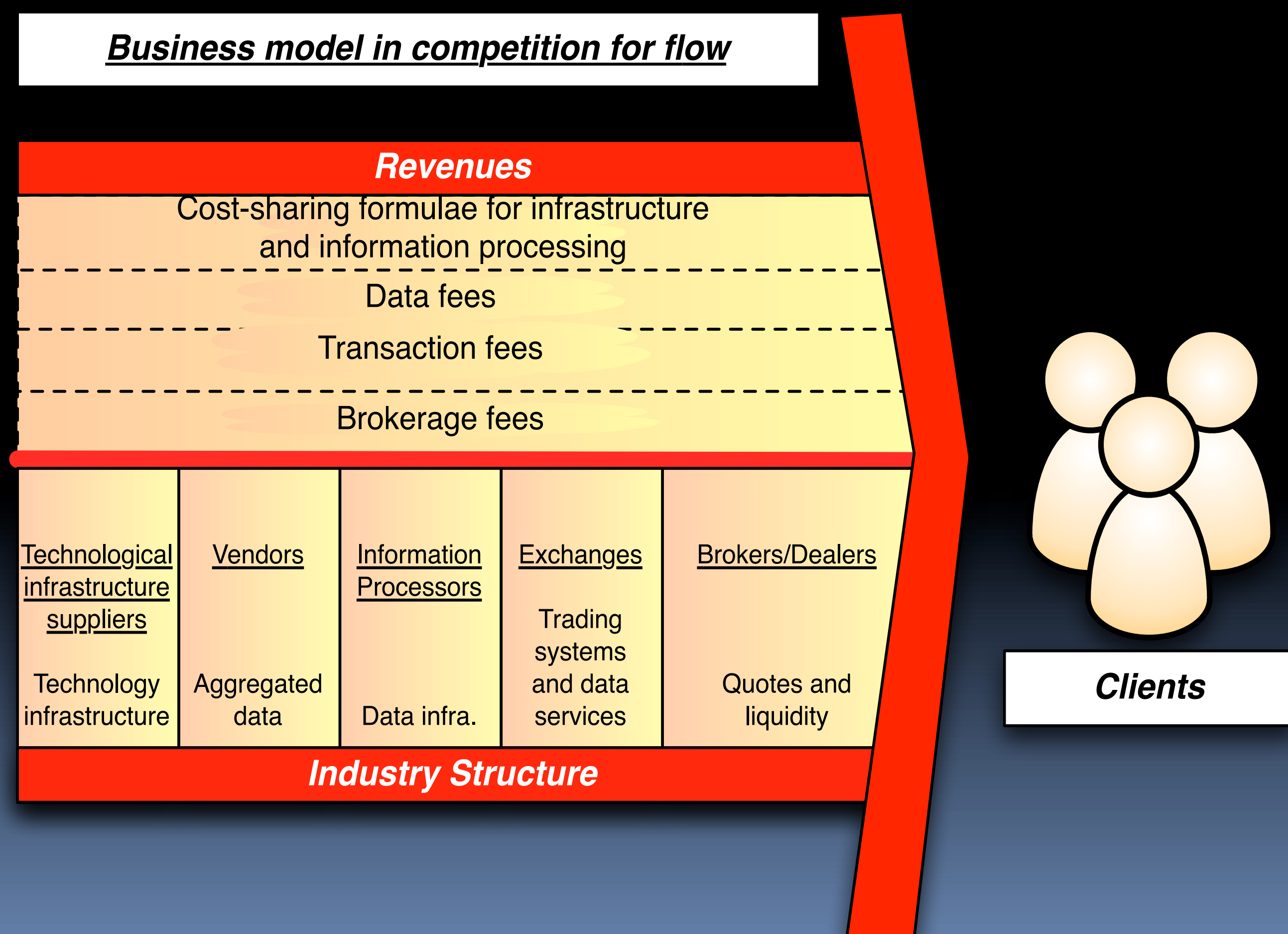
C. Business model and shortcomings

Vertical integration



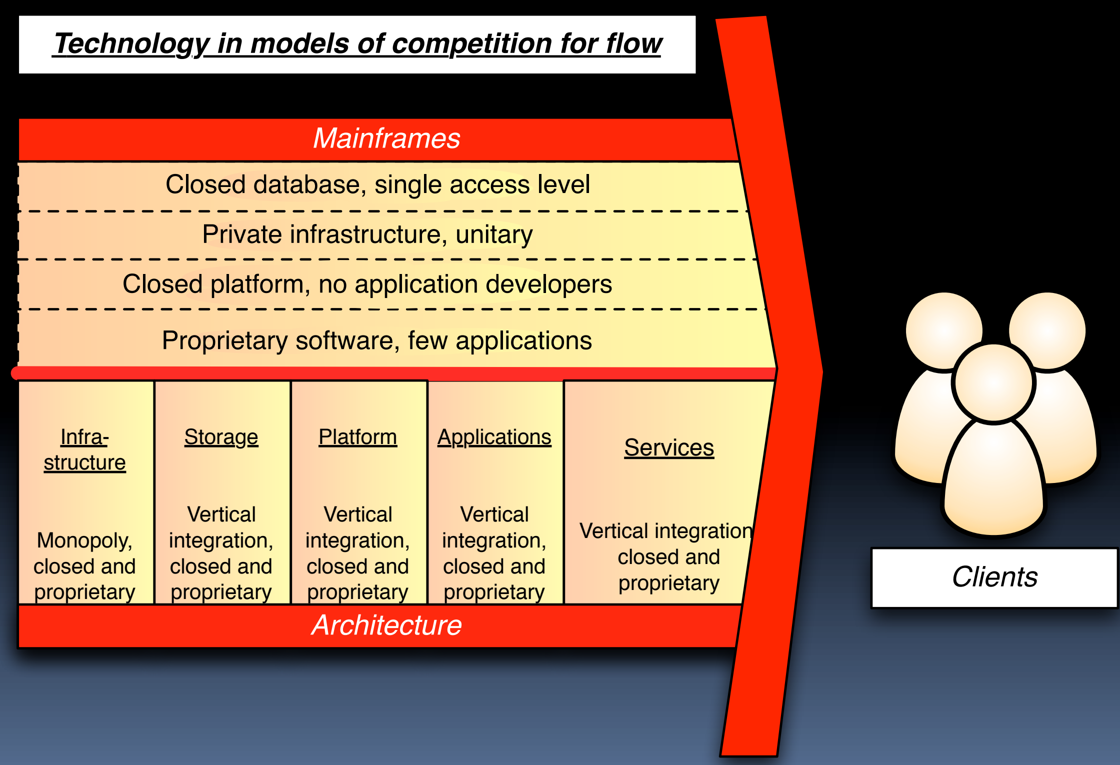
C. Business model and shortcomings

Platforms



C. Business model and shortcomings

Proprietary Technology



III. Competition for the monopoly of discrimination

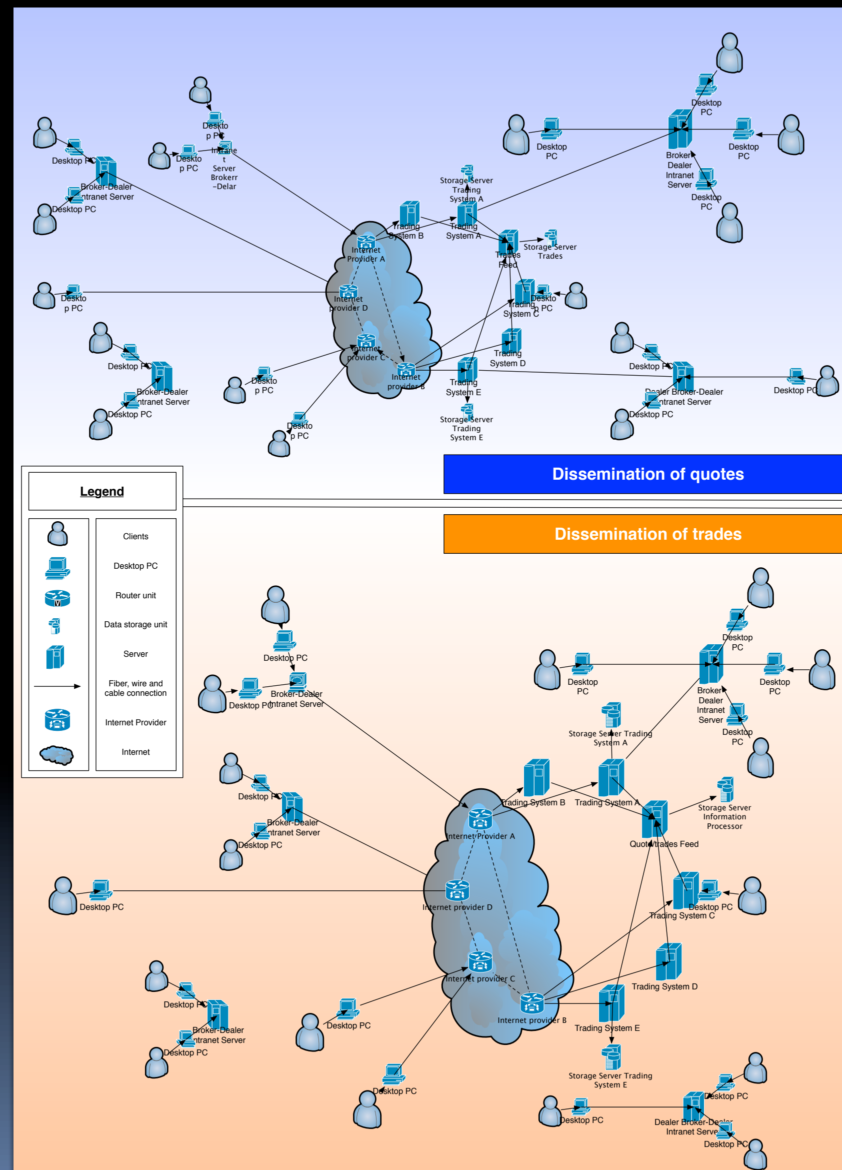
A. Regulatory structure and history

- Heavier hand and hard law: Introducing competition in the fringes of the market
  - Order handling and access reforms: *Order Handling rules* and *market access rules (regNMS)*
  - Transaction reforms: *Decimalization* and *Sub-penny (regNMS)*
  - Data reforms: *Blueprint* and *data rule* (regNMS)
  - Modified routing and order protection: *Best execution* and *order protection (regNMS)*
  - Modified private governance: reg*ATS, plans, revenue sharing* and NMS

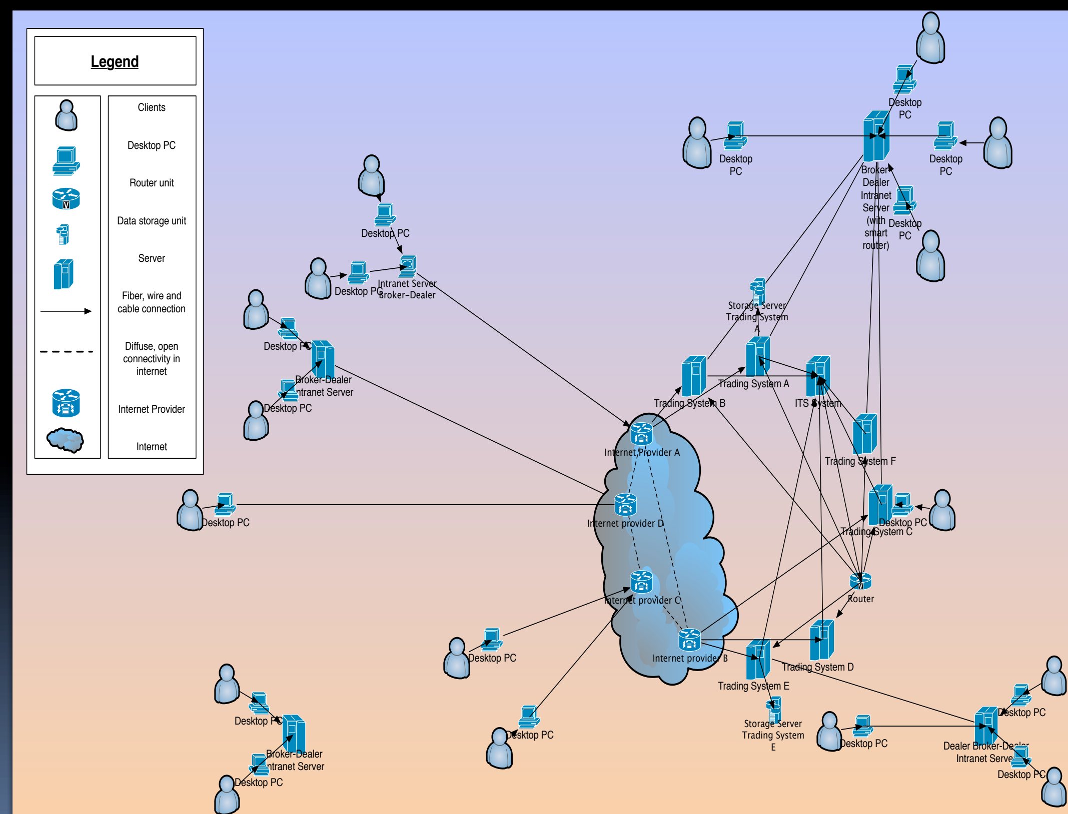
Objectives of the regulation

- Lower barriers to entry and exit of competitors
- Change incentives
  - Less collusion, disclosure of information
  - Governance changes, discourage rent extracting by incumbent
  - More innovation, bigger rewards and less risk for investments in advancements
- Less vertical integration

B. Regulation and market structure



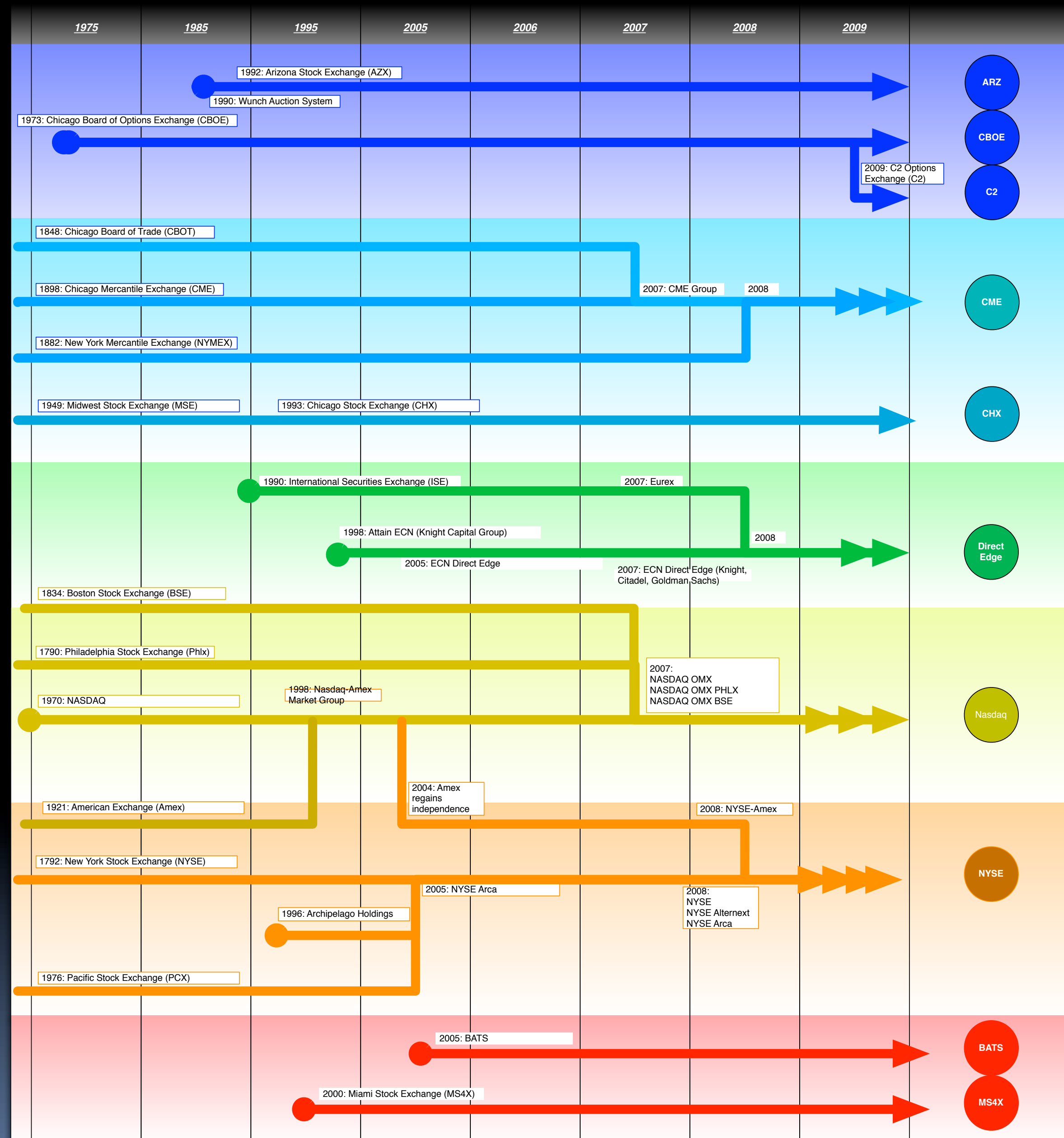
B. Regulation and market structure



Routing orders: the Intermarket Trading System (ITS), internalization, smart routers and other automated execution facilities

C. Business model and shortcomings

Mergers and demutualization



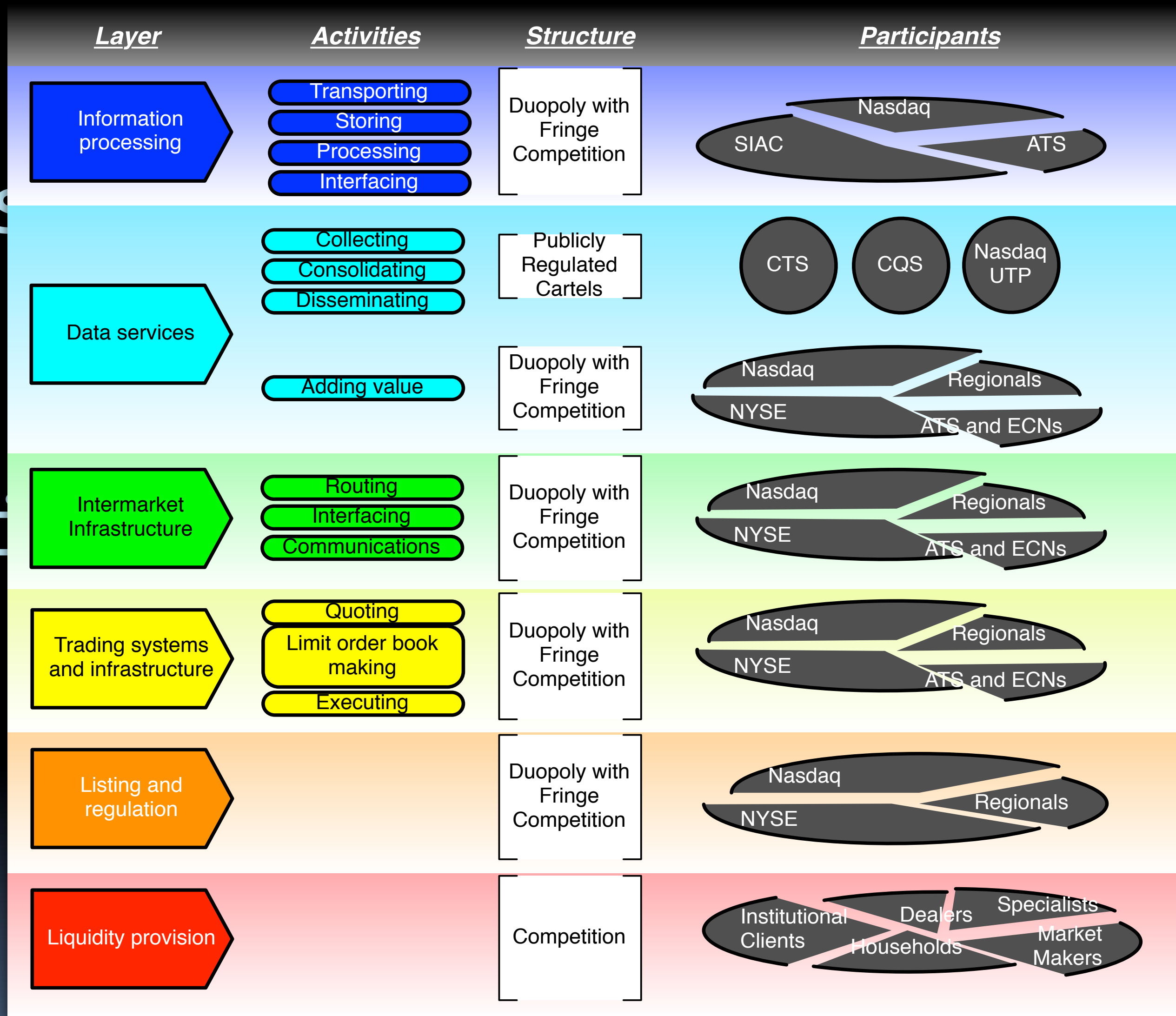
C. Business model and shortcomings

Mergers and demutualization

Exchange		Demutualization	IPO and Listing
New York Stock Exchange	*NYSE*	2006	2006
Nasdaq	*Nasdaq*	2001	2002
American Stock Exchange	*AMEX*	2006	2007
Chicago Mercantile Exchange	*CME*	2002	2002
Chicago Board of Trade	*CBOT*	2005	2005
Chicago Board Options Exchange	*CBOE*	2006	2006
International Securities Exchange	*ISE*	2002	2005

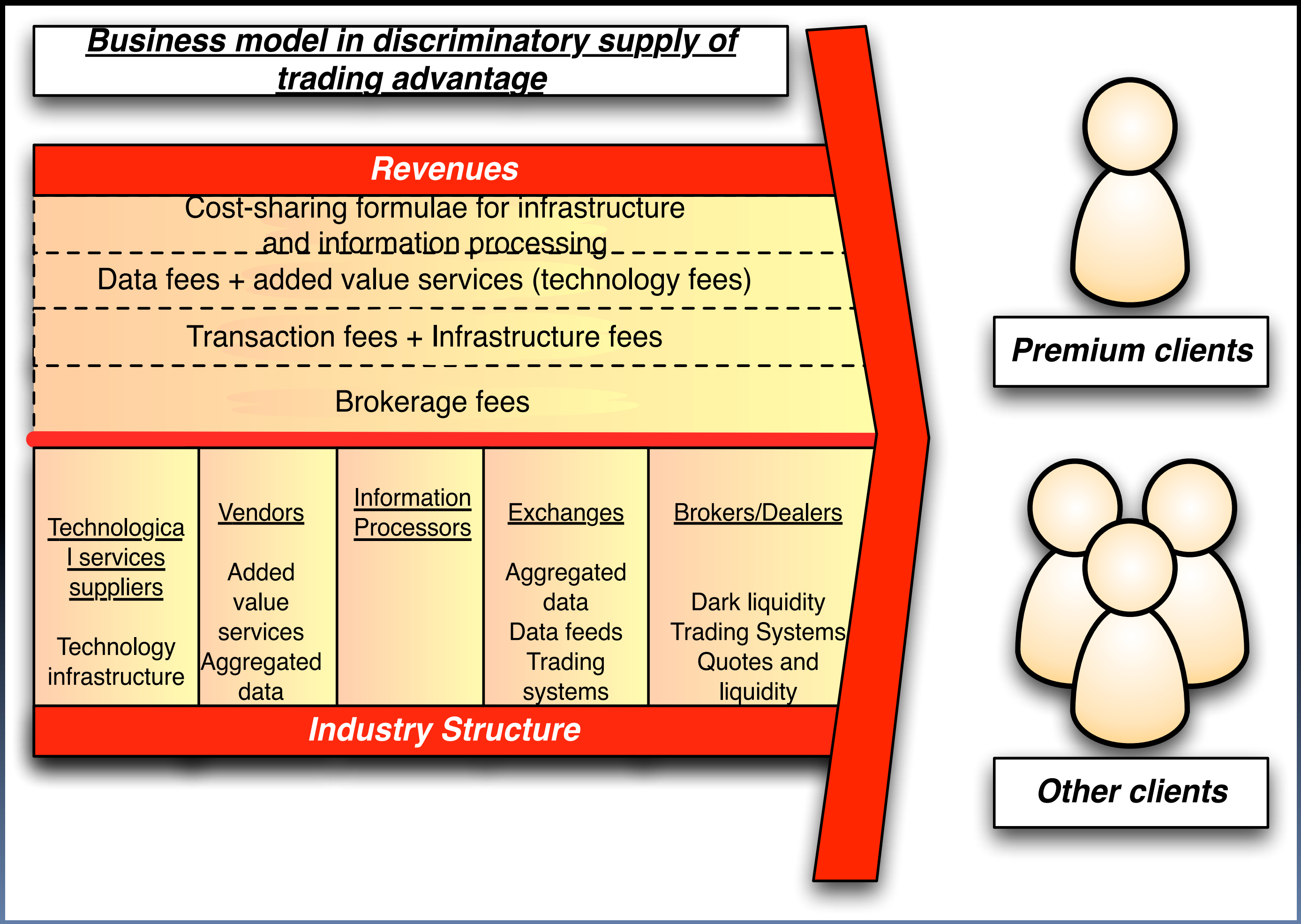
C. Business model and shortcomings

Vertical desintegration



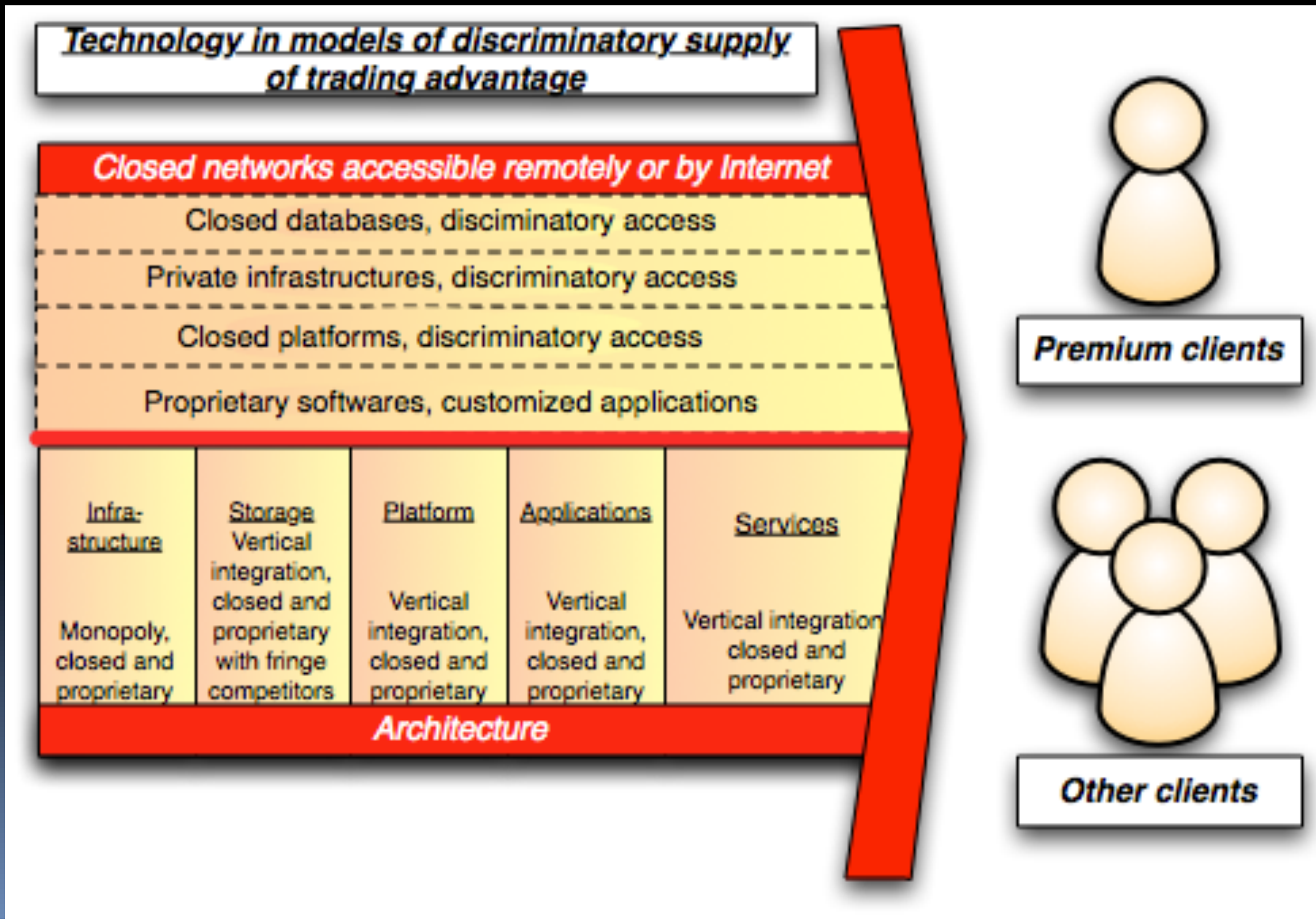
C. Business model and shortcomings

Discrimination



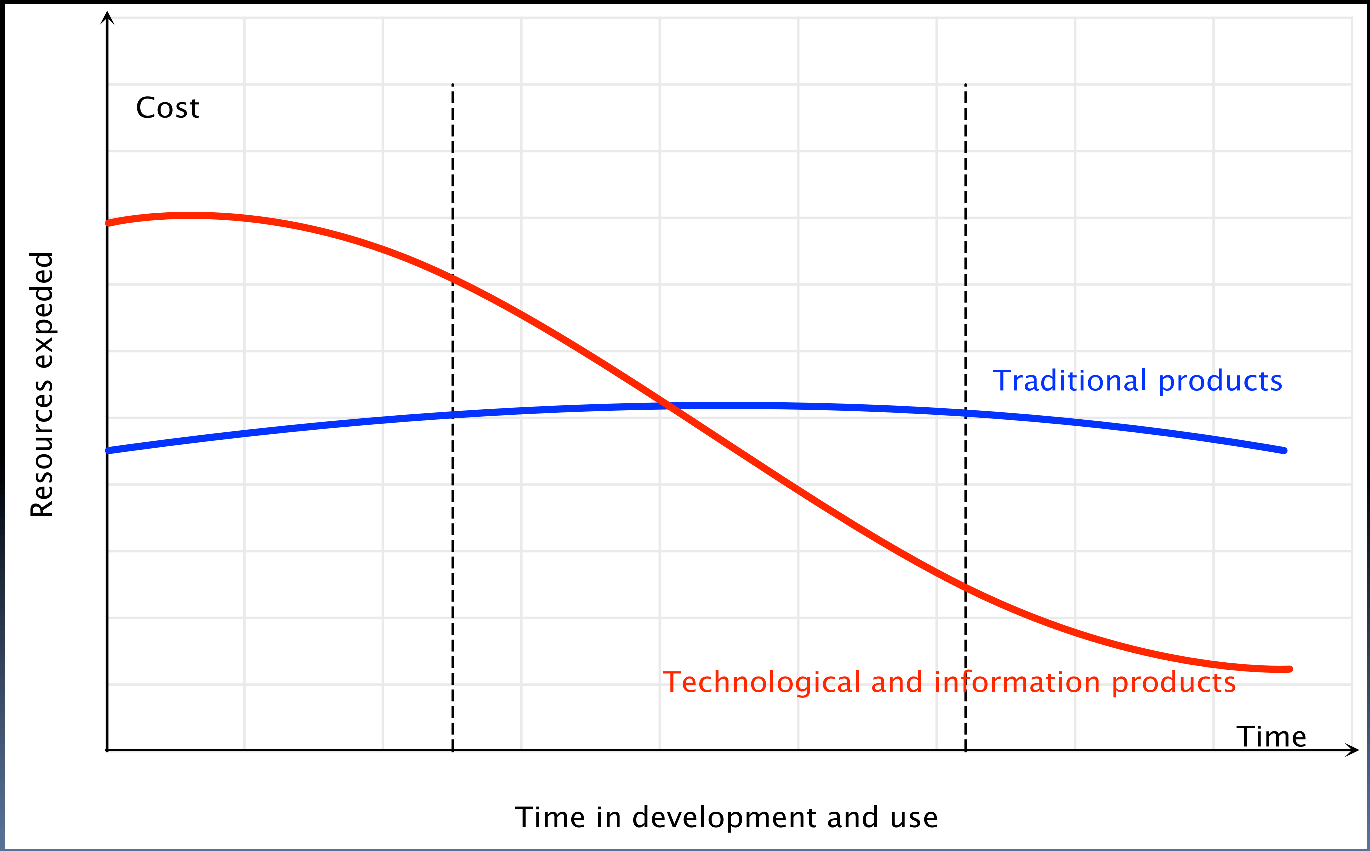
C. Business model and shortcomings

Proprietary Technologies



C. Business model and shortcomings

Favoring high frequency traders



C. Business model and shortcomings

Favoring high frequency traders

Preferences and Necessities

			Low-tech / High-tech					Databases				
			Capital turnover *Low-frequency / High-frequency*	***Strategy input*** *Semi-automated / Automated*	***Order input*** *Standard / Algorithmic*	***Co-location*** *With co-location / without co-location*	***Execution speed*** *High-latency / Low-latency*	***Core data***	***Historical data***	***Economic / governance data***	***Depth of the book data***	***Textual data***
Trading strategies		*Fundamental*	+	+	+	+	+	+	+	+++	+	+
		Technical	+	+	+	+	+	+	++	+	++	+
		Quantitative	+++	+++	+++	+++	+++	+	+++	+	+++	+++
Investors	**Time horizon**	*Long-term*	-	+	+	-	-	+	+	++	-	+
		Short-term (speculative)	++	++	++	++	++	+	+	+	++	++
	Use of rights	*Passive*	+	-	+	-	+	+	-	-	-	-
		Active	+	-	-	-	-	+	-	+	-	++
	Investor occupation	*Professional*	++	++	++	-	++	+	-	-	+	+
		Household	+	+	+	-	+	+	-	-	+	+
	Ownership of the capital	*Proprietary*	-	-	-	-	-	+	-	-	-	-
		Third-party	-	-	-	-	-	+	-	-	-	-
	Nature of the person	*Institutional*	+	+	++	-	++	+	-	-	-	-
		Personal	+	+	+	-	+	+	-	-	-	-

C. Business model and shortcomings

Favoring high frequency traders

			Contests									
			Low-tech / High-tech					Databases				
			Capital turnover *Lower-frequency v. Higher-frequency*	*Order input* *Less-automated v. More automated*	*Strategy input* *More standard v. More algo. Capable*	*Co-location* *Further v. closer location*	*Execution speed* *Higher-latency v. Lower-latency*	*Core data*	*Historical data*	*Economic / governance data*	*Depth of the book data*	*Textual data*
Trading strategies		*Fundamental*	+	+	+	+	+	+	+	+++	+	+
		Technical	+	+	+	+	+	+	++	+	++	+
		Quantitative	+++	+++	+++	+++	+++	+	+++	+	+++	+++
Investors	**Time horizon**	*Long-term*	-	-	-	-	-	+	+	++	-	+
		Short-term (speculative)	+	+	+	+	+	+	+	+	++	++
	Use of rights	*Passive*	-	-	-	-	-	+	-	-	-	-
		Active	-	-	-	-	-	+	-	+	-	+
	Investor occupation	*Professional*	-	-	-	-	-	+	-	-	-	-
		Household	-	-	-	-	-	+	-	-	-	-
	Ownership of the capital	*Proprietary*	-	-	-	-	-	+	-	-	-	-
		Third-party	-	-	-	-	-	+	-	-	-	-
	Nature of the person	*Institutional*	-	-	-	-	-	+	-	-	-	-
		Personal	-	-	-	-	-	+	-	-	-	-

IV. OpenTradeCloud model

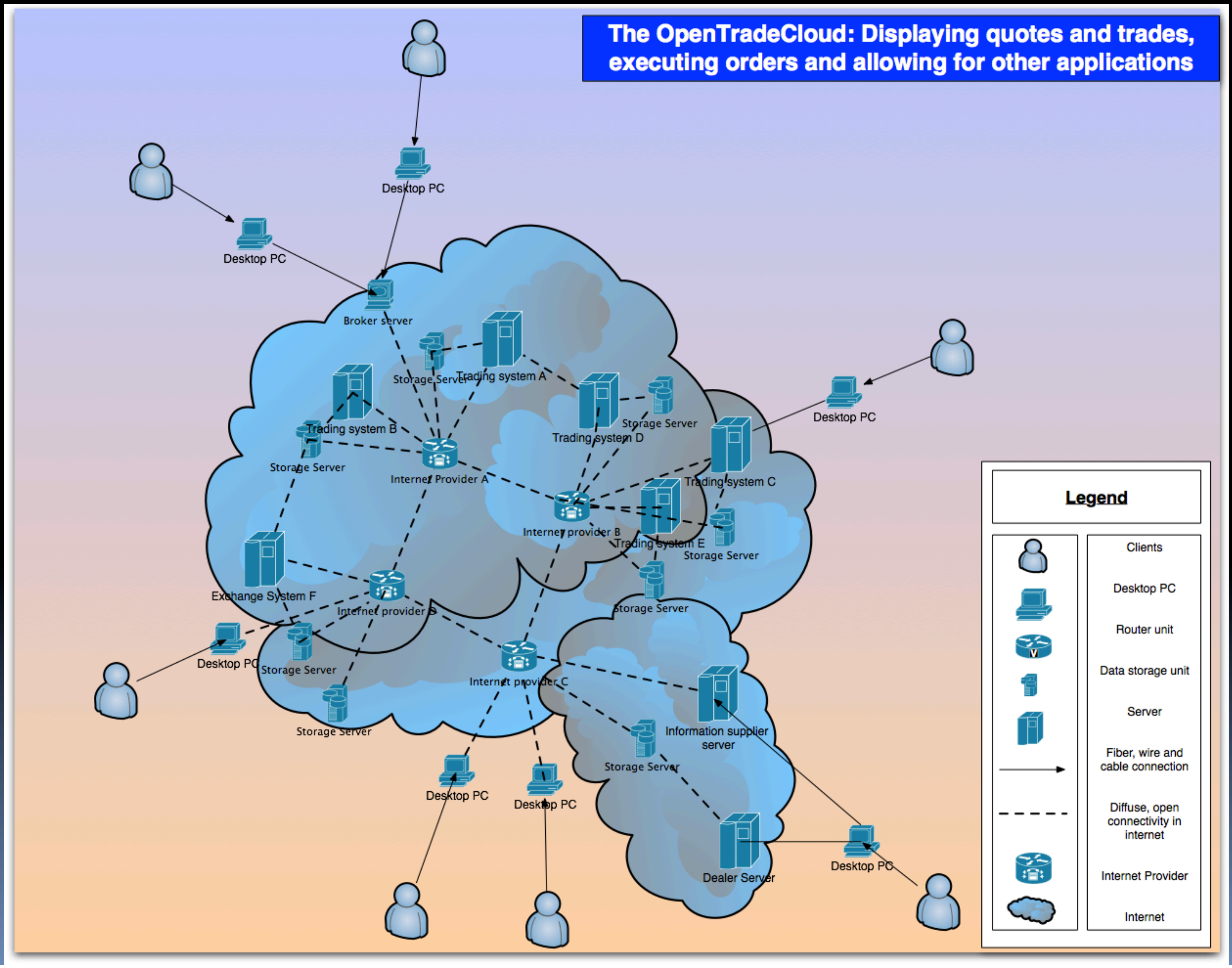
A. Proposed regulatory structure

- Interoperability: Enabling the cloud
  - Interoperation Interconnection obligations and standards
  - Cloud use rule
  - Cross execution: No more routing
- Data: Open standards and full disclosure
  - Publish and share rule
  - Disclosure standards
  - SmartBook and SmartQuote

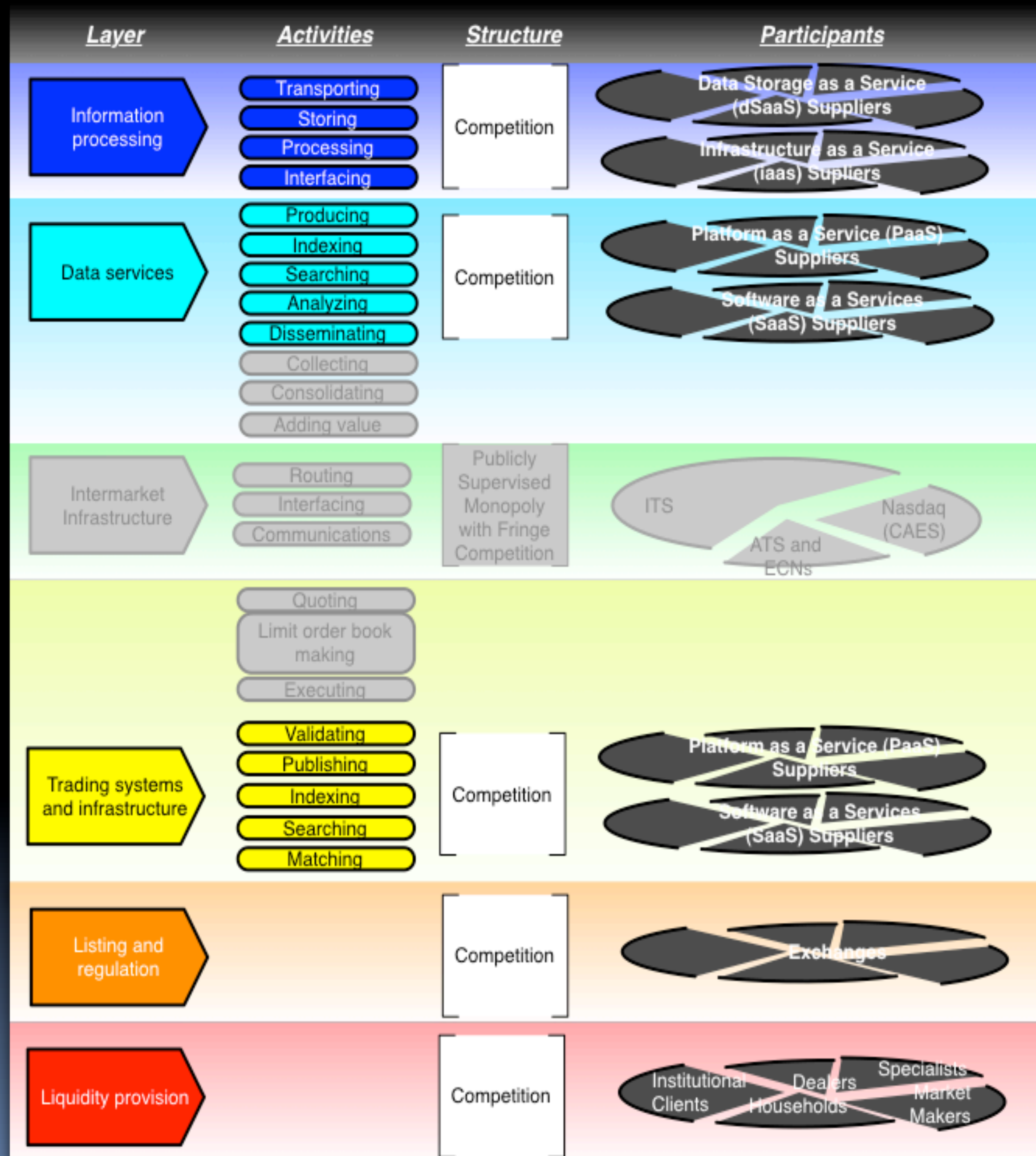
A. Proposed regulatory structure

- Transactions: No discrimination of content
  - Technological neutrality and equal access to protocols
- Access rules: No discrimination of infrastructure
  - Open standards for platform and applications building
  - Access standards for cloud database
- Private governance:
  - Standards discussed by groups (no plans)
  - No revenue sharing agreements, no technological favoritism

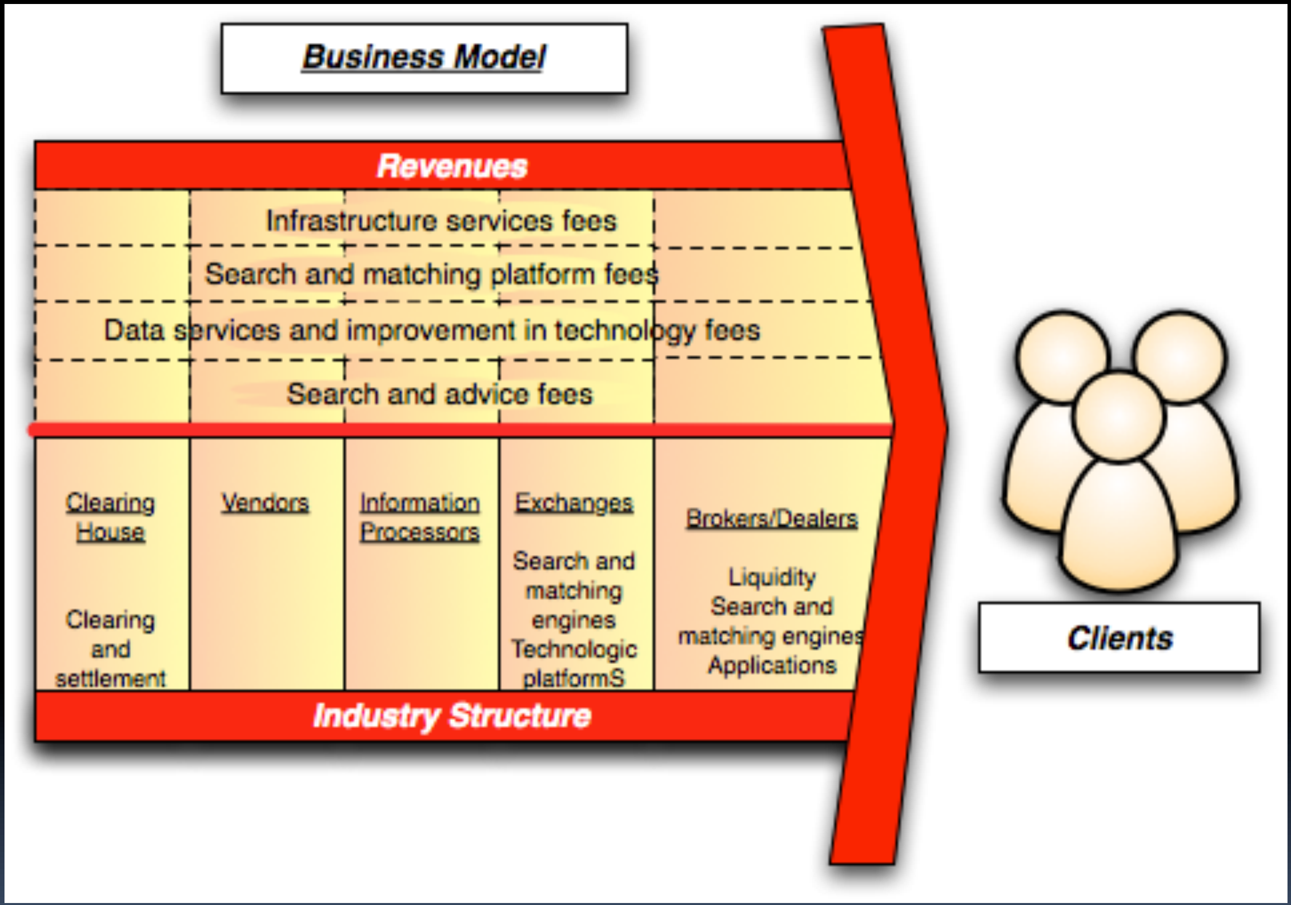
B. Proposed market structure



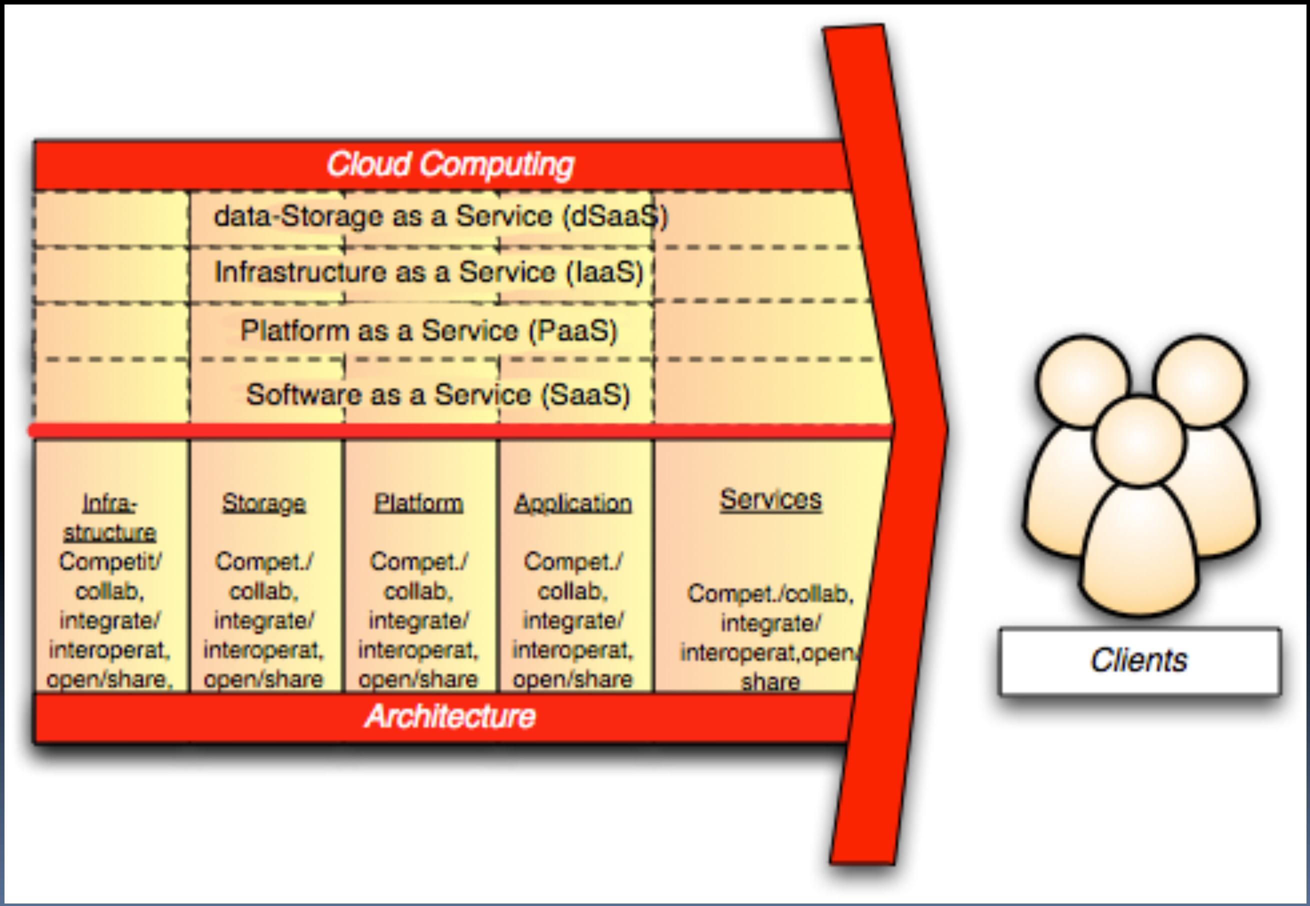
C. Business model



C. Possible business models



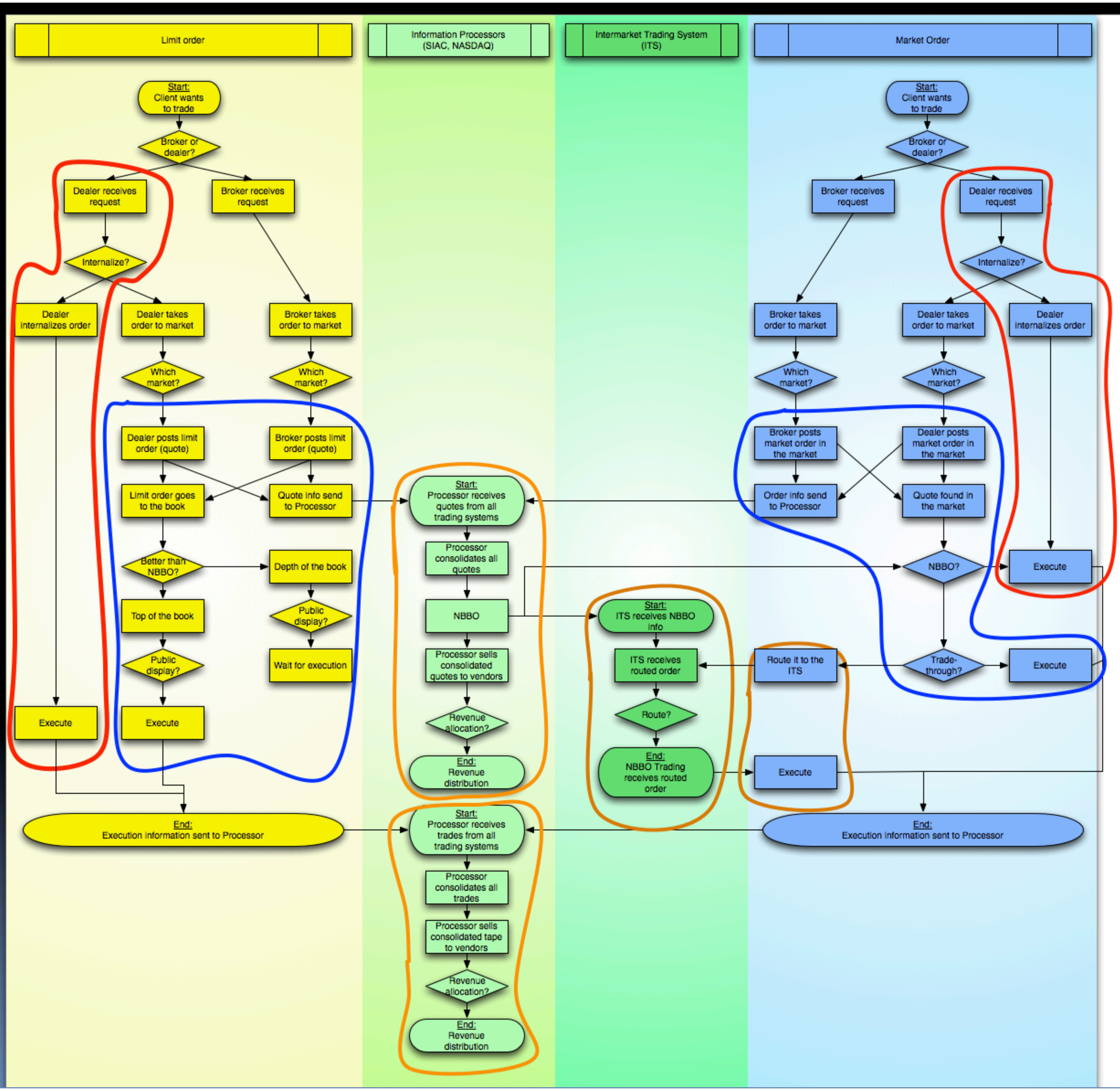
C. Possible business models



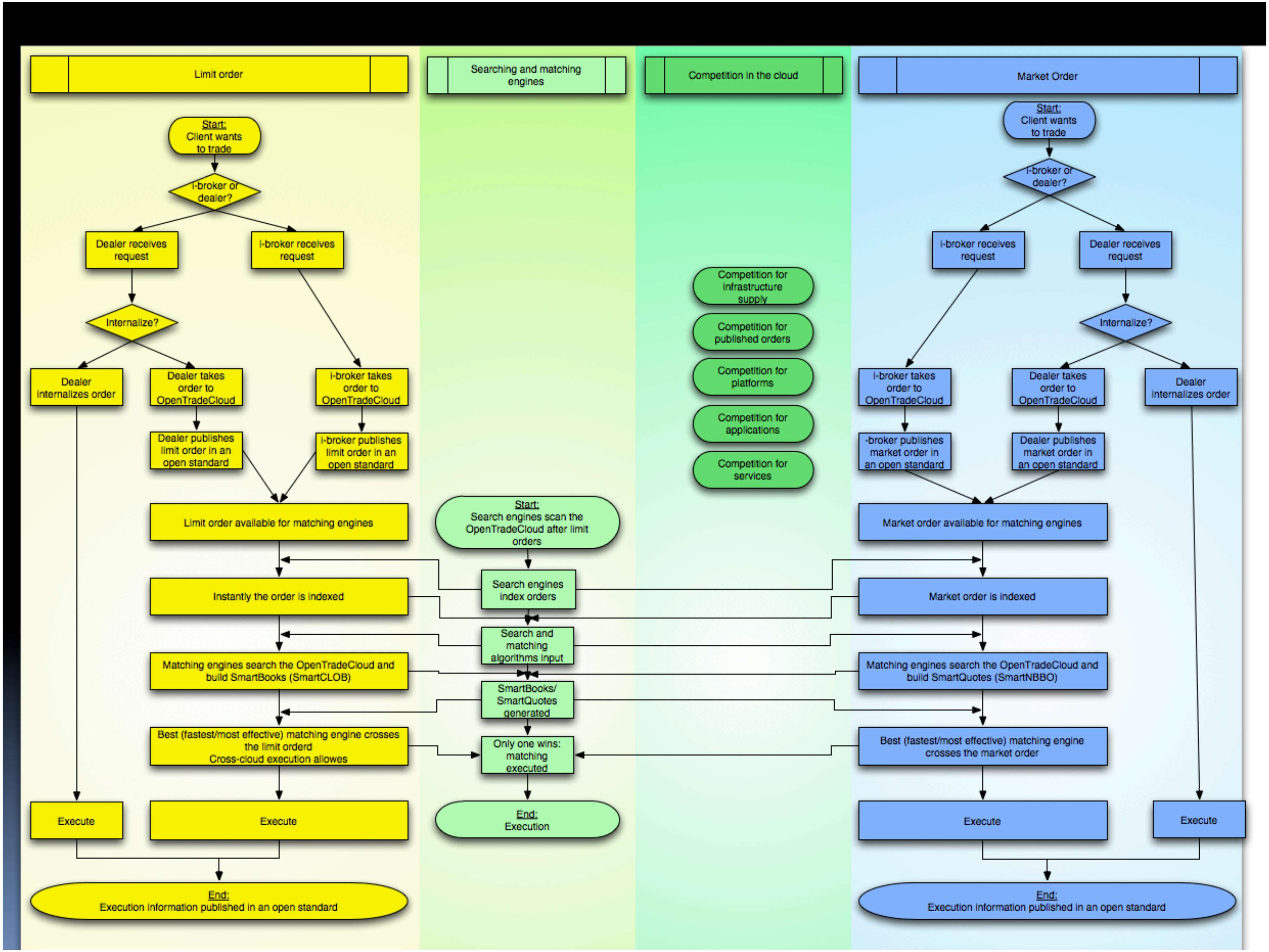
V. Comparisons

	NMS	**RegNMS**	**OpenTradeCloud**
Market Structure	Private networks + Linkages	Private networks + Linkages + Rules	Open Cloud + dSaaS IaaS PaaS SaaS
Consolidation/Competition	Consolidation with central consolidation + No competition data dissemination	Consolidation with central consolidator + Competition for order flow + Competition data dissemination	Consolidation with no consolidator + Competition/collaboration in data storage, infrastructure, platforms, applications and software
Quotes and execution	Intranetwork + Routing ITS	Intranetwork + Routing ITS + Internalization	OpenTradeCloud + SmartBook and SmartQuote + OpenTradeCloud
Data dissemination	Proprietary database	Proprietary databases	OpenTradeCloud
Technological infrastructure	Mainframes and private networks + proprietary technology private network	Mainframes and private networks + proprietary technology private network internet	Open cloud computing + Open databases Open infrastructure Open platforms Open/proprietary applications Open/proprietary services
Infrastructure operator	SIAC + NASDAQ	SIAC + NASDAQ	Many
Venues	National Exchanges (NYSE, Amex) Regional Exchanges ([complete]) Dealers Association (NASDAQ)	National Exchanges (NYSE, NASDAQ, BATS) ATS/ECNs	OpenTradeCloud

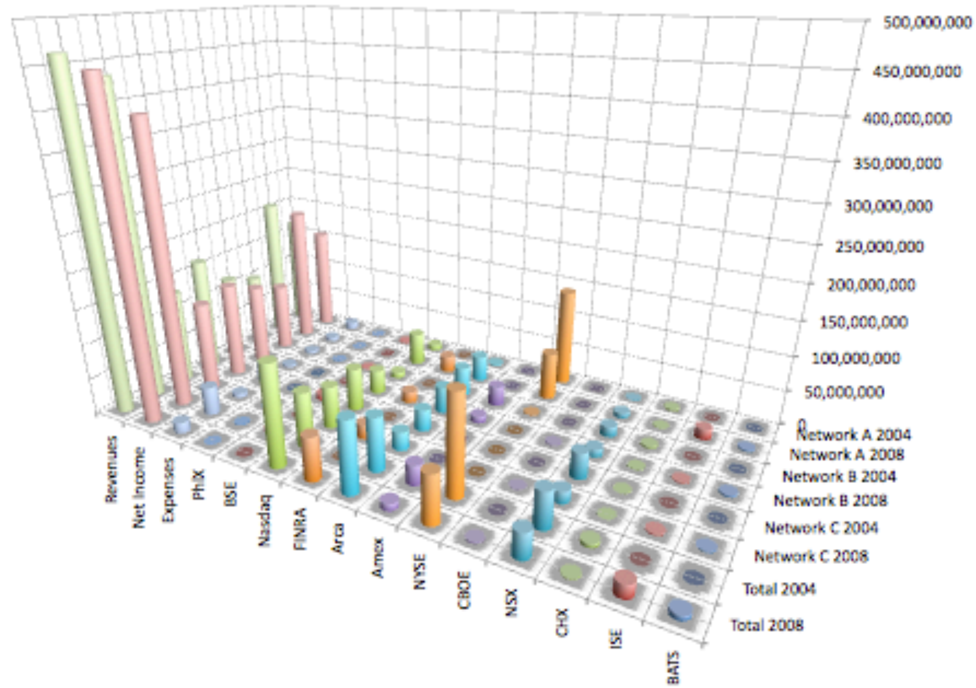
	NMS	RegNMS	OpenTradeCloud
Regulatory paradigm	Public cartel with regulated revenue sharing formula	Fringe competition	Open standards
		Interconnection	Interoperability
	Centralization	Unbundling	Neutrality
		Fees ceilings/formulas	Open access
Governance mechanism	Mutuals	Private exchanges	Technical standards setters
	+	+	+
	Industry organizations	Industry organizations	SEC intervention
	=	+	=
	Contracts	SEC intervention	Open standards
	(Plans)	=	Open protocols
		Rules (Trade-through, data, others)	Technological neutrality
		+	
		Contracts (Plans)	
Business model	Not a business	Competition for the monopoly of discriminating	Data analysis
	Mutuals/not for profit	Proprietary databases	IT providers
Sources of revenue	Members earn for being more informed	Revenue sharing	dSaaS
	Revenue sharing for data and infrastructure	Free availability of NBBO	IaaS
		Charging added value services	PaaS
		Competition for flows	SaaS
		Proprietary databases	Specialties: Data analysis, search engines, mathing engines
		Investment in infrastructure and discrimination	
Speed	Manual	Manual	Automatic
	+	+	+
	Automatic	Automatic	High frequency
		+	
		High frequency	
Users	Brokers	Brokers	Clients
	Dealers	Dealers	Institutional Investors
	Market Makers	Market Makers	Dealers
		Institutional Investors	Market-makers



Limit order
Information Processors (SIAC, NASDAQ)
Intermarket Trading System (ITS)
Market Order
Start: Client wants to trade
Broker or dealer?
Dealer receives request
Broker receives request
Internalize?
Dealer internalizes order
Dealer takes order to market
Broker takes order to market
Which market?
Dealer posts limit order (quote)
Broker posts limit order (quote)
Limit order goes to the book
Quote info send to Processor
Better than NBBO?
Depth of the book
Top of the book
Public display?
Wait for execution
Execute
End: Execution information sent to Processor
Start: Processor receives quotes from all trading systems
Processor consolidates all quotes
NBBO
Processor sells consolidated quotes to vendors
Revenue allocation?
End: Revenue distribution
Start: Processor receives trades from all trading systems
Processor consolidates all trades
Processor sells consolidated tape to vendors
Start: ITS receives NBBO info
ITS receives routed order
Route?
End: NBBO Trading receives routed order
Route it to the ITS
Broker posts market order in the market
Dealer posts market order in the market
Order info send to Processor
Quote found in the market
NBBO?
Trade-through?

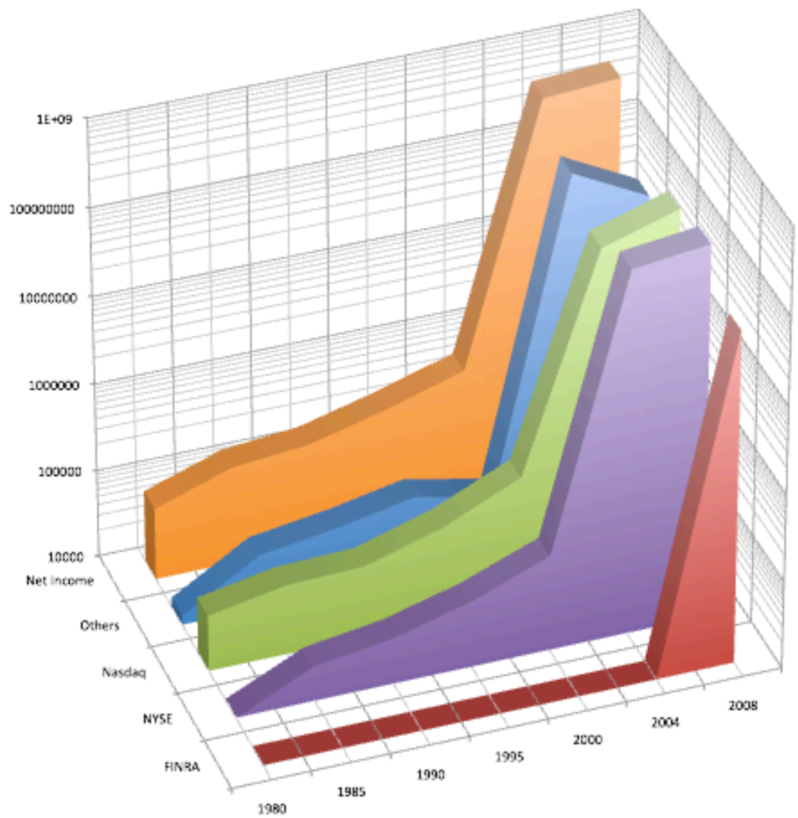

Limit order
Searching and matching engines
Competition in the cloud
Market Order
Start: Client wants to trade
i-broker or dealer?
Dealer receives request
i-broker receives request
Internalize?
Dealer internalizes order
Dealer takes order to OpenTradeCloud
i-broker takes order to OpenTradeCloud
Dealer publishes limit order in an open standard
i-broker publishes limit order in an open standard
Limit order available for matching engines
Instantly the order is indexed
Matching engines search the OpenTradeCloud and build SmartBooks (SmartCLOB)
Best (fastest/most effective) matching engine crosses the limit orderd Cross-cloud execution allowes
Execute
Execute
End: Execution information published in an open standard
Start: Search engines scan the OpenTradeCloud after limit orders
Search engines index orders
Search and matching algorithms input
SmartBooks/ SmartQuotes generated
Only one wins: matching executed
End: Execution
Competition for infrastructure supply
Competition for published orders
Competition for platforms
Competition for applications
Competition for services
Start: Client wants to trade
i-broker or dealer?
i-broker receives request
Dealer receives request
Internalize?
i-broker takes order to OpenTradeCloud
Dealer takes order to OpenTradeCloud
Dealer internalizes order
-broker publishes market order in an open standard
Dealer publishes market order in an open standard
Market order available for matching engines
Market order is indexed
Matching engines search the OpenTradeCloud and build SmartQuotes (SmartNBBO)
Best (fastest/most effective) matching engine crosses the market order
Execute
Execute
End: Execution information published in an open standard

Income and Sharing



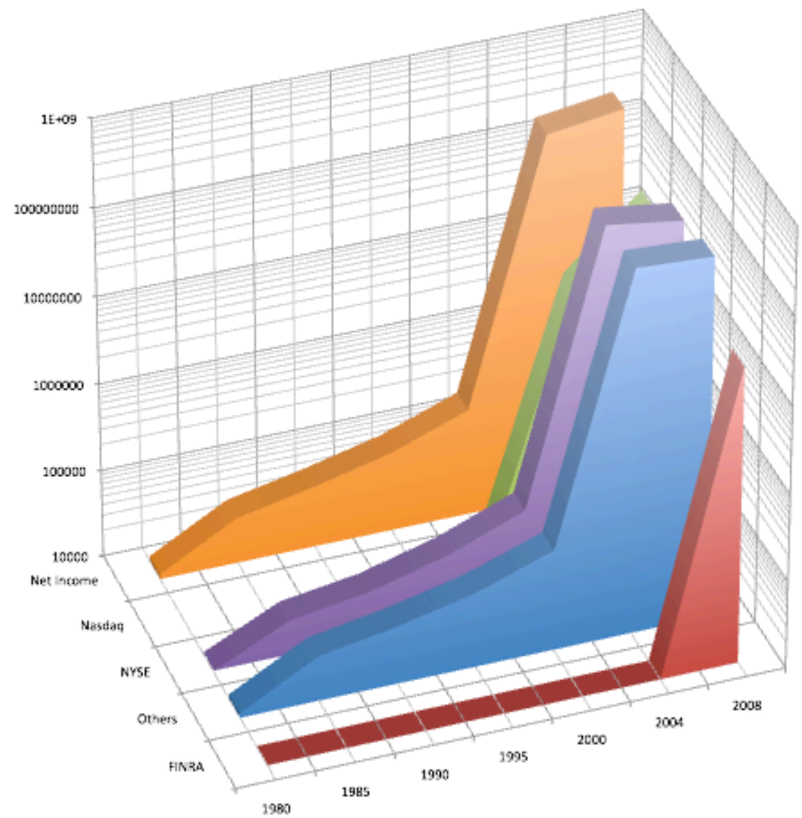
	Network A 2004	Network A 2008	Network B 2004	Network B 2008	Network C 2004	Network C 2008	Total 2004	Total 2008
Revenues	165,588,000	209,218,000	103,901,000	119,876,000	164,656,000	134,861,000	434,145,000	463,955,000
Net Income	155,271,000	203,140,000	99,980,000	116,810,000	138,460,000	129,132,000	393,711,000	449,082,000
Expenses	10,317,000	6,078,000	3,921,000	3,066,000	26,196,000	5,729,000	40,434,000	14,873,000
PhlX	189,000	134,000	446,000	30,000	0	146,000	635,000	310,000
BSE	1,345,000	3,000	850,000	0	8,757,000	4,000	10,952,000	7,000
Nasdaq	8,296,000	47,845,000	8,360,000	34,885,000	61,672,000	60,614,000	78,328,000	143,344,000
FINRA	0	24,325,000	0	16,458,000	0	20,772,000	0	61,555,000
Arca	2,091,000	37,080,000	43,276,000	38,235,000	30,804,000	26,307,000	76,171,000	101,622,000
Amex	0	1,000	28,301,000	9,760,000	30,000	14,000	28,331,000	9,775,000
NYSE	140,661,000	68,391,000	1,296,000	0	0	0	141,957,000	68,391,000
CBOE	0	80,000	7,000	1,046,000	0	433,000	7,000	1,559,000
NSX	694,000	7,100,000	14,498,000	11,575,000	36,717,000	17,123,000	51,909,000	35,798,000
CHX	1,995,000	565,000	2,946,000	574,000	480,000	298,000	5,421,000	1,437,000
ISE	0	15,260,000	0	1,477,000	0	1,883,000	0	18,620,000
BATS	0	2,356,000	0	2,770,000	0	1,538,000	0	6,664,000

Total Income:
Duopoly + Fringe



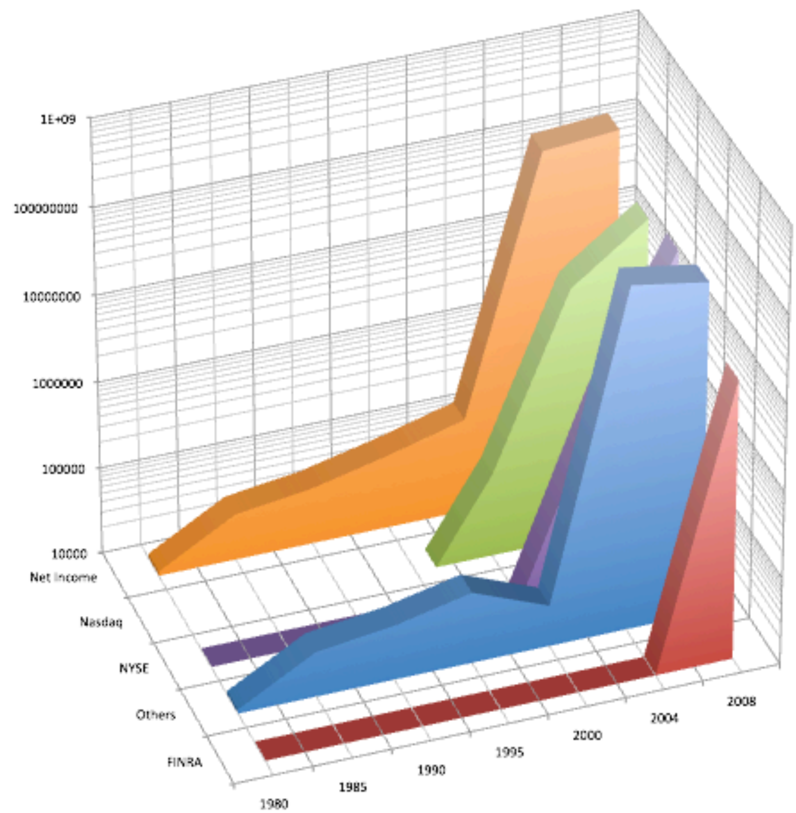
	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	61,555,000
NYSE	9884	25,123	33,678	57,277	123,027	141,957,000	179,788,000
Nasdaq	43644	63,193	67,357	121,731	296,017	78,328,000	143,661,000
Others	12,630	41,235	55,398	81,571	53,556	173,426,000	64,078,000
Net Income	66158	129,551	156,433	260,579	472,600	393,711,000	449,082,000

Network A Income:
Duopoly + Fringe



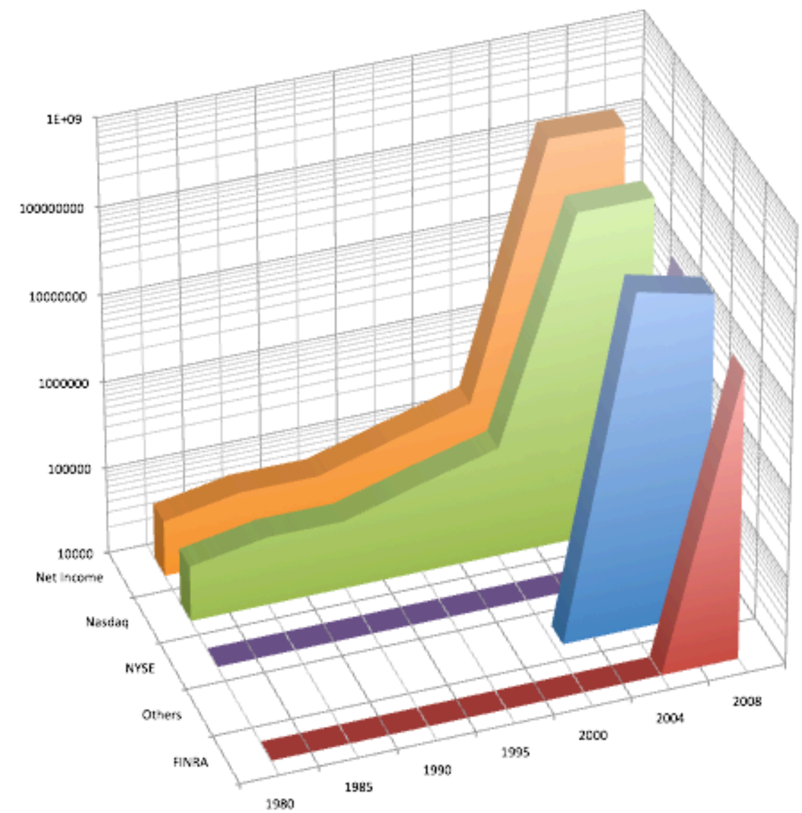
	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	24325000
Others	11,355	32,898	46,026	72,162	143,345	146,975,000	130,833,000
NYSE	9884	25123	33678	57277	123027	140661000	105,472,000
Nasdaq	79	551	4166	8434	21,383	8,296,000	47,982,000
Net Income	11434	33449	50192	80596	164728	155271000	203140000

Network B Income:
Duopoly + Fringe



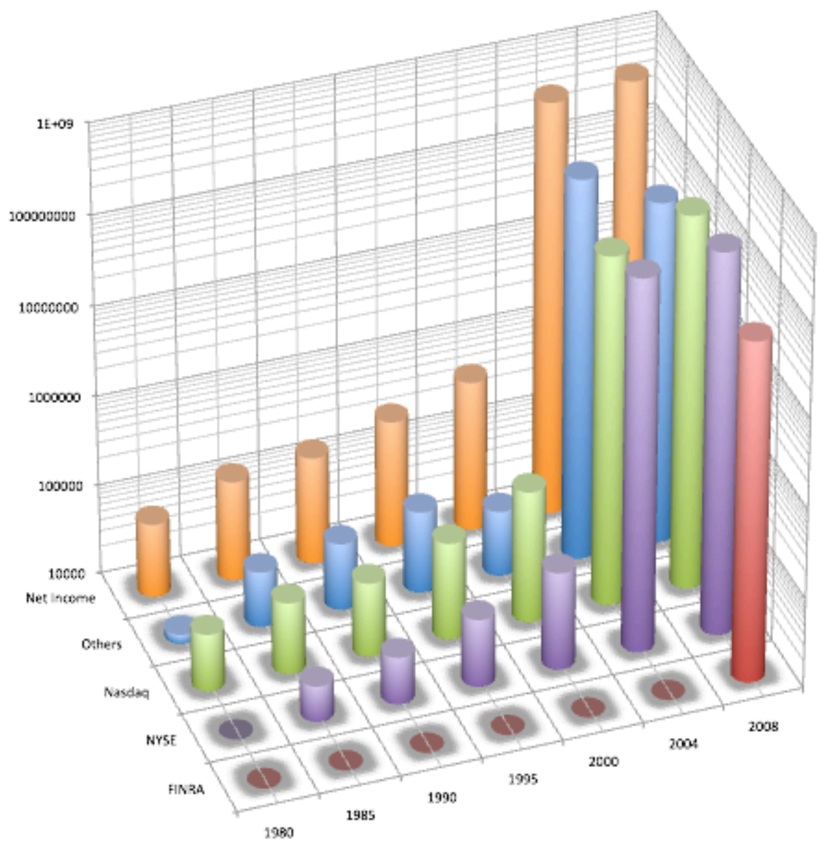
	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	16458000
Others	11,159	33,306	42,800	66,267	29,732	91,620,000	65,437,000
NYSE	0	0	0	0	0	1296000	47,995,000
Nasdaq	65	696	1774	4524	91,083	8,360,000	34,915,000
Net Income	11224	34002	44574	70791	120815	99980000	116810000

Network C Income:
Duopoly + Fringe



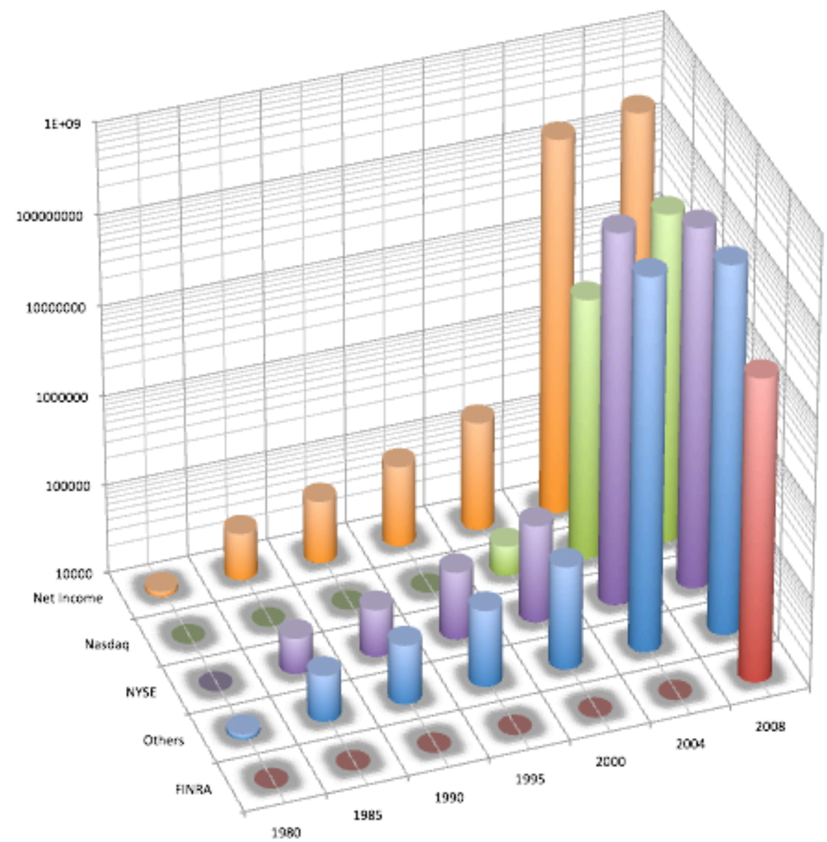
	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	20772000
Others	0	154	250	419	3,506	76,788,000	47,596,000
NYSE	0	0	0	0	0	0	26,321,000
Nasdaq	43500	61946	61417	108773	183,551	61,672,000	60,764,000
Net Income	43500	62100	61667	109192	187057	138460000	129132000

Total Income:
Duopoly + Fringe



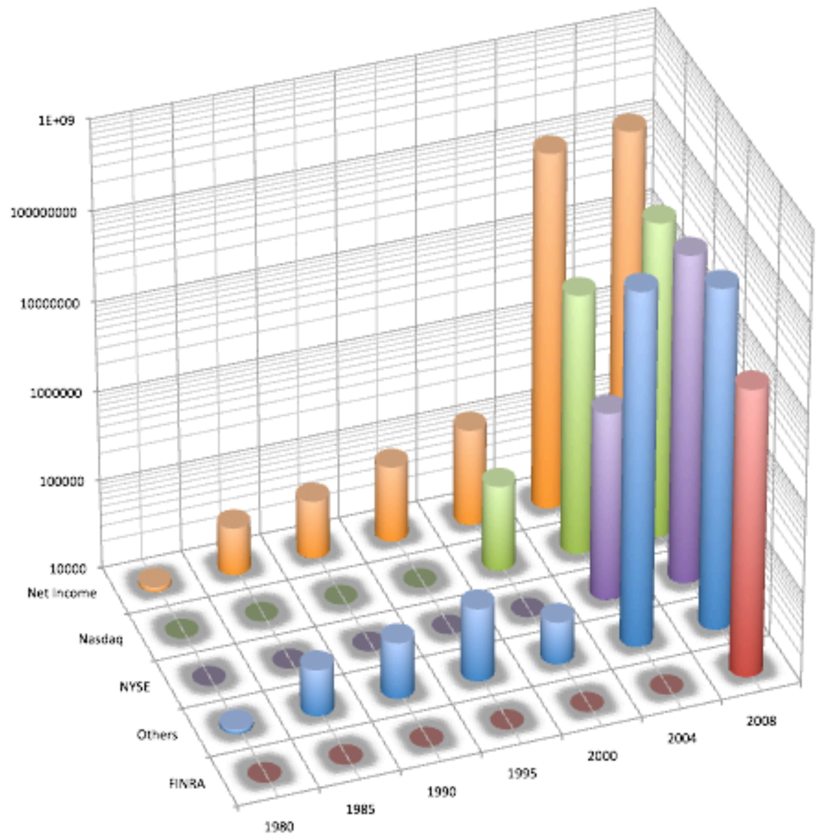
	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	61,555,000
NYSE	9884	25,123	33,678	57,277	123,027	141,957,000	179,788,000
Nasdaq	43644	63,193	67,357	121,731	296,017	78,328,000	143,661,000
Others	12,630	41,235	55,398	81,571	53,556	173,426,000	64,078,000
Net Income	66158	129,551	156,433	260,579	472,600	393,711,000	449,082,000

Network A Income:
Duopoly + Fringe



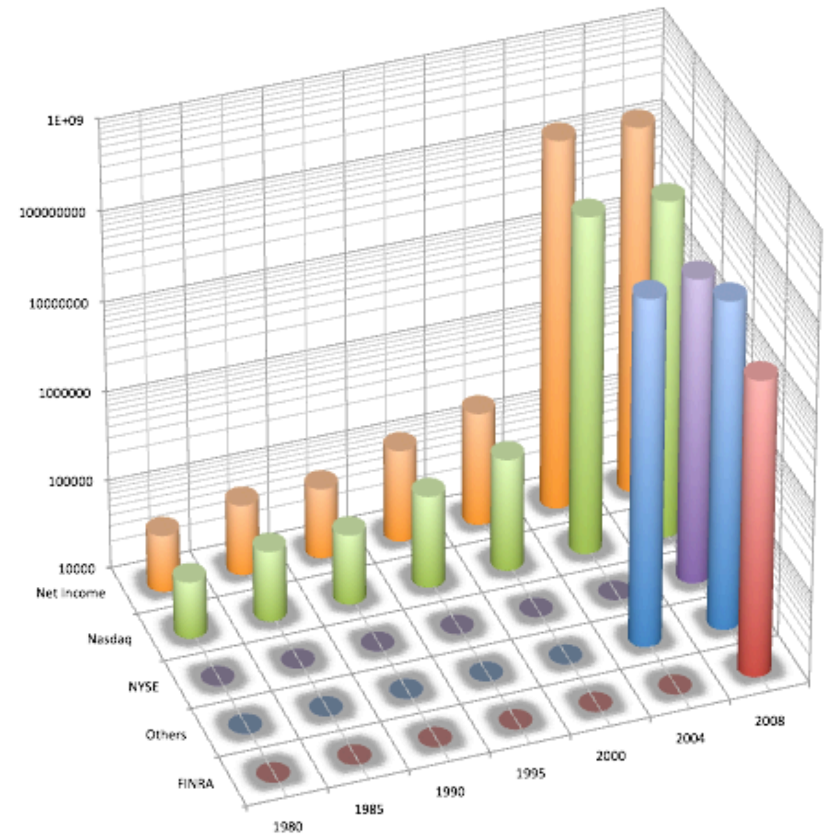
	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	24325000
Others	11,355	32,898	46,026	72,162	143,345	146,975,000	130,833,000
NYSE	9884	25123	33678	57277	123027	140661000	105,472,000
Nasdaq	79	551	4166	8434	21,383	8,296,000	47,982,000
Net Income	11434	33449	50192	80596	164728	155271000	203140000

Network B Income:
Duopoly + Fringe



	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	16458000
Others	11,159	33,306	42,800	66,267	29,732	91,620,000	65,437,000
NYSE	0	0	0	0	0	1296000	47,995,000
Nasdaq	65	696	1774	4524	91,083	8,360,000	34,915,000
Net Income	11224	34002	44574	70791	120815	99980000	116810000

Network C Income:
Duopoly + Fringe



	1980	1985	1990	1995	2000	2004	2008
FINRA	0	0	0	0	0	0	20772000
Others	0	154	250	419	3,506	76,788,000	47,596,000
NYSE	0	0	0	0	0	0	26,321,000
Nasdaq	43500	61946	61417	108773	183,551	61,672,000	60,764,000
Net Income	43500	62100	61667	109192	187057	138460000	129132000