International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249 – 8958, Volume-2, Issue-4, April 2013

An Application of SOBI Architecture for Cross-selling in Telecoms Industry

Mona Bakharaei Nia, Tanko Ishaya, Mehdi Shajari

Abstract— Mobile market is becoming saturated and competitive in telecoms industry. To diversify their business, mobile operators are moving away from traditional voice communication to mobile value-added services (VAS), which are new services to generate more average revenue per user (ARPU). Therefore, it is important to find the relationship between some products in order to sell appropriate products or services to appropriate customers at an appropriate time. This is why cross-selling is critical for mobile telecom operators to expand their revenue and profit. In this study, we investigate the application of a Service Oriented Business Intelligence (SOBI) architecture by aggregating subscriber usage data from multiple sources, including transactional call data records (CDR), recharge records, billing systems and VAS service usage records towards helping operators to identify a wide range of service usage patterns of Telecoms operations. The extended architecture assists analytics-driven marketing solutions for operators to not only develop Upsell & Cross sell strategies to maximize customer's revenue but would also serve as a basis decision-making required to optimize product combination and selling settlement issues. The architecture integrates data from heterogeneous data sources of the organization.

Index Terms— Service oriented architectures; SOBI; CRM; VAS; Cross-Selling; CDR; Data mining

I. INTRODUCTION

As mobile market becomes more and more saturated, Mobile Operators are moving away from voice communication to mobile value add services (VAS) such as communication entertainment, e.g. text messages, Internet browsing, playing games, and listening to music [19, 20]. With the next generation of telecom such as 4G, the amount of value added operations would continue to increase. Those mobile users who use these services and/or products may be great business opportunities for mobile service operators. Thus, it becomes critical for the operators to find appropriate and potential use of mobile VAS [6]. Essentially, the system that can categorizes customers more explicitly, so that specific services would be concentrated on specific groups of users. This will not only increase revenue for operators but also reduce the cost of investment through targeted marketing to users as final sales depends on many factors – including user profession, life style, region, religious, age, sex, etc [1, 11].

Manuscript received April, 2013

Mona Bokharaei Nia, Department of Computer Engineering & Information Technology, The Amirkabir University of Technology (Tehran Polytechnic), Iran.

Tanko Ishaya, Department of Computer Science, University of Jos, Jos, Nigeria.

Mehdi Shajari, Department of Computer Engineering & Information Technology, The Amirkabir University of Technology (Tehran Polytechnic), Iran.

Up-sell and cross-sell is a functionality that would enable operators to strengthen their relationship with their subscribers [9, 20]. Up-sell is offering a better priced or better version of the products to the subscriber and cross-sell is offering a related product to the subscribers. Products can be up-sold or cross-sold through various channels. The main business benefits of the functionality are:

- **Customer engagement and retention** - Up-selling and cross-selling capabilities would facilitate an operator to increase customer engagement. The architecture being proposed in this paper can be used by telecom operators to create exciting product offerings for new and existing customers by combining different products. The subscribers can be provided with these new, useful and interesting products with various price points, which could be a perfect fit to their needs through the recommendations provided by the analytics engine based on the analysis of various factors such as usage history, behavior, demographics and preferences. The proposed architecture of up-selling and cross-selling will help operators in building long lasting relationship with their subscribers by increasing customer engagement
- **Cost reduction** - Self-Care would enable telecom operators to provide a rich customer experience to the subscribers by offering them higher version products and related products through the Self-Care from which they can choose the products they desire. This would empower Telecom companies to retain their subscribers and reduce the high costs of customer acquisition by offering them state of art products through this proposed architecture and excellent customer service through Self-Care.
- **Boost in revenue** - Existing subscribers of telecom companies can be provided with unique offerings based on their needs from the same or different product categories through the up-sell and cross-sell functionality. For example, a prepaid subscriber with high Internet usage can be offered a Wimax product or a Wimax user can be offered a higher bandwidth plan at a discounted value or with associated freebies. Targeting the subscribers with exclusive products from different product categories or higher priced products from same product category backed by a strong customer service would lead to revenue improvement.
- **Reward loyal customers** - With a huge prepaid customer base, it is essential that a subscriber be rewarded for their loyalty. Various loyalty promotions can be created by using the Loyalty Management System based on the subscriber information such as usage, bill amount, how long they have been with the network, etc., to reward the loyal subscribers. Telecom operators can offer loyal subscribers based on their usage various

different products through up-sell and cross-sell technique at discounted rates.

- **Churn Propensity Control -** Helps to arrive at a score for a subscriber by analyzing the changes in the behavior pattern of the subscriber. The scoring happens based on the different attributes of the subscriber like Age on Network, Last Recharge date, Last SMS/call usage, decrementing trends, VAS usage, etc.

Therefore, through the up-sell and cross sell of personalized products based on the subscriber information, telecom companies can enhance the life time value of the subscriber by increasing customer engagement and retention, reducing churn, driving revenue and improving customer loyalty [9, 19, 20]. The profitability of telecom industry is clearly linked to its subscriber base, which again depends on number of active customers, duration of calls made by customers, type of used products, quality of service, price as compare to others, and ability to satisfy customers [14, 20].

This paper investigate the application of a Service Oriented Business Intelligence (SOBI) architecture by aggregating subscriber usage data from multiple sources, including transactional call data records (CDR), recharge records, billing systems and VAS service usage records towards helping operators to identify a wide range of service usage patterns of Telecoms operations. The extended architecture assists analytics-driven marketing solutions for operators to not only develop Upsell & Cross sell strategies to maximize customer's revenue but would also serve as a basis decision-making required to optimize product combination and selling settlement issues. The remainder of the paper is organized as follows: Section 2 presents a review of current approaches used for BI and an analysis of Telecoms data. Section 3 presents the development of a Cross-selling Service Oriented Business Intelligence (SOBI) architecture based on an analysis of cross-selling requirements gathered from telecom organisations through interviews. A cross-selling SOBI prototype were developed and evaluated in Section 4, while Section 5 presents a conclusion and future work.

II. BACKGROUND TO BI WITIN TELECOMS

Cross-selling is a CRM-based marketing strategy to sell more products and services according to the perceived needs of customers. The banking sector has studied cross-selling and indicated the sequencing of the cross-selling products being offered to a customer and has assisted the bank's sale to define a ranking of the different products and select the products which corresponds best to a specific profile of a customer [3, 4]. Cross- selling in telecom industry is beginning to gain popularity in research and development. Li (2009) proposed and investigated a dynamic discrete of quantitative association rule that combine fuzzy c-means and subtractive cluster method to improve cross-selling efficiency. This fast discrete method can fasten iterative rate and identify classification of discrete self-adoption so as to help business department in their decision-making process [17], although volume of data and response time need to be considered. Hyunchul et al (2010) proposed a hybrid classification model, which combines several heterogeneous classifiers and predict results of each classifier by weighted-averaging method, although conventional combination methods just combines the prediction results by applying simple techniques such as averaging and majority voting [9].

On the other hand, large-scale telecom operators currently need to pay more efforts to utilize the advantages of information technology and developed systems such as operation data store, knowledge discovery key performance indicators, and data warehouse and customer relationship management in order to improve customer satisfaction [5]. The amounts of data with telecom enterprises are massive, including basic customer information, behaviour information and valuable information, such as time length, frequencies and region [11]. For the purpose of gaining competitive advantage, business intelligence system in telecom industry also changes from simple record data to complex analysis of customer behaviour and provides marketing decisions. Although the traditional approach to BI is concerned with data aggregation, business analytics, and data visualization [13, 22, 24]. Business intelligence system benefits more with sharing data collected by subsystems and use mass information to analysis customer behavior and improve marketing efficiency with the use of IT systems such as DWs, Data Marts, Metadata Data Mining, ETL, Query, rotation, drill and slice and Reporting Software, OLAP, and Visualization to support decision-making in an organization [9, 11]. BI tools can be used to develop a predictive model to determine buying, cross selling & up–selling propensity of the segment towards both new and existing products [1, 2, 25].

Cross –Selling is way of using existing data via BI tools to gain quick insight into what could be the new products that may be requested or required by the customers so that the right offer can be made to the customers when interacting or making contact with them [10]. The following section presents a brief analysis of some of the key data sources within Telecoms.

A. Analysis of Telecoms data

Telecom organizations have three major data types - CDR, network data and CRM. CDR is generated directly from Telco's network switch. CDR is a computer record containing details of call and such as the number making the call, number receiving the call, purchased content, date and time, call duration, call route, call type, charged amount, telephone switch identity, record identity, and fault condition encountered during the call usually generated by charging system of the telephone switch [10]. The sending telephone switches kept the CDR progressively until the end of the call, after which the Telecom billing support system can retrieve and process CDR for billing. Mobile CDR may contain information on more than one call type or traffic such as voice call, Short Message Service (SMS), Multi Media Service (MMS), Ring Back Tone (RTB), and other data services traffic. Due to valuable information contain in the CDR, Telecom operator can utilize CDR information as data sources for DWs and BI [5]. The mediation module prepares CDR data for downstream system such as DW and billing system by cleaning and transforming CDRs into format that is accessible for mentioned systems. In this paper, we considered the source of data for doing cross selling as subscriber CDR along with subscriber CRM information. The main reason for developing CRM is to manage customer interest to have intelligent cross selling by identifying who the customer is, understanding what customer needs and value of each customer, and interacting with them base on the information at hand [10]. Furthermore, CRM does not only contain data from CDR but also it contains customer profile

and Service Record to give more information about the customer in order to make more accurate and stronger decision to be able to make the right offer or cross selling to the right customer at right time.

The following section presents a developed an architecture that considers the integration and analysis of data from CRM and CDR (Call Data Record) of Telecom operator using SO approach for cross selling in the Telecom Industry.

III. A PROPOSED SERVICE ORIENTED BUSINESS INTELLIGENCE (SOBI) ARCHITECTURE FOR CROSS-SELLING

It is clear that telecom industries need BI that is capable of performing real-time analysis on massive amount of CDR & EDR data generated an able to analyze historical data of CDR to identify customer value and interests and make strategic decisions with respect to cross and up selling in order to retain, attract new customers, and to ensure their satisfaction towards increasing profitability [27, 28]. A Service-Oriented-Architecture (SOA) is an architecture upon which different standalone services can be loosely coupled over distributed systems [7]. They are business-centric IT architectural approach that supports the integration of business as connected and repeatable business services. A fundamental advantage of these services is that they can communicate with each other even though each service has different underlying implementation platform. It is therefore clear that a Service Oriented (SO) approach will provide a common, open, and interoperable solution to the problem encountered in traditional BI. SO can be adopted for agile and flexible applications, application-application integration, and high frequency events, real-time data analysis, reusable of services component, proper data formats and structures, and encapsulates and abstract functionality [4]. This section presents the Service Oriented Business Intelligence (SOBI) architecture for cross selling in Telecom. The architecture integrates data from heterogeneous data source of the network.

In SOBI paradigm, BI is seen as a collection of services such as Data Services, Transformation Services and so on, while SO is seen as a collection of data sources and event source. A service can promptly be opened "as a data source with the introduction of a simple decade layer that provides a mapping between the BI interface and interface exposed by the service" [4]. The façade layer also transforms the results set of the call from data schema used on the service bus to data format expected by the BI platform and returns the result to the caller.

The result of the analysis of customer profitability can help identify why some customer or subscribers are not as profitable as others. On the other hand, a customer might be unprofitable because the products used by them do not match their risk profile. Customer profitability analysis can significantly help in developing new offerings, customizing existing offerings and helping to target market segments for future growth [10].

A. Requirments Analysis for Cross-Selling

To create a cross and up selling model, the following requirement were identified as fundamental in the creation of SOBI architecture. The requirements have been analyzed based on the results of interviews conducted with a number of telecom operators and customers.

- Telecom operators need to analyze both real-time and historical data. Real-time analysis such as registering an event on CDR record to identifying customer making long duration call or recharge time and offer them the best personalized services. This can be considered as a cross or upselling decision-making process and communication. Analysis of historical data can provide adequate review of what tariff plan need to be set up, and other required services by which category or individual customer.
- Cross-selling engine needs to analyze customer usage pattern in various dimensions. This is important in order to understand why customers have behaved in a particular way at a particular time. For example, customers may have different calling habits depending on tariff plan, available service, time of the day, and so on. These analyses also enable the discovery of hidden behavior, which has not been noticed in the past and can feed in cross selling engine to offer appropriate and correct tariff plan and services to the customer.
- Cross selling Engine needs to be able to drill down and drill up while analyzing the customer usage pattern.
- Cross selling model needs BI architecture that is flexible to change in the business activities, which usually lead to change in business requirement and offering new service.
- Telecom operators need to ensure security of data stored in the OSS and DWs and during cross selling analysis. Security of operational data and customer information is very important to prevent loss, stolen, damage and authorize person from accessing the information while in storage, creating new campaign or during analysis.
- Cross selling Engine needs to combine call details with customer profile and demographic for more accurate decision making about customer used services and satisfaction. For example customer that is 40 years of age and above may make less call but there may be an issue of customer dissatisfaction when customer within the age 20-30 in is making less call.
- Cross selling Engine needs to suggest a reasonable tariffs or dynamically adjustable tariffs that would suite individual demands, which clearly require personalized plan for each subscriber.
- Cross selling Engine needs to inform subscriber about all current appropriate tariff , packages and services .

Thus, Figure 1, below shows all the steps that should be considered in developing an Upsell and Cross sell strategies.

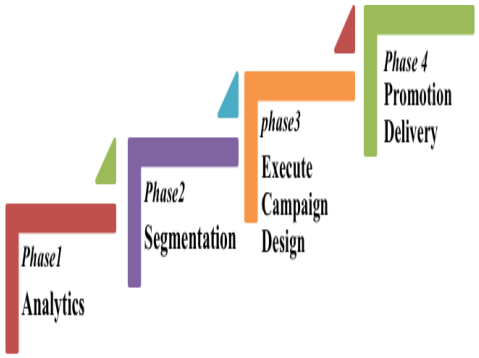

Figure 1. Cross-selling creation steps

A brief description of each of the steps in Figure 1 above is presented below:

Phase1. Data Analysis

Aggregates customer transactional data from multiple sources such as Voice, GPRS and Data nodes, which eliminates data silos and enables operators to obtain a 360-degree view of the customer. Processes and transforms raw transactional records into meaningful data, to enable operators achieve actionable insights to meaningfully segment customers.

Phase2. Customer Profiling & Segmentation

Different types of customers exhibit different services consumption trends. Operators planning marketing programs need to identify and then consequently leverage customer-specific "value levers". Revenue Plus helps identify niche segments that fit a suspected or known pattern using predefined criteria like: Recharge, Usage, VAS & Data preferences, etc.

Phase3. Execute Campaign design

Revenue Plus supports automated workflows to create campaigns based on identifiable business goals. The intuitive GUI-based business rule framework consolidates a variety of campaign-associated activities in a single, clearly defined, and easy to manage process. By taking the complexity out of promotions management, Revenue Plus empowers marketing managers to quickly create, execute, and administer a variety of simple or complex promotions that deliver value in real-time.

Scheduled when the Campaigns need to be delivered based on the business requirement and be able to define as per individual subscriber. System can schedule Campaigns either as one time or Recurring. The Campaigns can be scheduled on a daily basis or based on certain pre-defined events. Operators can sub-segment customers with the same transactional characteristics to measure the effectiveness of the campaign. Having defined the target segment, operators can ensure the campaign is delivered to certain members who fall within the group. This enables them to track transactional behavior of customers who have received the offer and those who have not received the offer.

Phase4. Campaign Delivery & Monitoring

System should enable multi-channel campaign delivery over SMS, USSD, IVR, OBD, Email, Social Media, STK and WAP. To ensure that an offer is delivered to the customer over their preferred channel, resulting in higher conversion rates.

Generates a set of comprehensive reports to track: Revenue-based reports, Successful Upsell Conversions, Campaign Delivery & Mode, Subscribers usage reports pre and post the Campaign, Campaign Fulfillment reports.

B. The Proposed Cross-Selling SOBI Architecture

The SOBI architecture for cross-selling is an extension of the one proposed in [10]. Main extension is the clear emphasis on the analysis of events as input of cross selling recommendation engine that should be performed on CDR data. Figure 2 below presents a graphical representation of the proposed SOBI architecture for cross selling in a telecom industry.

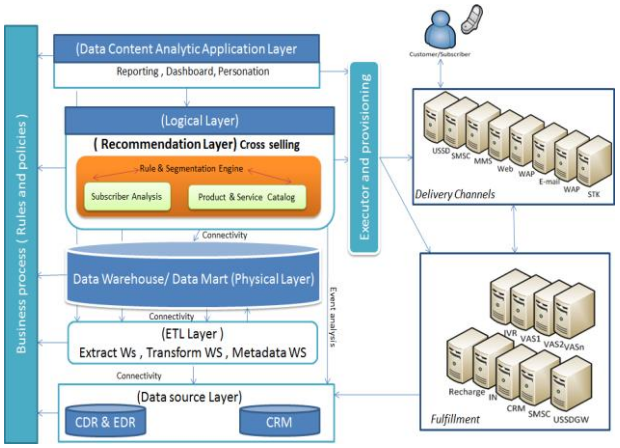

Figure 2. Cross selling SOBI Architecture

The Cross-selling SOBI architecture consists of 5 layers, which are Data Source Layer, ETL Layer, Physical Layer, Logical Layer, and Application Layer including Recommendation Sub Layer. Each of these layers defines a set of business process to ensure a successful Cross selling though BI. Each of the layers has been briefly described below.

The Data Source layer is the OSS database of Telecom operators where day-to-day business transaction and activities data are sorted. The cross- selling SOBI architecture had been designed to allow analysis of events on the CDR and CRM data source in order to provide to near real time analysis. Business intelligence tools are only as good as the data they use. Data is the most essential working material for business analysis and bad data can be very dangerous. As described in Analysis of telecoms data source section that will be gathered from many different telecom network nodes so to prevent data inconsistency, data redundancy and anomalies we need data modeling using ERM or Normalization approach. If this layer is established with good quality data, then the next layer will not face complexity in making ETL process, which could result into poor quality BI.

The ETL layer consist of Extract, Transform, and Loading Services. The first part of an ETL process is to extract data form the data source layer. The extract service extract all the required data for building cross and up selling from the OSS database, transform service transform the data into a format required by the DWs while the function of loading service is to load the data and information into the DWs.

The Physical Layer is the data repository centre of SOBI architecture and this is the layer where DWs are required to be developed. DWs have processes and architecture have been discussed in section 2. Before designing DWs, it is important to have DWs specific technical and functional requirements from the general requirements performed in section 3.

Logical layer /Recommendation layer (cross selling Engine) typically produces a list of possible Upsell/Cross sell Promotions by building a context around every customer/customer segment. Furthermore, this engine is based on the defined business rules, slices and dices the subscriber/product behavior data and builds a best fit model or context around the subscriber/product segment and arrives at the best possible recommendation options for products/services. These personalized Recommendations are scientifically derived at, by combining Collaborative Filtering Approach and Content based Filtering Approach.

The *Collaborative approach* attempts to build a model from a user's past behavior (products/services previously bought or selected and/or numerical ratings given to those items) from lower levels as well as similar decisions made by other users, then use that model to predict items (or ratings for items) that the user /segment may have an interest in. For example, those subscribers who used voice service too much they purchased friends and family packages as well.

The *Content based approach* takes into account the characteristics involved in a product or service a customer has opted for, and make recommendations based on similar characteristics. For example, consider the Romantic of the RBT song, and recommend RBT songs from the same romance category

The recommendation engine takes as input the subscription data for operator's various products and uses data mining techniques to find the association rules among different products based on the usage/cross usage patterns of the products. The usage/cross usage analysis helps in figuring out the subscriber's service consumption pattern. Depending on the portfolio of services held by the subscribers, the recommendation engine categorizes the subscriber base for the operator into different buckets of subscriber's profile.

- Executor checks for the programs/campaigns configured by the user using Graphical user interface.
- Executor performs 2 types of actions, delivery of campaign message and delivery or execution of fulfillment process.
- Based on the Recommendations analysis, the campaign will trigger an action.
- Executor delivers the campaign promotion message through different channels like, SMS, USSD, GPRS discounted Package, Content delivery service

If no events matches with the program/campaign, it checks for the next program/campaign until all the configured programs/campaigns are completed. Once the Executor finds the matching event, and is satisfied with all pre conditions, it then generates the root action information. The Executor continuously monitors the root actions and actions to be performed on the events. Executor delivers the data to the external servers and checks for success or failure event of delivery and accordingly performs the next action associated to this event. Further in implementation section we would example of how recommendation engine works with use-cases.

The Presentation layer (application layer) usually display data in form of reporting tools using tables, figures, charts, etc. to aid visualization for user. This Layer is where reporting and complex analysis are performed and rendered to the BI end user. This part has interactive functionalities with the user and decision makers to evaluate the result of any executed cross selling services. These reports can be ad hoc or drill down, etc. and these reports can be displayed in different formats. In business intelligence solution this part can be called as dashboard.

The proposed architecture and tools discussed above analyzes subscriber data and information to help telecom operator acquire insight and knowledge are now much more accessible to have intelligent cross selling. The Cross Selling Application (CSA) gather, manage and analyze data from subscriber after cross selling executions to improve and even modify strategic and tactical decision, and at same time condense the cycle between feedback analysis and decision making as well as into real-time. In order to demonstrate the feasibility of the presented architecture, the next section, presents the development of a cross-selling SOBI prototype

IV. DEVELOPMENT OF A CROSS-SELLING SOBI PROTOTYP

BI applications require a dynamic system development approach. The conceptual logical design of SOBI architecture is based on the defined layers presented in Figure 2. The prototype implementation is based on the scenario below:

The CSA takes as input the subscription data for operator's various products and uses data mining techniques to find the association rules among different products based on the usage/cross usage patterns of the products and subscriber behavior and demographics. The usage/cross usage analysis helps in figuring out the subscriber's service consumption pattern. Depending on the portfolio of services held by the subscribers, the recommendation engine (cross selling) recognizes a subscriber as an individual entity and offers appropriate personalized cross-selling services to the individual. Let us look at an illustrative example of how CSA works. Consider 5 subscribers and 5 operator services, with the subscriber service portfolio as given in table 1 below.

Subscriber	**Service used**
Subscriber 1	Voice , Ring Back Tone
Subscriber 2	SMS , GPRS , Ring Back Tone
Subscriber 3	SMS , Voice , GPRS
Subscriber 4	Content , Ring Back Tone , Voice
Subscriber 5	SMS , GPRS , Ring Back Tone

Table1. Subscriber used service

The CSA will create the cross usage matrix for the operator's products as shown in table 2 below. The value of this matrix indicates the total number or revenue or percentage of subscribers using the service.

	Voice	**SMS**	**GPRS**	**Ring Back Tone**	**Content**
Voice	10%	12%	30%	10%	50%
SMS	20%	31%	19%	6%	58%
GPRS	40%	2%	42%	9%	9%
Ring Back Tone	2%	17%	3%	0%	10%
Content	8%	20%	1%	0%	90%

Table2 Used service matrix

The operator can apply this rule to cross sell "Voice" to a segment of subscribers who have "Ring Back Tone" and "Content" in their service portfolio. The CSA can further build a purchase profiles for the operator's subscriber base depending on the primary service consumption data of the subscribers. Based on a particular subscriber's 360-degree profile, it will map the subscriber to appropriate purchase profile bucket and suggest the secondary services used for that particular bucket for the cross sell process.

A. Prototype requirements and Implementation Architecture

The design of the cross selling application was done according to the five layers of the architecture – Data source Layer, ETL Layer, Physical Layer, Logical Layer that contain cross selling and Application layer. The focus of the prototype using CDR and CRM data, extraction, transformation and loading of the data into developed DWs and does analysis by cross selling Engine. The prototype covered cross selling application that shows how Telecoms operator can analyze the customer call details and behavior over time and able to identify the relationship between services and tariff plan and customer usage, interest and behavior. The prototype is limited to subscriber voice call, SMS, GPRS, Content service, Ring Back Tone & GPRS of local subscriber. At the physical layer, a DW has been design to provide the required data repository for the SOBI telecom CDR & CRM data of subscriber.

B. Implementation of Cross-Selling (CSA) Prototype

To build CSA we used Oracle business Intelligence EE 11.1.1.6 32x to create analysis and define rules, provide SOAP web service and WDSL file and use WSS-Token Security method for request validation. Furthermore, Oracle SOA suite 11.1.1.6 32x integrated to BI with using PBEL for call OBIEE web service in Windows 2003 server R2 32X. The used web service was oracle web logic 11 32x with JDeveloper 11.1.1.6 32x as development tools.

The CSA prototype was developed using four steps as follows:

Step 1. Creating the Repository

The Oracle BI Administration Tool was used to maintain BI metadata repositories. It provides a graphical representation of the three layers of the repository as shown in figure 3. These are the Physical Layer, the Business Model and Mapping Layer, and the Presentation Layer.

The physical layer defines the data sources to which Oracle BI Server submits queries and the relationships between physical databases and other data sources that are used to process multiple data source queries. The business model and mapping layer defines the business, or logical, model of the data and specifies the mappings between the business model and the Physical layer schemas. This is where the physical schemas are simplified to form the basis for the users' view of the data. The presentation layer is built after the physical layer and business model and mapping layer, and adds a level of abstraction over the business model and mapping layer. It is the view of the data seen by end users in client tools and applications, such as Oracle BI Answers. The Presentation layer provides a means to further simplify or customize the business model and mapping layer for end users. For example, you can organize columns into catalogs and folders.

We applied 100 high usage subscribers selected for our analysis from real operator network that is including Voice, SMS, GPRS, MMS, Ring_back_Tone & downloaded content CDR & EDR of subscriber has been loaded into repository of DW as shown in figure 3.

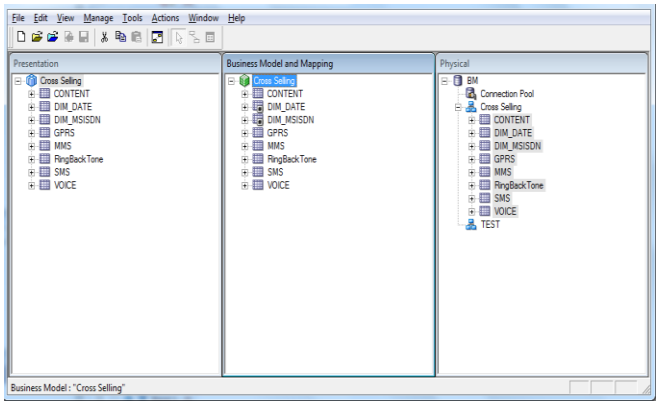

Figure 3 CDR Subscriber Repository

All details of the services that a subscriber used are extracted, transferred and loaded into the CSA repository for further analysis. For example, voice service contains data such as data and time of call, duration, charged amount, tariff type, etc and for RBT service information such as name of ring tone, charged amount, number of downloaded times, ring back tone provider name, etc.

Step 2. Creating and publishing campaigns

Figure 4 below shows an implementation of two example campaigns. Campaigns are created as ad hoc queries in OBIEE Analysis as shown in Figure 4 below.

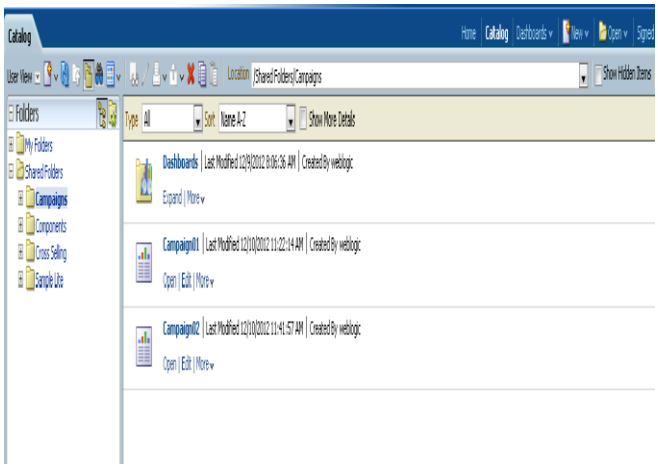

Figure 4. Defined campaigns

Let us look at an illustrative example of how recommendation engine works. Consider 2 groups of subscribers and 2 operator services, with the subscriber service portfolio as shown in table 1 above. *Campaign one* is to extract and identify those subscribers who has total usage for one month greater than or equal to 100, 000 IRR and Total voice amount is greater than or equal to 100, 000 IRR. The recommendation engine will create the cross usage matrix for the operator's products as shown in Table 3 below.

Item	Usage Subscriber model	Amount
1	SMS usage	100, 000 IRR
2	Voice usage	100, 000 IRR

Table3: Campaign_1 definition matrix

Figure 5 below is a screen shot of the implemented description of campaign_1.

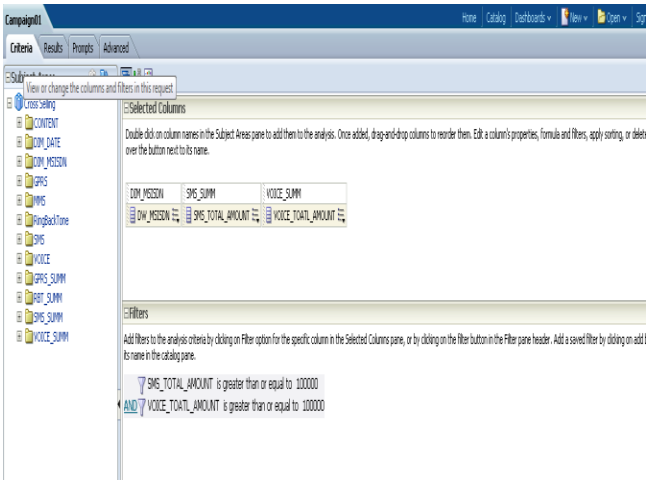

Figure 5. Defined Campaign_1

It is possible to define and run so many campaigns as operator requires. Another campaign is also defined as Campaign_2 with the defined metric presented in Table 4.

Item	Usage Subscriber Model	Amount	Recommended Services
1	GPRS usage	100 MB	GPRS package discount (1G)
2	RBT usage (purchased count)	10 MB	Voice discount service 100min on-net
3	SMS usage (count)	10 MB	Content service with x% discount

Table4: Campaign_2 definition matrix

User defines the campaigns based on the recommendations received & configures the triggers defined by the user.

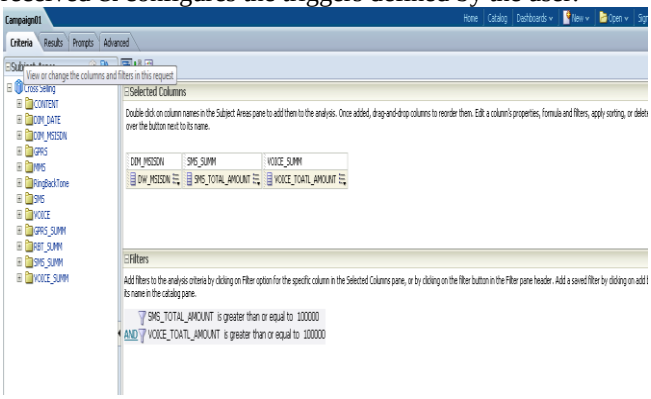

Figure 6. Defined Campaign_2

Up to this point, the analysis part has been done on subscriber behavior and used services, so there is need to expose a web service for another applications to provide those recommendation results on time or send notification to subscriber or ask subscriber to active recommended service for themselves. In figure 7 the flow of service invoking is shown. On the right hand side, results of cross selling from campaign_1 are added and through this web service, any other system can invoke results of cross selling. Furthermore, another cross selling application can also invoke an API for provisioning service for each and every subscriber. Hence either third party system can invoke our application or our application is able to expose an API. The process at the bottom of the right hand side of the screen, a calling camping _1 object is added and providing result for provisioning system bpelprocess1_client. By drag and drop and doing configuration for necessarily parameter cross-selling application can easily expose an API for any application with various methods. For example, in our campaign1, the recommended service for subscriber A that used SMS services 100 times is content service that can purchase and content service via SMS channel. In Figure 7 cross selling module for campaign1 will provide those subscribers, who used SMS 100 times and expose an API for Executor that is shown in the left hand side of the screen in Figure 7 to provide or send SMS notification to these subscribers to use Content services with x% discount via SMS channel.

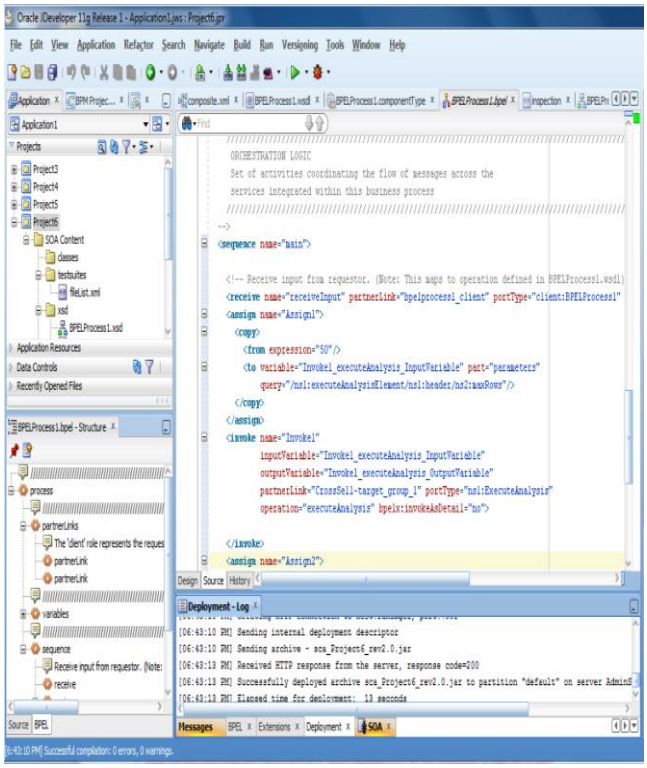

Figure 7. Service Invocation Flow

Step 3. Creating and Exposing Cross Sell Web Service

The final step is the part of the prototype that exposes the cross-selling services as a web service. This suite creates the process, which talks to BI and exposes a web service, which is called by external applications as, can be seen in Figure 8.

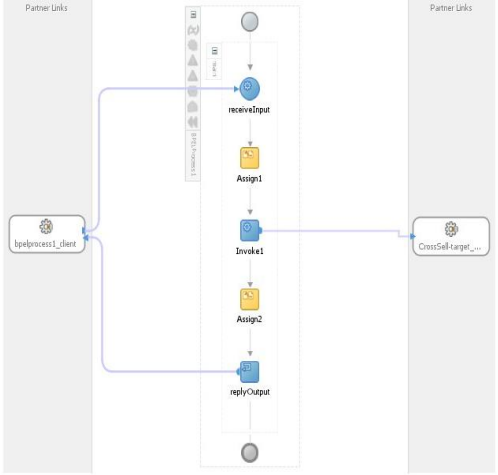

Figure 8. CSA campaign_1 service invoking

Once the Executor finds the matching event, and is satisfied with all pre conditions, it then generates the root action information.

In order to optimize the output value of CSA, results can have different criteria that only 50 subscribers data should be returned back or other criteria in Expression builder.

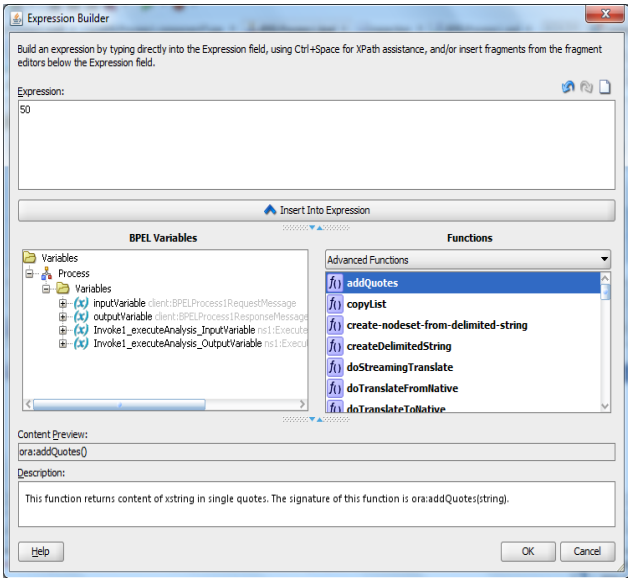

Figure 9. Cross-selling Expression builder

All inputs/outputs variables of CSA web service along with desire rules can be define in this window, which shows feasibility of system. XML of designed WSDL for cross selling application is shown in figure 10.

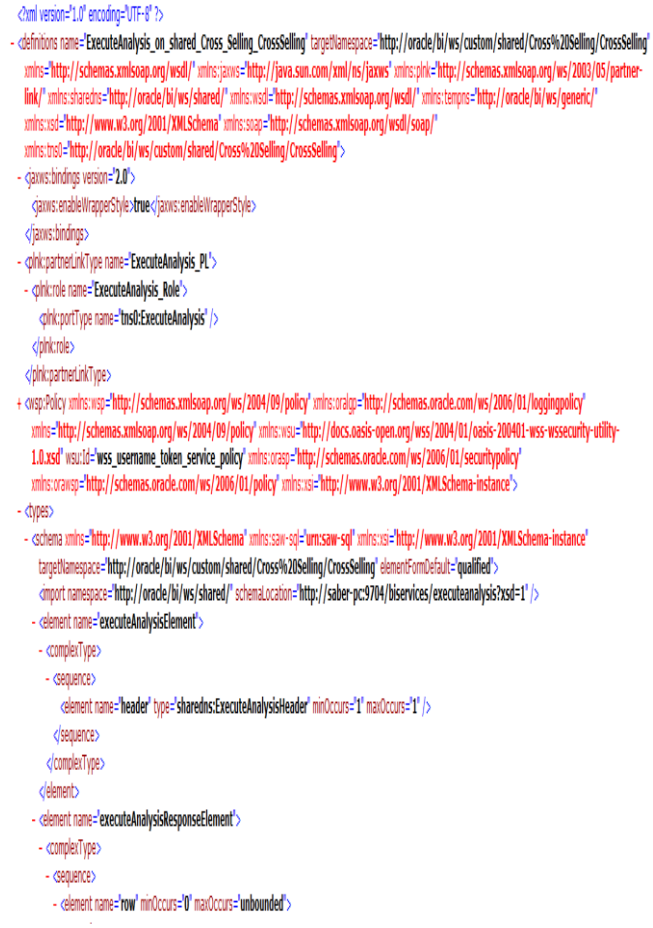

Figure 10. Cross-selling WSDL

Figure 11 shows result of analysis by calling that web services in order to keeping subscriber privacy some digit of subscriber MSISND has been removed. These MSISDN were eligible for campaign_1 as described above.

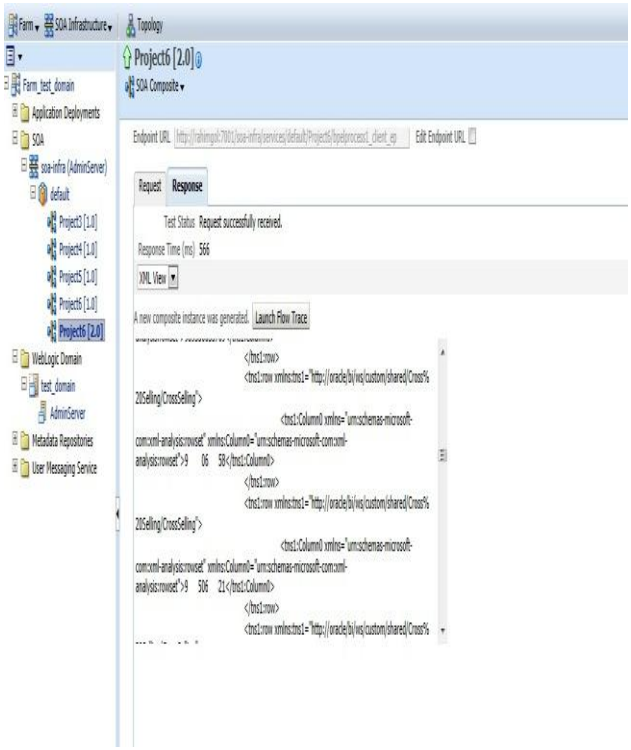

Figure 11. Result of calling CSA web service for Campain_1

The executor continuously monitors the root actions and actions to be performed on the events. The executor delivers the data to the external servers and checks for success or failure of delivery and accordingly performs the next action associated to the event. If no further action is defined, it enters to end stat

V. CONCLUSION AND FUTHER WORK

This chapter presents an application into the integration and analysis of data from CRM and CDR of Telecoms operators using SO approach to assist the organization in making real-time and accurate decision about the customer tariff plan and offer him better option as cross or up selling that would be aligned with his behavior to ensure customer satisfaction which in return can lead to increase in profit. Actually, our Cross Selling Application introduces an intelligent and flexible Analytic tool that can be able to use events on CDR along with subscriber profile that has the ability to offer the right product to the right customer at right time. The proposed Cross Selling Application can be leveraged to proactively target customers with highly relevant promotions & design winning marketing strategies for optimizing usage and enhancing revenues per customer. Telecom operator cannot do without such an application that can process massive data from 360 degree of subscriber view in the competitive market and ability to analyze, make decision, and act on the decision in time could be a significant advantage to exploit market opportunity. Current work is towards evaluating the approach and the application at an operator level with real subscribers.

REFERENCES

[1] Atre, S. (2008), Successful Business Intelligence: Secrets to Making BI a Killer App, the McGraw-Hill Companies, ISBN: 978-0-07-149851-7, Available at http://books.google.co.uk/ accessed [19 July 2010].

[2] Berthold, H., Rosch P., Zoller S., Wortmann F., Carenini A., Campbell S., Bisson P., and Strohmaier F. (2010) , An Architecture for Ad-Hoc and Collaborative Business Intelligence, ACM Conference Proceeding Series Vol. 426, Proceeding of the 2010 EDBT/ICDT Workshops, Lausanne, Switzerland, ISBN:978-1-60558-990-9, Article No. 13, Available at http://portal.acm.org/citation.cfm accessed [28 June 2010].

[3] Felix, R (2001). "FODM-9: fuzzy decision making with interacting goals applied to cross-selling decisions in the field of private customer banking", Fuzzy Systems, The 10th IEEE International Conference, 2001, pp.964-967.

[4] Gordon, S., Grigg, R., Horne, M., and Thurman, S. (2006), Service-Oriented Business Intelligence, Microsoft, Available at http://msdn.microsoft.com/en-us/library/bb245659.aspx accessed[18 June 2010].

[5] Griffin, J. (2003), A Challenge for the Telecom Industry: Converging Enterprise Portals and Business Intelligence to Produce a Collaborative Business Platform, Information Management Magazine, August 2003, Available at http://www.information-management.com/issues/20030801/7154-1.html accessed [6th July 2010].

[6] Hadden, J., Tiwari, A., Roy, R., and Ruta, D. (2007), Computer assisted customer churn management: State-of-the-art and Future Trends, Computers and Operations Research vol.34, No.10, pp2902-2917

[7] Hu, J., Khalil, I., Han, S., and Mahmood, A (2011). Seamless integration of dependability and security concepts in SOA: A feedback control system based framework and taxonomy. Journal of Network and Computer Applications Vol 34(4), July 2011, pp1150-1159

[8] Hung, S.Y, Yen, D.C, and Wang, H.Y. (2006), Applying Data Mining to Telecom Churn Management, Expert Systems with Application Vol.31, Issue 3, pp. 515-524, available at linkinghub.elsevier.com/retrieve/pii/S0957417405002654, accessed [2nd July 2010].

[9] Hyunchul, A., et al (2010), "Using Hybrid Data Mining Techniques for Facilitating Cross-selling of a Mobile Telecom Market to develop Customer Classification Model", Proceedings of the 43rd Hawaii International Conference on System Sciences – 2010

[10] Ishaya, T and Folarin, M. (2012). A service oriented approach to Business Intelligence in Telecoms industry, Telematics and Informatics 29 (2012) 273–285

[11] Ishaya, T., and Rigneau, J. (2007), Data Quality for Effective E-Commerce Customer Relationship Management, Proceedings of the 9th International Conference on Enterprise Information Systems, Funchal, Madeira, Portugal, ICEIS (4): 92-100.

[12] Johnstone, D., and Wong, C.Y. (2008), Billing Audit on a Mobile Operator-Call Detail Record, Information Systems Control Journal, Vol. 3.

[13] Kudyba, S., & Hoptroff, R. (2001). Data Mining and Business Intelligence: A Guide to Productivity. Hershey, PA: Idea Group Publishing.

[14] Kulkarni, U., Power, D. J. and Sharda, R. (2007), Decision Support for Global Enterprises: Annals of Information Systems, Vol. 1, Springer, Available at http://www.springerlink.com/content/g02v70027227648u/fulltext.pdf accessed [15 June 2011].

[15] Lee, J.H., and Park, S.C.(2005), Intelligent profitable customers segmentation system based on business on business intelligence tools, Expert Systems with Application Vol.29, pp.145-152, Available at http://www.sci.brooklyn.cuny.edu/~kopec/cis718/fall_2005/sdarticle2.pdf accessed[5th July 2010].

[16] Levin, S. (2002), Lessons in CRM: when it comes to caring for customers, telecom firms need to wise up. Here's a primer of best practices, complied from a roster of CRM experts - Telecom Corporate, Telecom Asia, Available at http://findarticles.com/p/articles/mi_m0FGI/is_10_13/ai_94010195/ , accessed [8th July 2012].

[17] Li, Q (2009) "An Algorithm of Quantitative Association Rule on Fuzzy Clustering with Application to Cross-selling in Telecom Industry" International Joint Conference on Computational Sciences and Optimization, 2009

[18] Madnick, S.E, Lee, Y.W, and Zhu H. (2009), Overview and Framework for data and Information quality research, ACM Journal, Data Information Quality 1(1)

[19] Normile, S. (2008) Business intelligence for Telecommunication Industry, INGRES Whitepaper

[20] Pareek, D. (2006), Business Intelligence for telecommunications, Auerbach Publications, ISBN: 0-8493-8792-2.

[21] Patrick, P. (2005), Impact of SOA on Enterprise Information Architectures, International Conference on Management of Data archive, Proceedings of the 2005 ACM SIGMOD International Conference on Management of Data, pp. 844-848.

[22] Raisinghani, M. (2004). Business Intelligence in the Digital Economy: Opportunities, Limitations and Risks. Hershey, PA: Idea Group Publishing.

[23] Ranjan, J. (2009), Business Intelligence: Concepts, Components, Technique and Benefits ,Journal of Theoretical and Applied Information Technology, Vol.9, No.1, Available at http://www.jatit.org/volumes/research-papers/Vol9No1/9Vol9No1.pdf accessed on [26 July 2010].

[24] Rus, V.R., and Toader, V. (2008), Business Intelligence for hotels' Management Performance, International Journal of Business Research, FindArticles.com, Available at http://findarticles.com/p/articles/mi_6773/is_4_8/ai_n31136506/ accessed [14 June 2010].

[25] Turban, E., Sharda, R., Aroson, J. E., & King, D. (2008). Business Intelligence: A Managerial Approach. Upper Sadle River, New Jersey: Pearson Prentice Hall.

[26] Watson, H.J. (2005), Real Time: The Next Generation of Decision Support Data Management, Business Intelligence Journal, 10(3), pp. 4-6

[27] Weiss, G.M. (2004), Data Mining in Telecommunications, kluwer, 2004.

[28] Wu, L., Barash, G. And Bartolini, C. (2007), A Service Oriented Architecture for Business Intelligence, IEEE International Conference on Service-Oriented Computing and Application (SOCA'07), Newport, Beach.

Mona Bokharaie Nia, received her M.S degree in Information Technology E-commerce Engineering with honors from Amirkabir University of Technology in 2011 after her BSc degree in Computer Software Engineering in 2009 from Tehran Information &Technology Development University as top student with honors. Her research interest is in Business Intelligence System especially in Telecommunication industry. She has started her career with Telecom's industry from 2007. She has been system analyst and solution design architecture for five years and has played key roles on IT solution design, with the focus on fraud management, revenue assurance and ITS applications. She has also worked with several international communication companies on assignments, including business analysis, requirements definition, solution design, information analysis and project management. Bokharaie has published in some International journals and conferences.

Dr Tanko Ishaya is computer scientist with a mathematics background. He has an MSc and PhD in Computation from the University of Manchester, UK. Joined the Centre for Internet Computing of the University of Hull in 2000 as a Lecturer and appointed Head of the Centre in 2005. He was with the University of Hull, until July. He is now the Director ICT and Acting Head of Computer Science Department of the University of Jos. His research interests range from technology support for learning, through information engineering, business intelligence, mobile and ubiquitous computing, to more technical aspects of security and trustworthy computing, and forensic computing. He is a professional member of BCS, IEEE, ACM and a certified Agile Project Practitioner and a Computer Forensics Investigator.

Mehdi Shajari is an Assistant Professor in the Department of Computer Engineering and Information Technology at the Amirkabir University of Technology in Tehran, Iran. His current research interests include e-commerce security, intrusion detection, and information search and retrieval. Mehdi Shajari received his M.S. with honors from Amirkabir University of Technology and Ph.D. from University of New Brunswick, in 1993 and 2005, respectively. He worked with National Research Council of Canada as a Research Officer and Trent University as an assistant Professor during 2001–2006. He was a lecturer at Amirkabir University of Technology during 1993–2000