Revolutionizing DEFINITY® Call Centers in the 1990s

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The award-winning AT&T DEFINITY® G3 Expert Agent Selection (EAS) feature has fundamentally changed the way in which call centers provide services for a variety of business applications. The skills-matching concept of EAS simplifies the problem of meeting incoming caller needs with trained call center agents. The Logical Agent part of EAS provides call center agents with an incentive for advancement while also providing new-found flexibility in how they perform their jobs. Both these EAS innovations are patented, with the skills-matching patent winning the 1995 AT&T Patent Recognition Award. This paper describes how EAS improves the efficiency of call centers, and it discusses the implementation approach used to realize this important new call center feature.

Introduction

In the 1970s, call centers were used by relatively few businesses for taking reservations and catalog orders, and by telephone companies for operator services. In 1995, analysts estimate that total revenues of equipment sales for new call centers worldwide will be approximately $1.5 billion. They also estimate that AT&T Global Business Communications Systems (GBCS) will have about a 30-percent share of this market.

Almost every mid- to large-size business in the United States has at least one call center typically used for services support, home shopping, or help desks. With today's trend for conducting business over the phone, a call center is the primary source of revenue for many companies.

AT&T customers require the tools and flexibility that the Expert Agent Selection (EAS) feature provides to manage their call centers, providing them with a competitive edge. For example, EAS has become popular in western Europe for handling the business needs of a multilingual marketplace and in Australia for managing businesses having diversified products.

The private branch exchange (PBX) features that initiated and stimulated the growth of call centers were first introduced in the late 1970s with the advent of incoming call-distribution features. These features automatically searched through lists of stations for idle agents who could answer incoming calls. The features' capabilities were limited, but AT&T customers soon used them to create the first implementations of PBX call centers using the Dimension® PBX.

The advent of the GBCS DEFINITY® System 75 and System 85 PBXs in the mid through late 1980s introduced new PBX features and adjunct products that propelled the call center business segment into one of the fastest growth areas of the telecommunications industry. Globally, annual growth has averaged about 20 percent in recent years.

Improvements to the DEFINITY Automatic Call Distribution (ACD) features in the 1980s allowed incoming traffic to be equitably distributed to the most idle agent in a group. The trend during this time was to create larger and larger homogeneous agent groups to gain efficiencies in numbers. However, it was difficult to make use of specialized agent skills in this environment, so all agents were trained generically with no individual career-development opportunities. Such a work environment contributed to high agent turnover.

Panel 1. Abbreviations, Acronyms, and Terms

ACD—Automatic Call Distribution, switching-system software that algorithmically distributes incoming calls to groups of agents, queuing calls if no agents are available

agent—the call center person who answers ACD calls

Agent LoginID—an extension-like number in the PBX that defines the characteristics of a call center agent, including the agent's skills, coverage path, calling permissions, and other feature capabilities

AWOH—Administration WithOut Hardware, a feature of the DEFINITY G3 PBX system

call center—a switching system designed to handle incoming and outgoing calls efficiently and profitably with an ACD system

call queuing—the call-processing function that (if no agents are available) queues incoming calls in their order of arrival, and then (if desired by the customer, using call vectoring) provides announcements and/or music until an agent becomes available

call vectoring—the DEFINITY PBX system's sophisticated ACD feature that allows a customer to define how a call to a Vector Directory Number (VDN) is to be treated and subsequently routed by means of vector programs. Vector programs, which specify how an incoming call is to be handled, are comprised of commands that resemble a high-level programming language

CMS—Call Management System, the adjunct system connected to a DEFINITY PBX system that provides call center management functions and collects ACD call-handling information

customer—for the purposes of this paper, the AT&T customer who is the owner of a call center

DEFINITY G3 PBX system—AT&T Global Business Communications Systems' PBX product that can serve a maximum of 25,000 station sets and 10,000 EAS agents

EAD—Expert Agent Distribution, an algorithm associated with the EAS skills-matching function

EAS—Expert Agent Selection, a feature of the DEFINITY G3 PBX system

hunt group—a group of non-EAS agents trained in handling certain types of ACD calls, defined as a group by using the agents' station-set extension numbers

PBX—private branch exchange, a business communications switching system that provides interconnections between station sets (usually at a single business location) and the public telephone network

skill group—a queue for incoming calls needing a particular EAS agent skill, and a queue for EAS agents who are trained with a certain call-handling skill

station set—a multibutton, multifunction telephone set

VDN—Vector Directory Number, an extension-like number in the DEFINITY PBX system used to route incoming callers to a particular call vector; each VDN can be used to distinguish the type of call center service needed by these callers

VDN skills—the skills that can be assigned to a VDN to indicate the agent needs of callers who are routed to that VDN

work modes—any of four ACD work states (auxiliary, after-call, auto-in, and manual-in) that an agent can select by pressing a station-set button or by dialing a code to control the delivery of ACD calls to that

The GBCS Call Management System (CMS) was also developed in the mid 1980s as an adjunct to the PBX to track the handling of incoming ACD calls accurately. A necessary element to CMS tracking was the concept of each agent having a *LoginID* that identified a particular person handling calls at a station set. However, an agent was still confined to logging in only at particular station sets, and the task of rearranging incoming call flows and agent group members by the call center system administrator was cumbersome and time consuming.

The EAS feature, introduced in the DEFINITY G3 Version 2 communications system, has made possible a new call center environment. The EAS skills-matching concept[1] allows easy classification of incoming call types (that is, incoming caller needs). It also simplifies programming of how incoming calls are routed to the proper agents

using a new call-distribution algorithm referred to as *Expert Agent Distribution (EAD)*. The *EAS Logical Agent concept*[2] allows agents to log in at any station set in the system, even from their home telephone if the CONVERSANT® system Home Agent® software feature is used.

Reasons for Developing EAS

EAS fundamentally changed the way in which DEFINITY Call Centers provide services for businesses. The reasons for EAS development are discussed next.

Improving Call-Routing Algorithms. In the 1980s, call-routing algorithms were too restrictive in that all agents designated to handle certain types of calls had to be placed in the same list of station extensions (referred to as a *hunt group*). These call-routing algorithms used a one-to-one association between the call type (that is, type of service needed to handle the call) and the hunt group that distributed the call to an idle agent in the group. Agents having either highly skilled expertise or broad expertise often were not fully used because they were "lumped" together with lesser-skilled agents. Call center managers sometimes moved agents having broad expertise from group to group to keep them busy. Furthermore, agents could not be classified by their level of expertise. Thus, calls could not be routed first to highly skilled agents.

Call center managers formed many small agent groups because of the desire to train agents specifically to handle unique caller needs. Not only was this inefficient in terms of the number of agents that had to be hired and trained. It also increased both the number of agent groups and the frequency of moving agents and station sets from one hunt group to another.

The DEFINITY G3 EAS feature allows customers to achieve new levels of call-routing flexibility by identifying incoming calls as having certain kinds of skill needs and then matching these calls with agents who are broadly trained or highly specialized.

Addressing Call Center Agent Issues with EAS. In the early 1990s, new trends in call centers started to emerge. *Agent empowerment* became a common theme. Agents now want to work in an environment in which they are not considered just a member of a group. Rather, they want to be treated as individuals having unique skills who contribute to the overall success of the business.

The ability of the EAS feature to provide support for agent empowerment programs was a key ingredient in its design. Agents not only want their fair share of calls, but also the opportunity to specialize and receive calls that make use of their special talents. Business managers for call centers have seen increased satisfaction of callers who interact with agents having a high level of job satisfaction.

Another aspect of morale in the call center addressed by the EAS feature is the personalization it provides through each agent's *Agent LoginID*. In previous systems, an agent worked as an anonymous user at a station set. With EAS, each agent activates unique attributes when logging in with an assigned Agent LoginID. This imparts a real sense of importance to each individual in the call center work environment.

Before EAS, agents belonging to multiple hunt groups handled calls with equal priority. With EAS, agents can be assigned two levels of expertise or call preference. They are assigned a skill type of *primary* for calls in which they are highly experienced or have a preference for handling. Agents are assigned a skill type of *secondary* for call types in which they are less experienced in handling or for which they serve as a back-up for other agents. Agents only receive calls for secondary skills if there are no calls waiting for their primary skill(s).

Making the Agent's Job Easier. Before EAS, an agent assigned to multiple hunt groups logged in to each group one at a time. In addition, most ACD buttons on a multibutton station set required a fixed hunt-group association. An agent logged in to three hunt groups required three copies of the same ACD buttons to handle incoming calls. Also, if requiring assistance with a call, an agent had to decide which of many Assist buttons to press to call the supervisor best qualified to help.

With EAS, when an agent logs in at a station set, all assigned skills automatically associate with a single set of ACD buttons on that station set. Pressing a single work-mode button, for example, affects the call-handling mode of all the agent's skills. Additionally, an agent need only press a single Assist button to instruct the DEFINITY PBX system to call a supervisor automatically, one who can best help the agent with the current call.

Saving the System Administrator's Time with EAS. Call center administrators realize a big savings in time and paperwork by no longer tracking the station set extensions where agents work and by not needing to readminister station set ACD buttons as agent responsibil-

ities change. Call center managers can quickly deal with such workplace matters as agent illness, work environment problems, and transitional sales promotions because call center administrators can easily rearrange the station sets at which EAS agents work and the types of calls the agents receive.

Call Center Problem Solving with EAS. The following are some common problems that had been identified in many call centers and how they can be solved by EAS.

Call center problem: Two agents missed the training for a new product being added to the call-handling responsibilities of a hunt group.

Pre-EAS solution: The only options were either to delay introduction of the new product or remove the two agents from the hunt group (preventing the agents from taking calls about existing products).

EAS solution: Each product can be assigned a skill number. Agents who have successfully completed their training are permitted to handle calls for the new product. The two agents who missed training are not assigned this skill, but they can continue to handle calls for other products.

Call center problem: During an emergency, agents must be able to occupy any work station and yet have supervisors, other agents, and outside clients call them directly.

Pre-EAS solution: Agents used station sets administered for a specific agent group, and the station set's ACD buttons were rigidly associated with a single agent group. When agents logged in at a different station set during an emergency, no easy way existed to call that agent directly.

EAS solution: EAS agents can answer calls at any station set because there is no administered association of a station set to an agent group. When the EAS agent logs in, the station set's ACD buttons are dynamically associated with all the skills assigned to that agent. When an Agent LoginID is dialed, the DEFINITY PBX system automatically directs the call to the location of the station set on which that agent is logged.

How EAS Skills Matching Works

The purpose of the EAS skills-matching call-processing algorithm is to match the skill needs of an incoming caller with the particular expertise of an agent who handles the call. Each incoming call can be assigned up to three Vector Directory Number (VDN) skills that represent the needs of the caller. VDN skills are those that can be assigned to a VDN to indicate the needs of callers who are routed to that VDN.

Each agent is assigned up to four agent skills that represent areas of expertise. The EAS skills-matching algorithm distributes an incoming call to the appropriate DEFINITY call queue(s) based on the skill(s) needed by the caller. Then, it directs the call to an agent assigned with a skill that matches at least one of the caller's needs.

The EAS skills-matching algorithm can be thought of as three separate call-processing functions:

1. Determining the needs of an incoming call (in terms of one or more skills);
2. Determining the agents having the necessary skills who are currently available to receive a call; and
3. Carrying out a best-fit matching of the incoming call needs to the agents who have the required skills.

The skill needs of an incoming call can be determined in a variety of ways. For example, callers' needs can be determined by the 800 number dialed, the phone number from which they are calling, the digits entered (or words spoken) in response to a call-prompting announcement, or through an adjunct processor interface to a host computer.

Next, the system determines the skills of agents currently available by examining the status of available-agent queues. All EAS agents are defined by a DEFINITY PBX system administrator to have up to four skills based on the knowledge and training that each agent possesses (for example, the ability to speak multiple languages, knowledge about certain products, or the interpersonal skills useful for dealing with customers). Each of an agent's four skills can be designated by the administrator as a primary or secondary skill. When logging in, an agent must enter an ACD work mode. This lets the system know that the agent is ready to receive an ACD call and makes the agent available in the agent's associated skill groups.

Finally, to do the *best-fit matching* of the skill needs of incoming calls to available agents, the highly flexible DEFINITY Call Vectoring feature is used. This feature provides the customer with the ability to create Call Vector programs that control the routing of incoming calls. The goal of most vectors is to place a call with a particular skill need in a call queue to be served by an

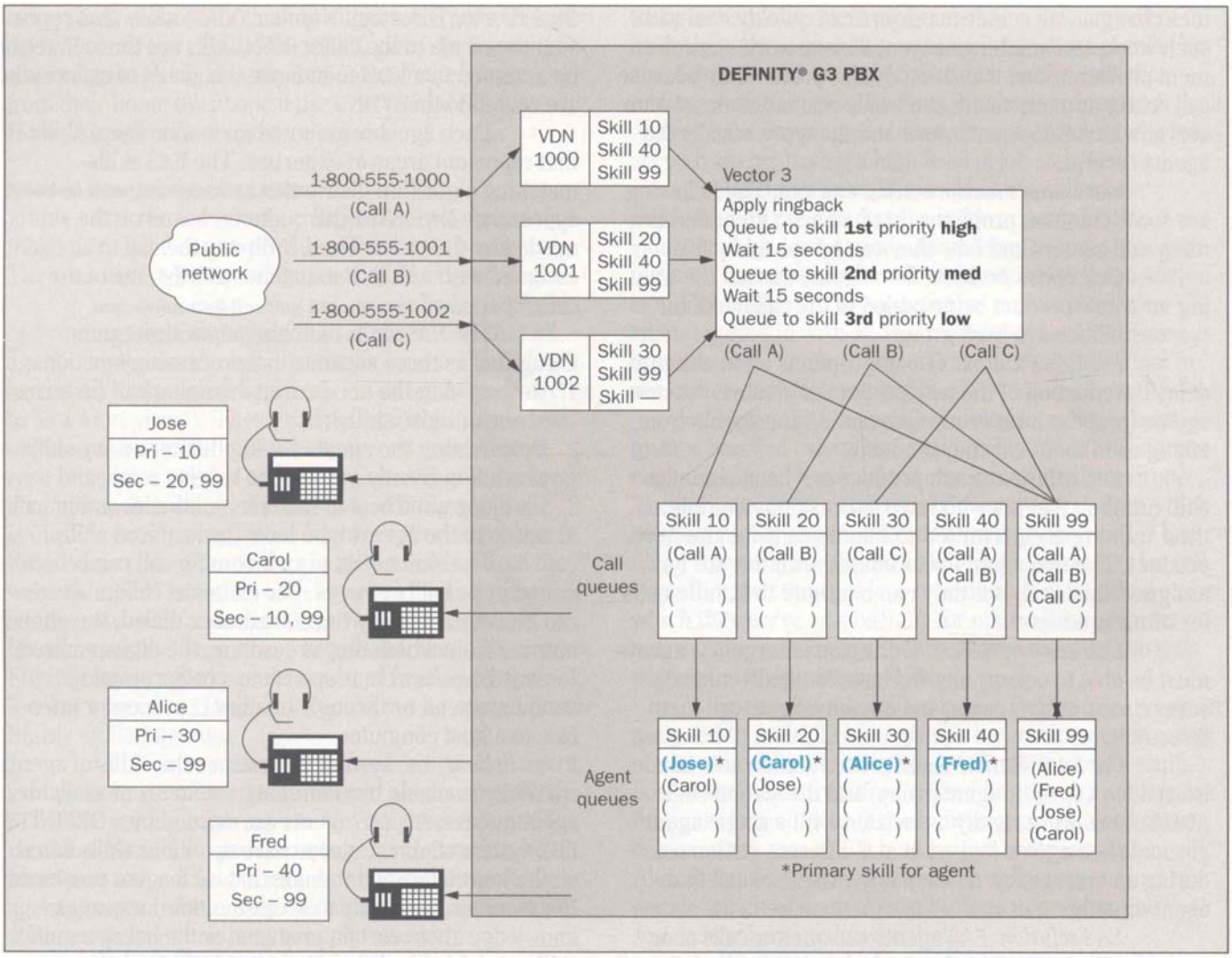

Figure 1. This illustration shows how incoming calls are routed using Expert Agent Selection (EAS) skills matching. The agent queues directly beneath each call queue maintain a list of agents who have either primary or secondary skills that match the incoming call types. Because of the Expert Agent Distribution algorithm, the primary-skill agents are always placed ahead of those having secondary skills in the skill-group queues.

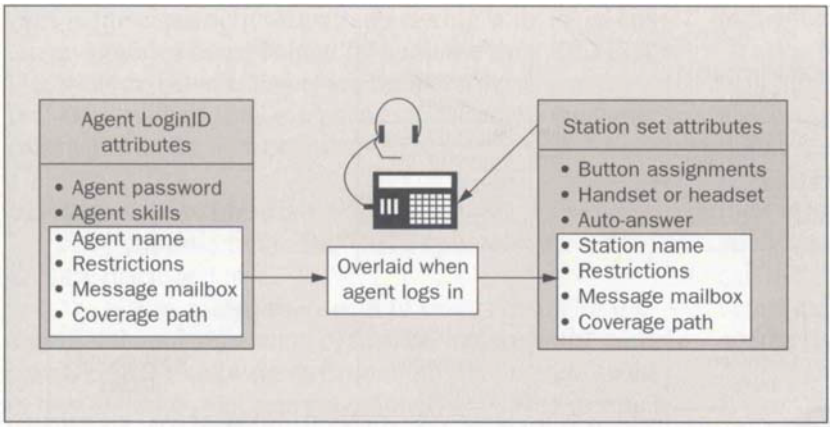

Figure 2. The drawing shows the overlaying of a station set's attributes during EAS agent login. The key to the Logical Agent feature is that each agent's Agent LoginID identifies the personality profile of the individual logged in at a station set. The system associates an Agent LoginID with a particular station set during the login process. As part of the login processing, the attributes of the Agent LoginID temporarily overlay the corresponding attributes administered for the station set.

agent having that skill. While the caller waits in the queue until an agent becomes available, some form of audible feedback (for example, music, recorded messages, ring back, and so forth) typically is provided.

When an agent becomes available, vector processing stops and the call is immediately delivered to that agent. Following is an example of a call vector that matches an incoming call's skill needs to an available agent having the appropriate skill:

1. Queue to main skill first priority medium
2. Wait ten seconds hearing ringback
3. Announcement 83221 "Thank you for calling ..."
4. Check backup skill 47 priority high if calls queued < 5
5. Wait time 30 seconds hearing music
6. Check backup skill 58 priority high if oldest call waiting < 30
7. Announcement 83555 "Please stay on the line ..."
8. Go to step 5

Figure 1 shows how incoming calls are routed to a VDN having associated skill numbers and how they are then processed by vector commands to place the call in queues that match the incoming callers' needs. The agent queues directly beneath each call queue maintain a list of agents who have either primary or secondary skills that match the incoming call types. Note that for the EAD algorithm, the primary-skill agents are always placed ahead of secondary-skill agents in the skill-group agent queues.

How the EAS Logical Agent Works. As previously noted, the Logical Agent part of EAS provides great flexibility in allowing call center agents to log in and answer calls at any station set connected to the DEFINITY PBX system, a significant departure from the traditional DEFINITY call center environment. The key to the Logical Agent feature is that each Agent LoginID identifies the personality profile of the individual logging in at a station set. The system associates an Agent LoginID with a particular station set during the login process. On logging in, the attributes of the Agent LoginID temporarily overlay the corresponding attributes administered for the station set (see Figure 2).

After the agent is logged in, calls to an Agent LoginID are automatically routed to the station set at which the agent is working. Calls to and from the station set are controlled by the calling permissions administered for the Agent LoginID. For example, a station set's calling permissions could be set up to prevent making long-distance calls. If an Agent LoginID's calling permissions are set to allow the dialing of long-distance calls, an agent is enabled to make long-distance calls after logging in at that station.

Any outside caller who wishes to contact a specific agent can use an Agent LoginID to call an agent, no matter where that agent has logged in. If the agent is not currently logged in or is busy, and if the Agent LoginID is administered with a coverage path, the call can be routed to another Agent LoginID, the agent's supervisor, or a voice mailbox for the agent. Such alternate routing allows agents to provide personalized service to their customers, as well as to ensure a caller does not hear continuous ringing.

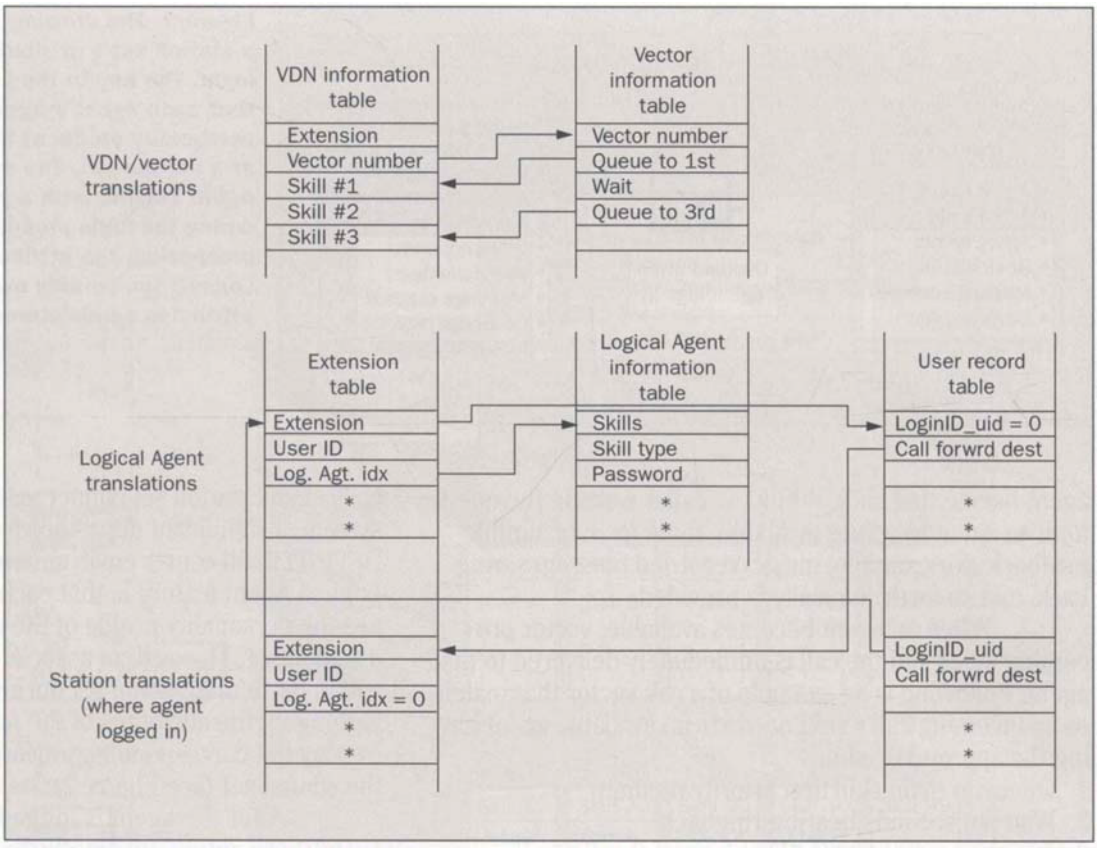

Figure 3. This block diagram summarizes the EAS data structures. With the exception of new database items associated with assigning Vector Directory Number (VDN) skills to a VDN, EAS skills matching was accomplished by reusing and modifying the existing DEFINITY call-queue and hunt-group data structures. To support call processing for Agent LoginIDs, entries reside in the extension and user record tables just like station set extensions.

One Customer's Implementation of EAS

One of the first DEFINITY G3 EAS customers was Hanover Direct of Hanover, Pennsylvania. This company receives telephone orders from customers who shop through catalogs. The range of products offered includes gifts, apparel, safety items, and linens. Hanover Direct selected the EAS feature because EAS supports many diverse caller needs and agent skills that are easily quantified and managed.

Hanover Direct defines various EAS skills to indicate a specific catalog or a combination of catalogs, customer services, and fluency in Spanish. A caller's needs are identified primarily by noting the 800 number dialed or by using a call-prompting voice message that directs, "Press 1 to place an order; press 2 to request a catalog."

Nearly all Hanover Direct employees (and not just their call center agents) are trained to take catalog orders. When call volume peaks, associates in the mail room and other support organizations log in and help take orders. Managers are members of a "SWAT" team who also log in when the incoming call volume is overwhelming. Because each Agent LoginID identifies the types of incoming calls a person is trained to handle, members of backup teams can sit at any desk equipped with the proper order-entry terminal. Station sets and ACD buttons no longer need reassigning for such emergencies. Thus, Hanover Direct has realized a 25-percent savings in system administration time with EAS.

EAS gives Hanover Direct the training flexibility it needs. Agents begin their instruction by learning order-entry skills. Later, they can expand their proficiency by acquiring customer-service skills, increasing their value and standing in the company.

To make the job of training new agents easier, Hanover Direct temporarily furnishes each trainee with a separate skill. This skill allows the practice handling of

calls in the classroom without interfering with actual customer inquiries being routed through the same DEFINITY PBX system. Later, trainees are temporarily assigned a real agent skill so they can answer some actual customer calls while under instructor supervision.

DEFINITY EAS Realization

Four keys to the DEFINITY system's realization of EAS are discussed next.

Overall Design Strategy. A primary reason for the successful implementation of the EAS feature in the complex DEFINITY software environment was the time spent in the preliminary design stages analyzing areas in which existing code could be reused. Instead of embarking on an entirely new software architecture for EAS, older code used for traditional ACD call processing was overlaid with new data structures and call-routing algorithms. This strategy resulted in a substantial reduction in the expected EAS software development effort.

Implementing EAS Skill Matching. The primary software change involved in implementing the EAS skills-matching function of *determining the needs of an incoming call* was adding the capability for VDN skills. This involved the addition of a new data structure in the existing software tables to allow up to three VDN skills to be stored for each VDN extension. When the customer designs a vector that uses the "1st," "2nd," or "3rd" keywords to specify the location at which the incoming call is to be queued, the call-processing software references the corresponding VDN skill associated with the currently active VDN to determine the exact skill number for the call (see Figure 1). Then, EAS call-processing software places the incoming call in the proper skill group to route the call to an agent (if one is available).

The changes required for the EAS skills-matching function of *determining the agents having the necessary skills* required the addition of the EAD algorithm. When a primary-skill agent becomes available to receive a call, the EAD algorithm ensures that the agent is placed in that skill group behind all other *primary-skill* agents (and ahead of any secondary-skill agents) already queued in that group. When a secondary-skill agent becomes available, the EAD algorithm places the agent behind all other *secondary-skill* agents already queued in that group. In this way, the primary-skill agent who has not received a call for the longest amount of time moves to the top of the available-agent queue for that skill.

The changes required for the EAS best-fit skills-matching function involved implementing a call-processing algorithm that determines—in a new way—the next call to route to an agent when the agent completes a current call. In previous DEFINITY systems, there was no priority given to searching the call queues an agent was logged into before routing the next waiting call to that agent. When the agent became available, the oldest call waiting in the *entire set* of hunt groups the agent was logged into was routed to the agent.

Now, with EAS, a new algorithm is implemented. It searches first through only the set of *primary-skill groups* associated with the agent who just finished a call, and then it routes the oldest call waiting in those skill groups to the agent. If no waiting calls are found in the agent's primary-skill groups, then the skill-group call queues associated with the agent's *secondary-skill groups* are searched for waiting calls. In this way, the system does a best-fit match to direct an incoming call having a particular skill need to an agent who can best handle the call.

Implementing EAS Logical Agent. For the EAS Logical Agent capability, building on existing DEFINITY features and data resulted in savings of both development effort and memory use. Although an Agent LoginID does not seem to have much similarity with a station set, the Agent LoginID still needs some of the software characteristics of a real station set. For example, a requirement is that a call can be routed both to an Agent LoginID and an agent's coverage path as if the call was made to a normal station set.

The DEFINITY Administration WithOut Hardware (AWOH) feature was reused to allow attributes to be assigned to an Agent LoginID. Originally, the AWOH feature was developed to allow DEFINITY customers to define the attributes of users' station sets before the system was actually installed, and then allow users to self-install their own station sets simply by plugging them in and dialing the appropriate AWOH feature code. In the EAS software design, the AWOH processing concept was modified to allow the attributes of an Agent LoginID to be administered for an agent without binding the Agent LoginID to a real station set. This approach yielded a significant savings in development effort.

The design of the Logical Agent capability also capitalized on Call Forwarding, a commonly used PBX

feature. Logging in with an EAS Agent LoginID overlays the *call-forwarding destination* database item for that LoginID with the extension number of the station set at which the agent logs in. Then, when a user calls an EAS agent by dialing the Agent LoginID, the PBX routes the call to that agent as if it were call forwarded. With this approach, much development effort was saved by sharing code and the software data structures previously implemented for the Call Forwarding feature.

EAS Data Structures. As shown in Figure 3—and with the exception of new database items associated with assigning VDN skills to a VDN—EAS skills matching was accomplished by reusing and modifying the existing DEFINITY call-queue and hunt-group data structures. To support call processing for Agent LoginIDs, entries reside in the extension and user record tables just like station-set extensions.

Information specific to Agent LoginIDs (such as agent passwords) could have been included in the existing tables for all extension numbers in the DEFINITY PBX system. Valuable system memory would also have been required, however, for each station set to store this information even though the station would not have used it. Thus, to conserve memory, this information was placed in a new Logical Agent information table.

The entry in the extension table for the Agent LoginID provides the index into the Logical Agent information table, which contains data (password, skills, and skill types) needed to process the agent's login operation. On logging in, the call-forwarding destination field of the user record entry for an agent's Agent LoginID is populated with the extension of the station set at which the agent has logged in. This information is used to route calls to the Agent LoginID and the station set at which the agent is logged in. Also on logging in, the *LoginID_uid* field of the station set's user record is populated with a User Identifier (UID) associated with the agent's Agent LoginID. This field allows call-processing software triggered by some agent action (such as picking up the handset to make a call) to change the station set's identity to the logged-in agent's identity.

Summary

The current and future benefits realized with the introduction of EAS into the DEFINITY G3 PBX Call Center product include the following:

- Two innovative concepts have been patented that will help AT&T achieve a marketing and sales advantage over similar PBX products from non-AT&T vendors;
- Much of the EAS feature implementation was achieved by building on (and reusing) the current set of DEFINITY Call Center features; and
- EAS has created a new call center environment that provides enhanced functionality for AT&T customers and improves agent productivity.

Acknowledgments

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