US 20050256846A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0256846 A1

Zigmond et al. (43) Pub. Date: Nov. 17, 2005

(54) INTERACTIVE CLIENT-SERVER DATA SEARCH

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(21) Appl. No.: **10/844,091**

(22) Filed: **May 12, 2004**

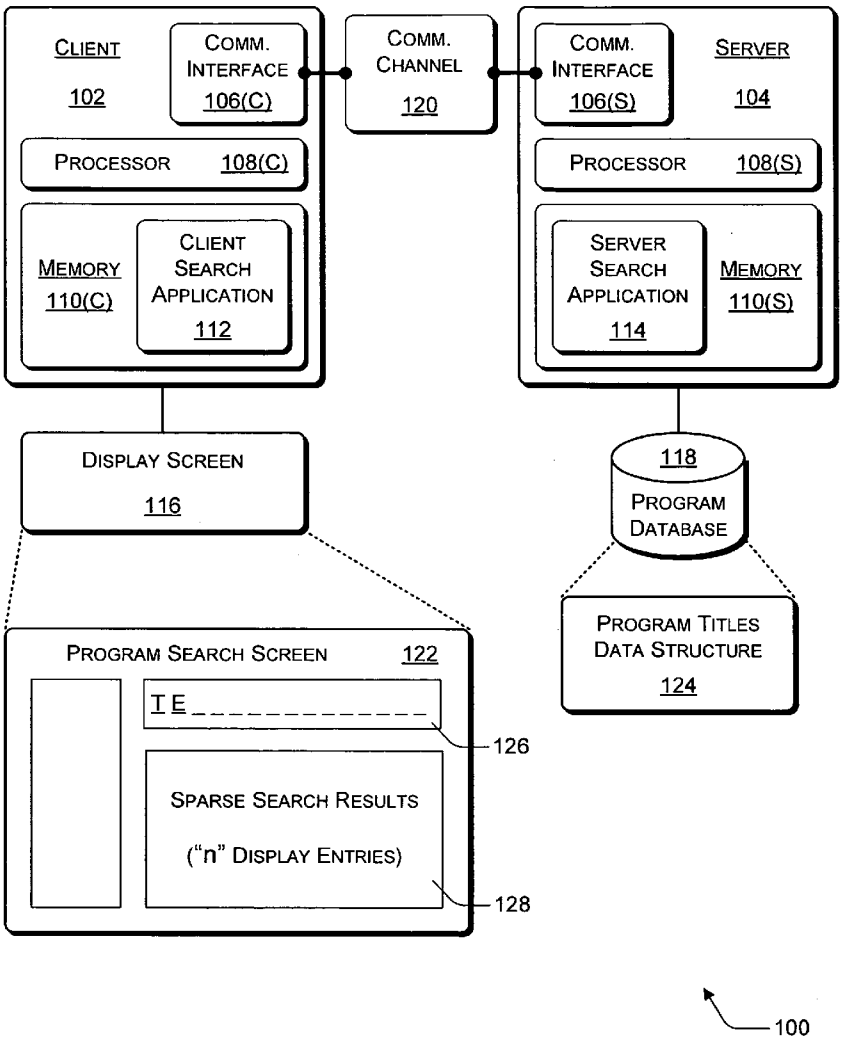
Publication Classification

(51) **Int. Cl.**[7] **G06F 7/00**

(52) **U.S. Cl.** **707/3**

(57) **ABSTRACT**

An interactive client-server data search involves accepting search-related inputs from a user at a client and having the search performed on a data collection at a server. To reduce transmission latencies, the client prefetches search results prior to input from the user. When a user indicates that a search is to be requested, the client prefetches a sparse subset of data of a size that is sufficient to fill a search results display area of the client regardless of a first input character. In other words, a number of possible results for each character that might be first input is prefetched from the server. This number of possible results per character is set responsive to a number of displayable entries at the client. When a user actually inputs a character, the possible results for the input character is retrieved from the sparse subset of data and presented to the user.



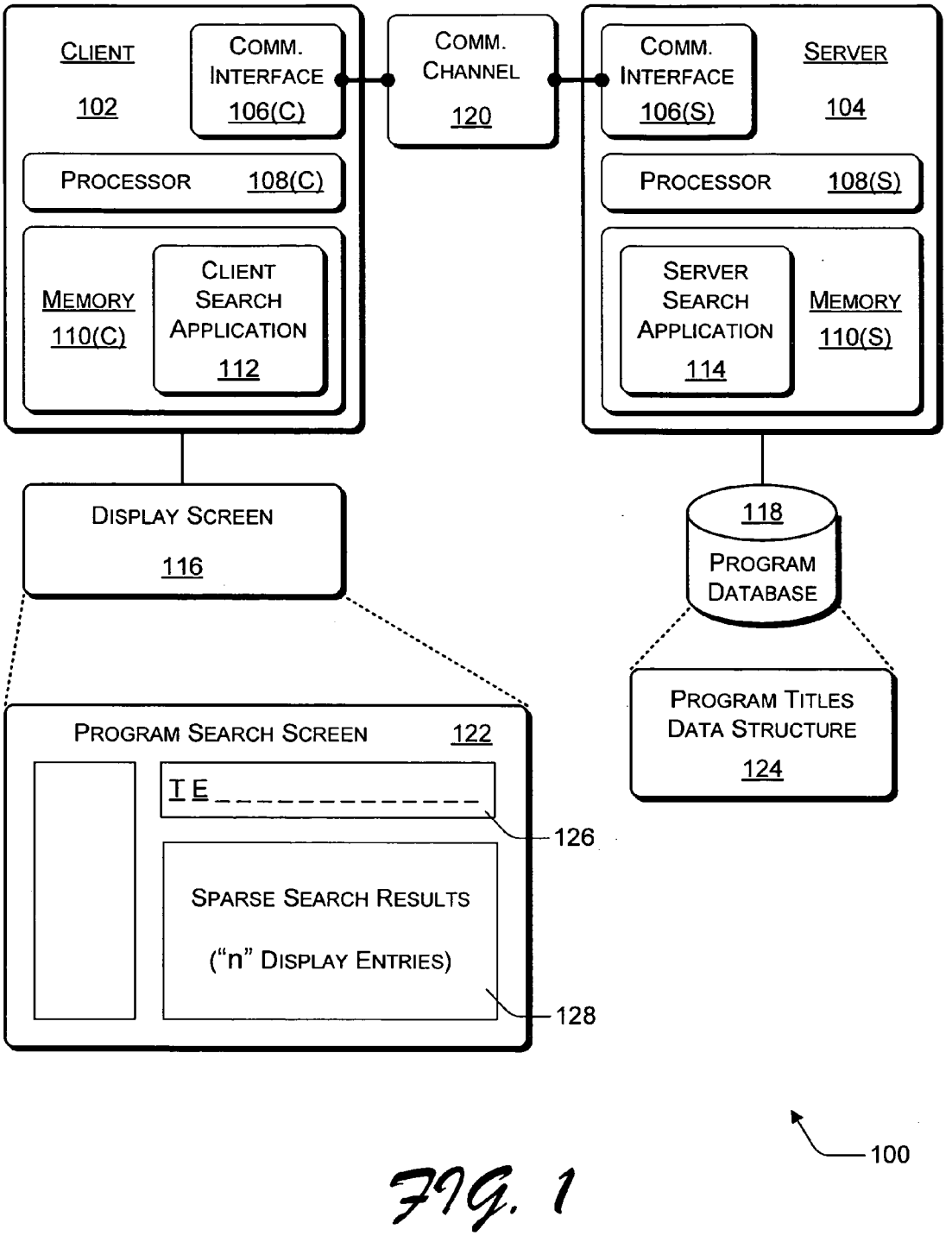

CLIENT
102
COMM. INTERFACE
106(C)
COMM. CHANNEL
120
COMM. INTERFACE
106(S)
SERVER
104
PROCESSOR
108(C)
PROCESSOR
108(S)
MEMORY
110(C)
CLIENT SEARCH APPLICATION
112
SERVER SEARCH APPLICATION
114
MEMORY
110(S)
DISPLAY SCREEN
116
118
PROGRAM DATABASE
PROGRAM TITLES DATA STRUCTURE
124
PROGRAM SEARCH SCREEN
122
T E
126
SPARSE SEARCH RESULTS
("n" DISPLAY ENTRIES)
128
100

FIG. 1

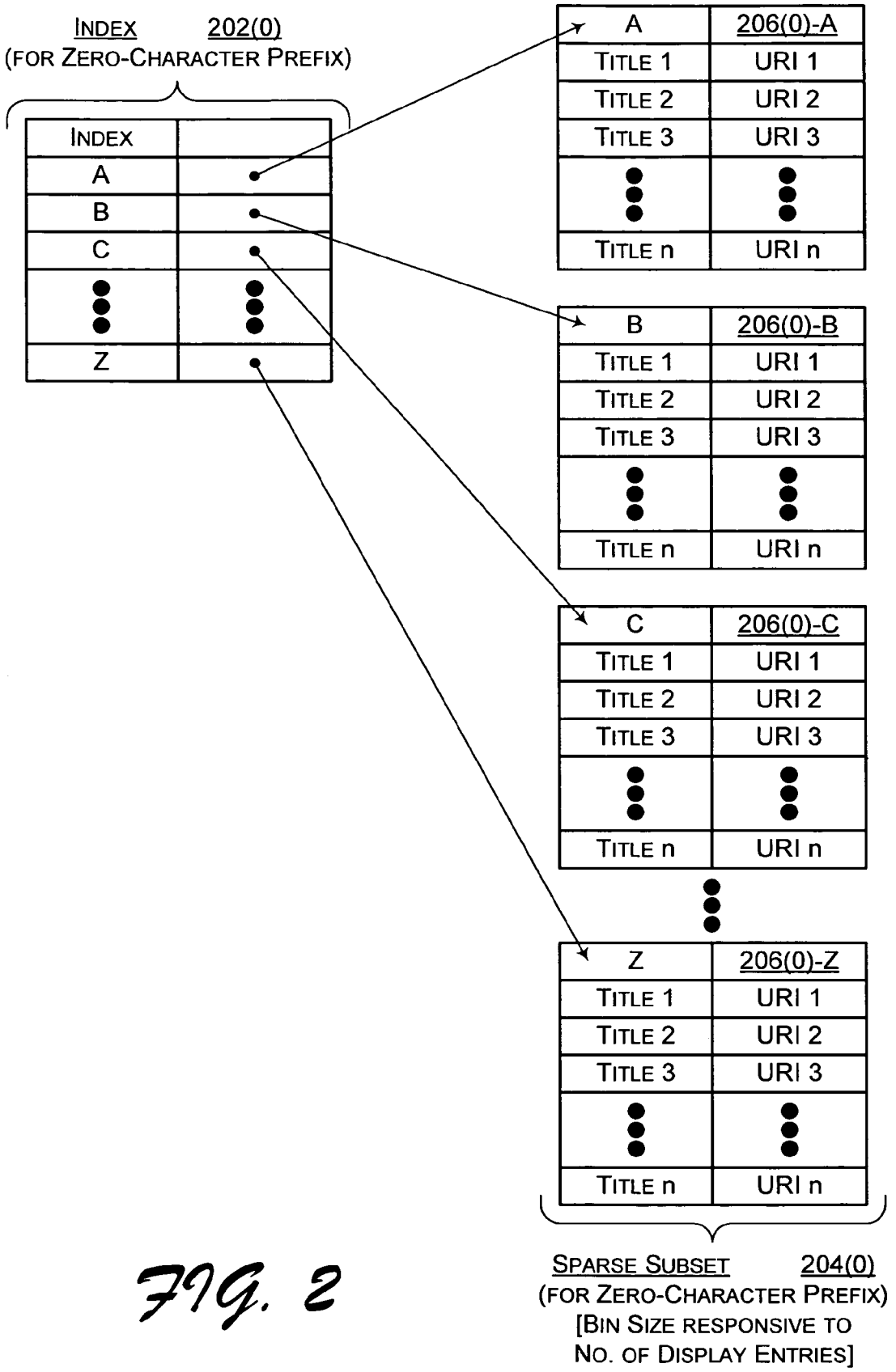

INDEX 202(0)
(FOR ZERO-CHARACTER PREFIX)
INDEX
A
B
C
Z
A
206(0)-A
TITLE 1
URI 1
TITLE 2
URI 2
TITLE 3
URI 3
TITLE n
URI n
B
206(0)-B
TITLE 1
URI 1
TITLE 2
URI 2
TITLE 3
URI 3
TITLE n
URI n
C
206(0)-C
TITLE 1
URI 1
TITLE 2
URI 2
TITLE 3
URI 3
TITLE n
URI n
Z
206(0)-Z
TITLE 1
URI 1
TITLE 2
URI 2
TITLE 3
URI 3
TITLE n
URI n
SPARSE SUBSET 204(0)
(FOR ZERO-CHARACTER PREFIX)
[BIN SIZE RESPONSIVE TO
NO. OF DISPLAY ENTRIES]

FIG. 2

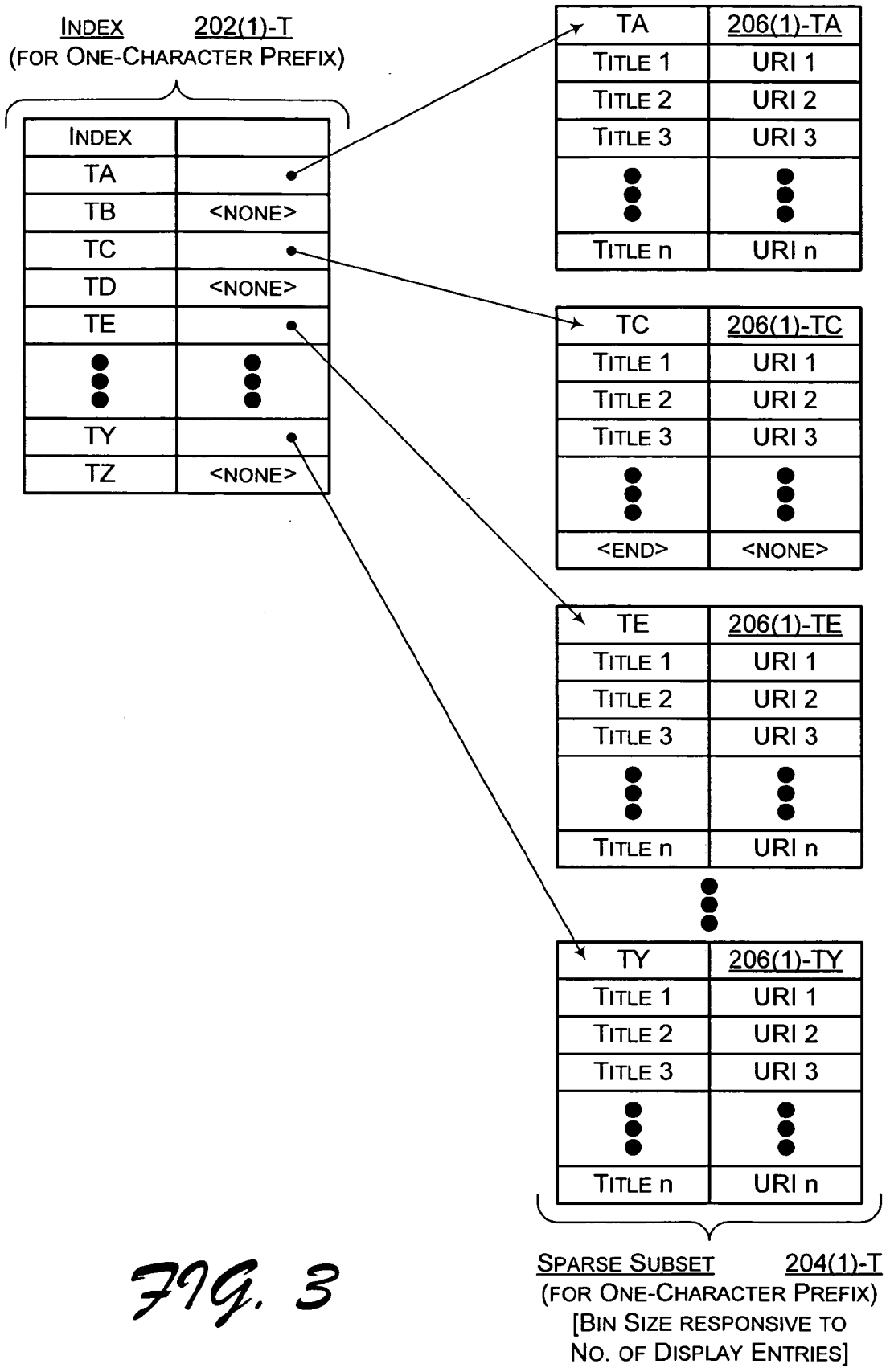

INDEX 202(1)-T
(FOR ONE-CHARACTER PREFIX)
INDEX
TA
TB <NONE>
TC
TD <NONE>
TE
TY
TZ <NONE>
TA 206(1)-TA
TITLE 1 URI 1
TITLE 2 URI 2
TITLE 3 URI 3
TITLE n URI n
TC 206(1)-TC
TITLE 1 URI 1
TITLE 2 URI 2
TITLE 3 URI 3
<END> <NONE>
TE 206(1)-TE
TITLE 1 URI 1
TITLE 2 URI 2
TITLE 3 URI 3
TITLE n URI n
TY 206(1)-TY
TITLE 1 URI 1
TITLE 2 URI 2
TITLE 3 URI 3
TITLE n URI n
SPARSE SUBSET 204(1)-T
(FOR ONE-CHARACTER PREFIX)
[BIN SIZE RESPONSIVE TO
NO. OF DISPLAY ENTRIES]

FIG. 3

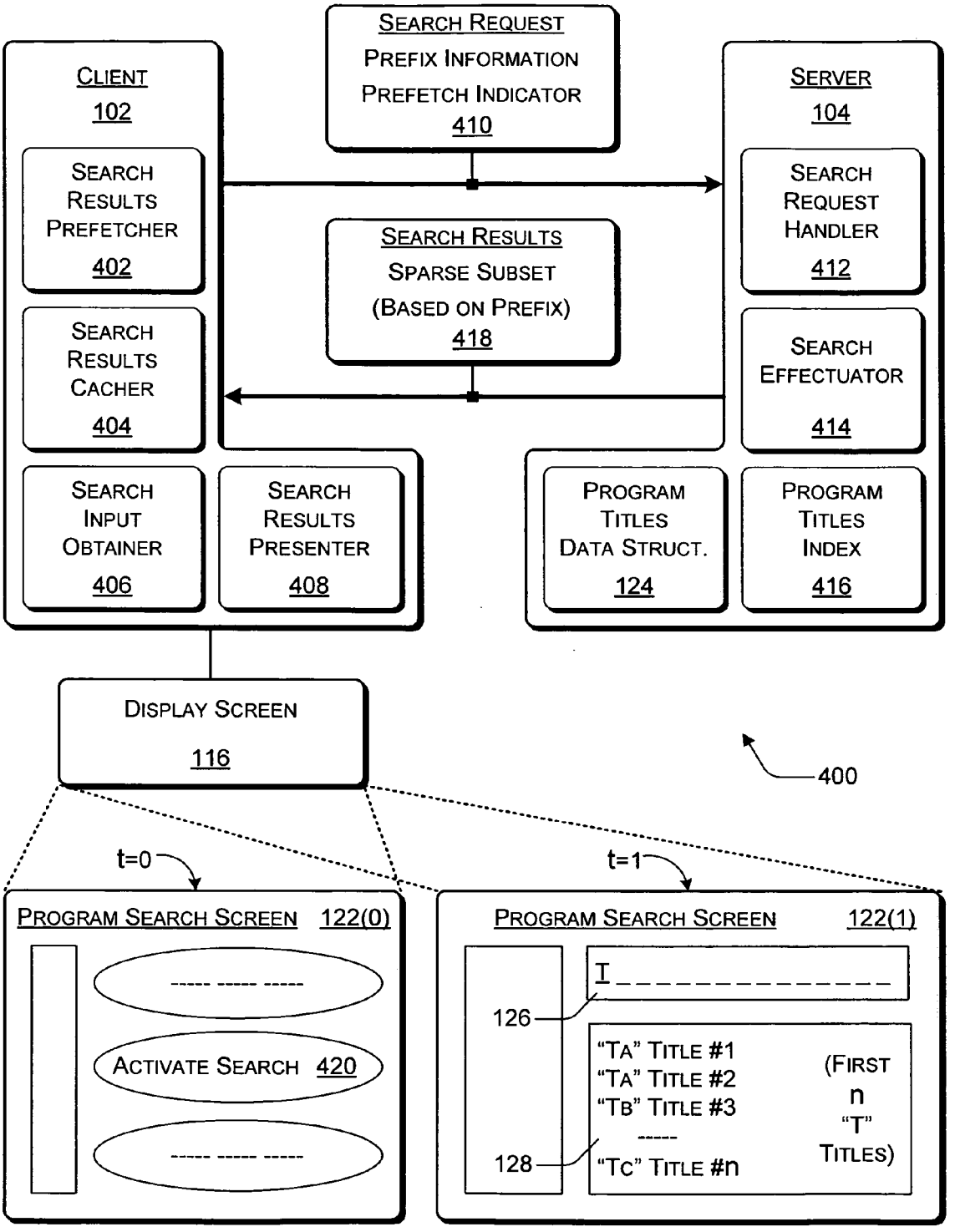

SEARCH REQUEST
PREFIX INFORMATION
PREFETCH INDICATOR
410
CLIENT
102
SERVER
104
SEARCH RESULTS PREFETCHER
402
SEARCH REQUEST HANDLER
412
SEARCH RESULTS
SPARSE SUBSET
(BASED ON PREFIX)
418
SEARCH RESULTS CACHER
404
SEARCH EFFECTUATOR
414
SEARCH INPUT OBTAINER
406
SEARCH RESULTS PRESENTER
408
PROGRAM TITLES DATA STRUCT.
124
PROGRAM TITLES INDEX
416
DISPLAY SCREEN
116
400
t=0
t=1
PROGRAM SEARCH SCREEN 122(0)
ACTIVATE SEARCH 420
PROGRAM SEARCH SCREEN 122(1)
126
128
"TA" TITLE #1
"TA" TITLE #2
"TB" TITLE #3
"TC" TITLE #n
(FIRST n "T" TITLES)

FIG. 4

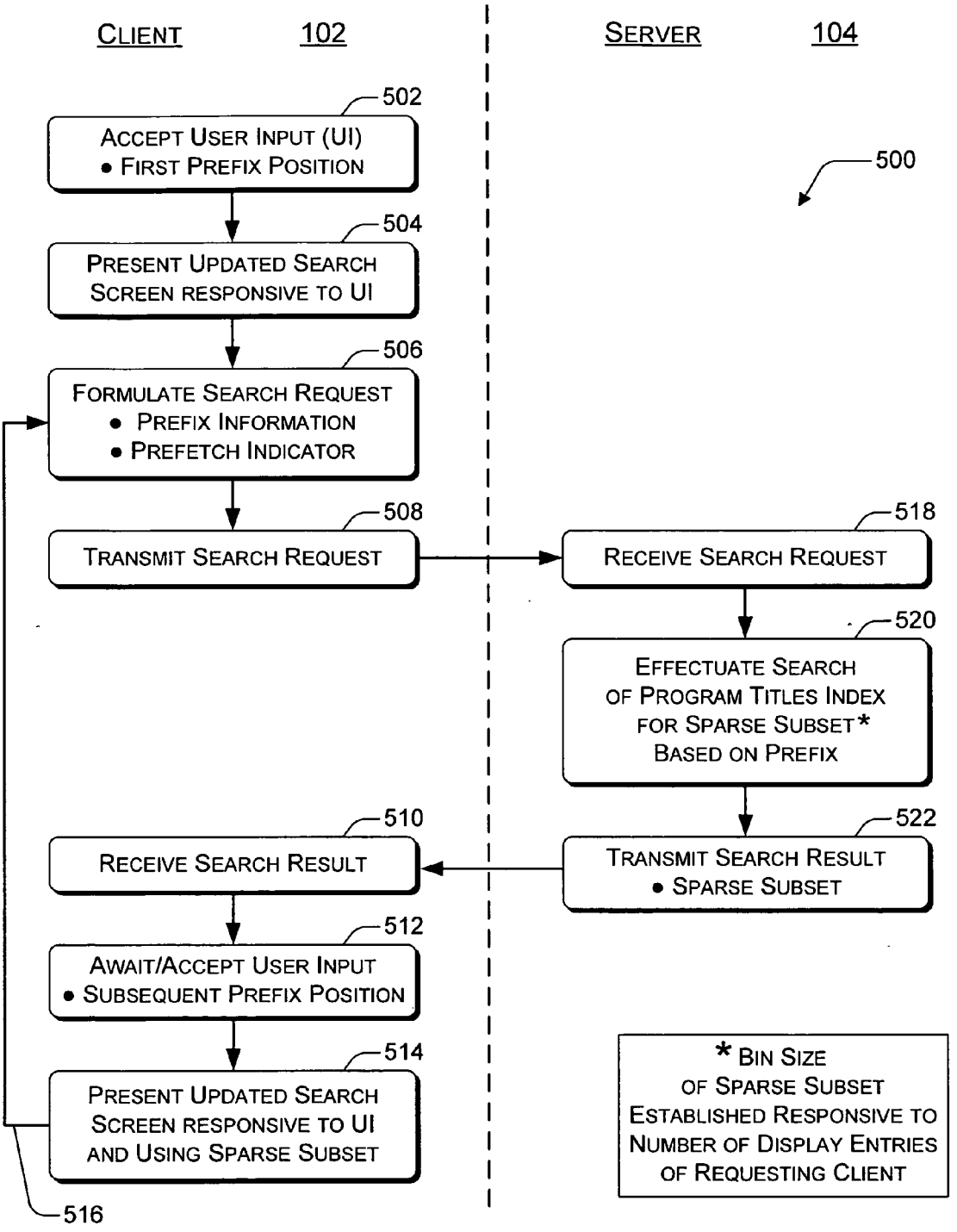

CLIENT 102
SERVER 104
500
502
ACCEPT USER INPUT (UI)
• FIRST PREFIX POSITION
504
PRESENT UPDATED SEARCH SCREEN RESPONSIVE TO UI
506
FORMULATE SEARCH REQUEST
• PREFIX INFORMATION
• PREFETCH INDICATOR
508
TRANSMIT SEARCH REQUEST
518
RECEIVE SEARCH REQUEST
520
EFFECTUATE SEARCH OF PROGRAM TITLES INDEX FOR SPARSE SUBSET* BASED ON PREFIX
522
TRANSMIT SEARCH RESULT
• SPARSE SUBSET
510
RECEIVE SEARCH RESULT
512
AWAIT/ACCEPT USER INPUT
• SUBSEQUENT PREFIX POSITION
514
PRESENT UPDATED SEARCH SCREEN RESPONSIVE TO UI AND USING SPARSE SUBSET
516
* BIN SIZE OF SPARSE SUBSET ESTABLISHED RESPONSIVE TO NUMBER OF DISPLAY ENTRIES OF REQUESTING CLIENT

FIG. 5

INTERACTIVE CLIENT-SERVER DATA SEARCH

TECHNICAL FIELD

[0001] This disclosure relates in general to an interactive data search between a client and a server and in particular, by way of example but not limitation, to presenting search results from interactive data searches between a client and a server using sparse subsets of the searched data.

BACKGROUND

[0002] Many modern television systems offer hundreds of channels. While customers enjoy having this many viewing options, trying to find a desirable program can be a daunting and time-consuming task. For example, the sheer number of channel options makes scrolling through every channel impractical. One feature used by such modern television systems to combat the overwhelming number of viewing options is the search feature. A user of a television device can activate a search feature and then enter letters until a looked-for title entry is provided on a display screen of the television device.

[0003] Some television systems today offer a search-as-you-type feature in which a list of title-matching programs that is provided on the display screen is automatically updated as a user enters additional letters. For example, when the user types "F," the programs having titles starting with 'F" are displayed. If the user next types "R," then the list is narrowed to only those programs having titles starting with "FR." This continues until the user either sees the program title he or she is looking for or decides to scroll manually through the resulting, narrowed list.

[0004] This program-title-searching feature may be offered to users by storing a complete list of all program titles on each user's client television device and by performing the program title search locally. Unfortunately, this requires that a large amount of program title data be stored on the client television device, which mandates a large memory storage capability. Furthermore, this local storage requires that the program title data be kept up-to-date, which can introduce significant overhead bandwidth traffic into a television-based network. This bandwidth traffic overhead can be especially severe when the list of available programs changes frequently and therefore causes the client television device to risk becoming out-of-date absent frequent updates of the locally-stored program title data.

[0005] Accordingly, there is a need for schemes and/or techniques that can provide a program-searching feature to users of client television devices in an up-to-date and/or efficient manner.

SUMMARY

[0006] An interactive client-server data search involves accepting search-related inputs from a user at a client and having the search performed on an indexed data collection at a server. To reduce transmission latencies, the client prefetches search results prior to input from the user. When a user indicates that a search is to be requested, the client prefetches a sparse subset of data of a size that is sufficient to fill a search results display area of the client regardless of a first input character. In other words, a number of possible results for each character that might be input by the user is prefetched from the server. This number of possible results per character is set responsive to a number of displayable entries at the client. When a user actually inputs a character, the number of possible results for the input character is retrieved from the sparse subset of data and presented to the user.

[0007] The input character is also used to prefetch another sparse subset of data in which the input character is used as a one-character prefix for this other sparse subset of data. This other sparse subset of data now includes sufficient results for each possible second character to fill the search results display area of the client. Consequently, the visually-presented search results can be further narrowed responsive to the inputting of another character without waiting for another communication from the server. The procedure may continue until the user elects to manually scroll through the remaining, relatively narrow search results.

[0008] Other method, system, approach, apparatus, server, client, device, media, procedure, arrangement, etc. implementations are described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The same numbers are used throughout the drawings to reference like and/or corresponding aspects, features, and components.

[0010] **FIG. 1** is a block diagram illustrating an example of a client providing a program search function via interaction with a server capable of performing a search of program data.

[0011] **FIG. 2** illustrates an example of an index and a sparse subset with regard to a zero-character prefix for a program titles data structure.

[0012] **FIG. 3** illustrates an example of an index and a sparse subset with regard to a one-character prefix for a program titles data structure.

[0013] **FIG. 4** is a block diagram illustrating an example of an approach to a client-server interactive data search in which a search request having prefix information and search results having a sparse subset are exchanged between a client and a server.

[0014] **FIG. 5** is a flow diagram that illustrates an example of a method for performing an interactive client-server data search responsive to user input along with a search results presentation.

DETAILED DESCRIPTION

[0015] Introduction

[0016] Searches of program data are enabled using an interactive approach between a client device and a server. The client device is responsive to user input instructing the client device to effectuate a search of the program data. The program data is located at and the search is actually performed at the server. In this manner, effects from storage limitations at the client, as well as network traffic overhead from frequent programming data updates, are ameliorated.

[0017] When a user activates a search function, the client device prefetches from the server an initial sparse subset of all programming titles of the program data. A size of the sparse subset is established, at least in part, responsive to the

number of display entries of a display screen associated with the client device. More specifically, the initial sparse subset may include a number of titles equal to the number of display entries times each character that may be in a programming title. For each given character of a total character set, the initial sparse subset includes a number of titles starting with the given character that equals the number of display entries.

[0018] When a user inputs an initial character, the portion of the initial sparse subset corresponding to the initial character is presented on the display screen by the client device, where the portion is of a size equal to the number of display entries. The client device also prefetches from the server a second sparse subset of programming titles of the program data that have the input initial character as their initial character. This second sparse subset also includes a number of titles equal to the number of display entries times each character that may be in a programming title, but the second sparse subset is selected from those titles that also start with the input initial character.

[0019] When a user inputs a second character, the portion of the second sparse subset, which portion is of a size equal to the number of display entries, corresponding to the second (and first) character is presented on the display screen by the client device. The client device also prefetches from the server a third sparse subset of programming titles of the program data that have the input initial character as their initial character and the input second character as the second character. This third sparse subset also includes a number of titles equal to the number of display entries times each character that may be in a programming title, but the third sparse subset is selected from those titles that also start with the input initial character and the input second character.

[0020] The accepting of additional user input and the prefetching of the next sparse subset may continue until the user attempts to scroll through a presented listing of a portion of a sparse subset. After scrolling is commenced, a dense listing that precedes or follows the currently-presented sparse subset may also be prefetched.

[0021] Example of Environment for Interactive Client-Server Data Searches

[0022] **FIG. 1** is a block diagram **100** illustrating an example of a client **102** providing a program search function via interaction with a server **104** capable of performing a search of program data associated with program database **118**. Client **102** is in communication with server **104** over a communication channel **120**. In a described implementation, client **102** comprises a television-based device having an associated display screen **116**, communication channel **120** comprises a television-based (e.g., cable, satellite, etc.) network or link(s) thereof, and server **104** comprises at least part of a headend or other node of a television-based network.

[0023] Client **102** receives television content, possibly from server **104**, through communication channel **120**. Such television content is displayed by client **102** on display screen **116**. Display screen **116** may be integral with or merely connected (wirelessly or by wire) to client **102**. Alternatively, client **102** may receive television content through a separate and different communication channel (not shown).

[0024] Client **102** includes one or more processors **108**(C), at least one memory **110**(C), and a communication interface **106**(C) that is coupled to communication channel **120**. Memory **110**(C) includes processor-executable instructions that are executable by processor **108**(C) to effectuate functions of client **102**. Memory **110**(C) may be realized as volatile and/or nonvolatile memory. More generally, client **102** may include and/or be coupled to media generally (e.g., electromagnetic or optical media) that may be volatile or non-volatile media, removable or non-removable media, storage or transmission media, some combination thereof, and so forth.

[0025] Memory **110**(C) includes a client search application **112**, which may comprise processor-executable instructions. More generally, client search application **112** may comprise hardware, software, firmware, or some combination thereof, and so forth. Although not explicitly shown, client **102** is capable of accepting user input (e.g., from a remote, a keypad, a touch pad/tablet, a keyboard, etc.). This user input may be provided to client search application **112**.

[0026] In response to user input, client search application **112** enables a user to have a search performed on program data via interaction with server **104**. Server **104** is described further herein below.

[0027] Specifically, client search application **112** is capable of presenting a program search screen **122** on display screen **116**. Client search application **112** enables a user to input a search term at character input field **126**. Two exemplary characters, "T" and "E", are illustrated in character input field **126**. The input search terms, using a search-as-the-user-types mechanism, are forwarded to server **104** as search requests (not shown in **FIG. 1**). Client search application **112** is also capable of presenting search results received from server **104** at search results field **128**. Client **102** is adapted to display "n" entries in search results field **128**, where "n" is set, at least partially, by a resolution capability of display screen **116**.

[0028] In order to present program search screen **122**, client search application **112** may be part of, may include part of, and/or may work in conjunction with an electronic program guide (EPG) application (not shown). Such an EPG application and client search application **112** jointly present program search screen **122**, including character input field **126** and search results field **128**, on display screen **116**. As is described further below with particular reference to **FIGS. 2 and 3**, sparse search results may be presented in search results field **128** by client search application **112**.

[0029] Server **104** includes one or more processors **108**(S), at least one memory **110**(S), and a communication interface **106**(S) that is coupled to communication channel **120**. Memory **110**(S) includes processor-executable instructions that are executable by processor **108**(S) to effectuate functions of server **104**. Memory **110**(S) may be realized as volatile and/or nonvolatile memory. More generally, server **104** may include and/or be coupled to media generally (e.g., electromagnetic or optical media) that may be volatile or non-volatile media, removable or non-removable media, storage or transmission media, some combination thereof, and so forth.

[0030] Memory **110**(S) includes a server search application **114**, which may comprise processor-executable instruc-

tions. More generally, server search application **114** may comprise hardware, software, firmware, or some combination thereof, and so forth. Server search application **114** provides search-related access to program database **118**. Program database **118** includes a program titles data structure **124**. Program titles data structure **124** comprises program titles for those programs that are stored in program database **118**. Program titles data structure **124** may be part of or separate from program database **118**. As described further herein below, additional elements (e.g., informational aspects) of program database **118** (in addition to program titles) may also be searched by server search application **114**. For example, program descriptions, actors, directors, producers, reviews, etc. may additionally be searched.

[**0031**] In response to search requests received from client **102**, server search application **114** performs searches on program titles data structure **124** based on the search term characters that have thus far been input. The search produces a sparse subset of program titles that is based on the input characters of the search term. Server **104** then transmits these search results to client **102**.

[**0032**] As noted above, local memory constraints as well as requisite data updating can render storing an entire program title database at client **102** costly and/or ineffective. The program-title-database-size problem is intensified with a digital video recording (DVR)-based system. In any given two-week period, there may be approximately 100,000 distinct programs being shown. It is relatively impractical to maintain a program title database containing 100,000 titles (much less 200,000 titles for a month) in local storage, especially when the program title listing is changing essentially constantly.

[**0033**] If the program title database is located and maintained at the server, then one approach is to do all client-initiated searches remotely at the server. However, this introduces a significant delay (e.g., approximately 500 milliseconds) into the search function of the user interface. In other words, each keystroke (including button presses) triggers a server query that can result in a half second delay for each letter before any search results are presented. In contradistinction to this approach, client search application **112** of client **102**, in conjunction with server search application **114**, prefetches sparse search results from server **104** prior to a relevant user input.

[**0034**] Client search application **112** recognizes that client **102** can display a predetermined (although possibly adjustable) number of program titles at any given time (e.g., 15 display entries in the following example). Consequently, for a 26-character character set, there are 390 (i.e., 15×26) possible program titles that may be relevant for a first keystroke. When a user initiates a search, client **102** requests an initial "sparse subset" of program titles (for zero-character prefixes) so that client search application **112** may respond immediately (e.g., without waiting for a communication from server **104**) when the user types the first letter. A graphical depiction of a sparse subset is shown in **FIG. 2** and in **FIG. 3**.

[**0035**] When the user begins inputting characters, client search application **112** performs two tasks. First, it searches through the prefetched initial sparse subset of program titles sent from server **104** to find the first 15 program titles starting with the input character, and it presents these 15 program titles on display screen **116**. Second, client search application **112** sends a search request to server **104** for all of the program titles starting with that first input character (a one-character prefix). Once server **104** responds, client **102** can search locally through this new "dense subset" of program titles as the user presses additional keys.

[**0036**] Alternatively, the second and possibly subsequent search requests sent from client **102** may result in additional sparse subsets until two, three, or more characters have been input and a dense subset based on the multiple input characters is of a sufficiently small size. Additional details and permutations of such an interactive client-server data search are described further below with reference to **FIGS. 4 and 5**.

[**0037**] Interactive client-server data search is described herein primarily in the context of a television-based system. However, client **102** may more generally be any electronic device with an associated display screen **116**, especially those having a display screen of relatively low resolution, as is described further below. Examples of such client devices **102** include set-top boxes, mobile phones, personal digital assistants (PDAs), console and portable gaming devices, and so forth. Similarly, server **104** may generally be any server that is accessible by a network and is coupled to or otherwise has access to program data base **118**, or at least program titles data structure **124**. Hence, communication channel **120** may be comprised of one or more network links of networks that operate in a wired and/or wireless manner.

[**0038**] Example of Indexes and Sparse Subsets Related Thereto for a Program Title Data Structure

[**0039**] **FIG. 2** illustrates an example of an index **202(0)** and a sparse subset **204(0)** with regard to a zero-character prefix for a program titles data structure **124**. Generally, an index **202** is a data structure that indexes the words and characters of program titles data structure **124**. Indexes **202** can be configured for zero-character prefixes, one-character prefixes, two-character prefixes, three-character prefixes, etc. as input by a user at a client **102**. Similarly, sparse subsets **204** can also be configured for zero-character prefixes, one-character prefixes, two-character prefixes, three-character prefixes, and so forth.

[**0040**] As illustrated in **FIG. 2**, index **202(0)** is configured with regard to a zero-character prefix. Hence, index **202(0)** is tailored for use when a search is initially activated by a user prior to the inputting of any characters. Correspondingly, sparse subset **204(0)** is configured with regard to a zero-character prefix as well.

[**0041**] Characters may be alphanumeric characters (e.g., letters and numbers), international characters, punctuation marks, other symbols, and so forth. It should be noted that multiple keystrokes or button presses (sequentially or simultaneously) may be used to generate a single character (e.g., to input Japanese characters). Regardless, indexes **202** and sparse subsets **204** are described below using a 26-character character set of 26 letters.

[**0042**] Thus, in a described implementation, index **202(0)** includes 26 segments for 26 characters A, B, C . . . Z. Being configured for zero-character prefixes, each segment of index **202(0)** is associated with one (as-of-yet not inputted) character. Each segment of index **202(0)** also links or

corresponds to a bin **206(0)** of sparse subset **204(0)**. Specifically, sparse subset **204(0)** includes 26 bins **206(0)**. These 26 bins **206(0)** are for the 26 characters A, B, C . . . Z and are indicated by **206(0)**-A, **206(0)**-B, **206(0)**-C . . . **206(0)**-Z, respectively. For example, when a user initially activates a search, the 26 bins **206(0)** of sparse subset **204(0)** are prefetched from server **104** and returned to client **102** to prepare for inputting of the first character.

[**0043**] The bin size of each bin **206(0)** is established responsive to the number "n" of display entries for the requesting client **102**. Consequently, at least the first "n" titles for each character of the 26 characters are present in each bin **206(0)**. There are therefore "n" segments in each bin **206(0)**. Alternatively, each bin **206** may have a few more titles than "n". For example, "n" may be selected for a maximum number of display entries for all devices that may be requesting a search. Regardless, each sparse subset **204** includes segments for each particular bin **206** corresponding to a given character or character combination, for each existing character prefix for a relevant character set, without including all possible matching segments of each such particular bin **206**. In other words, each sparse subset **204** has bins **206** that do not include all possible titles based on a given prefix; on the other hand, bins of a dense subset (not shown) do include all possible titles based on a given prefix.

[**0044**] Each segment of each bin **206(0)** is associated with one of these first "n" titles and corresponds to a universal resource identifier (URI) of the associated titled program. For example, when a user inputs the character "C" as the first letter of a search, the "n" titles from the "C" bin **206(0)**-C of sparse subset **204(0)** are presented on display screen **116** by client search application **112**.

[**0045**] **FIG. 3** illustrates an example of an index **202(1)**-T and a sparse subset **204(1)**-T with regard to a one-character prefix for a program titles data structure **124**. As illustrated in **FIG. 3**, index **202(1)**-T is configured with regard to a one-character prefix, which is "T" in this example. Hence, index **202(1)**-T is tailored for use when a user inputs "T" as a first character of a search. Correspondingly, sparse subset **204(1)**-T is configured with regard to the one-character prefix "T" as well.

[**0046**] In this described implementation, index **202(1)**-T includes 26 segments having two-character fields for TA, TB, TC, TD, TE . . . TY, and TZ. Being configured for one-character prefixes, each segment of index **202(1)**-T is associated with one already-inputted character (e.g., "T") and one (as-of-yet not inputted) character. Each segment of index **202(1)**-T also links or corresponds to a bin **206(1)**-T of sparse subset **204(1)**-T, or to an empty set (e.g., "<NONE>", a null vector, etc.) if there are no titles starting with an associated character combination.

[**0047**] Specifically, sparse subset **204(1)**-T includes up to 26 bins **206(1)**-T and up to 23 bins **206(1)**-T as shown. These 23 bins are for the 23 two-character combinations TA, TC, TE . . . TY and are indicated by **206(1)**-TA, **206(1)**-TC, **206(1)**-TE . . . **206(1)**-TY, respectively. For example, after a user inputs "T" as a first character of a search, the (up to) **23** bins **206(1)**-T of sparse subset **204(1)**-T are prefetched from server **104** and returned to client **102** to prepare for inputting of the second character.

[**0048**] The bin size of each bin **206(1)**-T continues to be established responsive to the number "n" of display entries for the requesting client **102**. Consequently, the first "n" titles for each two-character combination of the relevant **23** two-character combinations are present in each bin **206(1)**-T. If there are not "n" titles for a given character combination (e.g., "TC"), then the segments of the bin thereof (e.g., bin **206(1)**-TC) end prior to "n" segments. Otherwise, there are therefore "n" segments in each bin **206(1)**-T, with each segment of each bin **206(1)**-T being associated with one of these first "n" titles and corresponding to a URI of the associated titled program. For example, when a user inputs the character "E" as the second letter of a search following the inputting of the character "T", the "n" titles from the "TE" bin **206(1)**-TE of sparse subset **204(1)**-T are presented on display screen **116** by client search application **112**.

[**0049**] Example Approaches and Methods for Interactive Client-Server Data Search

[**0050**] **FIG. 4** is a block diagram **400** illustrating an example of an approach to a client-server interactive data search in which a search request **410** having prefix information and search results **418** having a sparse subset are exchanged between a client **102** and a server **104**. As part of the search function, client **102** produces on display screen **116** program search screen **122**. As illustrated, a program search screen **122(0)** is presented on display screen **116** at time=0 prior to the inputting of any characters, and a program search screen **122(1)** is presented on display screen **116** at time=1 after one character (e.g., "T") has been input.

[**0051**] Client **102** includes a search results prefetcher **402**, a search results cacher **404**, a search input obtainer **406**, and a search results presenter **408**. These four components may be located at memory **110**(C) (of **FIG. 1**) and functional in conjunction with processor **108**(C). Additionally, one or more of these four components may comprise all or part of client search application **112**.

[**0052**] Search input obtainer **406** obtains search-related user inputs via program search screens **122**. Such user inputs may be to activate a search **420**, to input characters at character input field **126**, and so forth.

[**0053**] Search results prefetcher **402** formulates search requests **410** with prefix information based on user input accepted through search input obtainer **406**. Search requests **410** are transmitted from client **102** to server **104**. In response to sending a search request **410**, search results **418** are received from server **104** at client **102**. Search results **418** includes a sparse subset **204** with multiple bins **206**.

[**0054**] Search results cacher **404** caches received search results **418** until additional or subsequent user input accepted through search input obtainer **406** indicates a selected bin **206** of sparse subset **204**. Search results presenter **408** then presents the bin **206** for the selected character (including selected character combination) at search results field **128** of program search screen **122(1)**.

[**0055**] Server **104** includes a search request handler **412**, a search effectuator **414**, a program titles index **416**, and program titles data structure **124**. These four components may be located at memory **110**(S) (of **FIG. 1**) and functional in conjunction with processor **108**(S). Program titles index **416** and program titles data structure **124** may alternatively be located at program database **118**. Additionally, one or more of these four components may comprise all or part of server search application **114**.

[0056] Search request handler **412** receives search requests **410** from client **102** and forwards them to search effectuator **414**. Program titles index **416** is an index to words and characters of program titles data structure **124**. Hence, program titles index **416** includes, for example, index **202(0)** (of **FIG. 2**), index **202(1)**-T (of **FIG. 3**), etc. for a zero-character prefix, for one-character prefixes, for two-character prefixes, and so forth.

[0057] Search effectuator **414** causes a search to be preformed on program titles index **416** based on the prefix information of a received search request **410**. Search results **418**, which includes a sparse subset **204**, is produced from the search. Search results **418** are then transmitted from server **104** to client **102**.

[0058] In operation, a user causes program search screen **122(0)** to appear on display screen **116** through one or a series of key presses. When search input obtainer **406** detects an initial search activation **420** (which may be when program search screen **122(0)** is first ordered to appear by user input), search input obtainer **406** notifies search results prefetcher **402**.

[0059] Search results prefetcher **402** formulates a search request **410** with prefix information and a prefetch indicator. The prefix information is a zero-character prefix for an initial search request **410**. The prefetch indicator is included to notify server **104** that a sparse subset **204** may be returned. A separate prefetch indicator may be omitted if all search requests are for sparse subsets **204**, if a format used by search request **410** is reserved for prefetching of sparse subsets **204**, and so forth.

[0060] Search results prefetcher **402** has search request **410** transmitted from client **102** to server **104** (e.g., over communication channel **120** via communication interfaces **106**(C) and **106**(S) (of **FIG. 1**)). Search request handler **412** receives search request **410** at server **104** from client **102**. Search request handler **412** forwards search request **410** to search effectuator **414**.

[0061] Search effectuator **414** effectuates a search of program titles index **416** based on the prefix information of search request **410**. At this initial searach time, the prefix information comprises a zero-character prefix; consequently, search effectuator **414** searches index **202(0)** (of **FIG. 2**) and retrieves sparse subset **204(0)**. Each bin **206(0)** of sparse subset **204(0)** has a bin size established responsive to a number "n" of entries displayed or displayable by client **102** on display screen **116** (including as defined by search results field **128** of program search screen **122(1)**).

[0062] Server **104** may already know the value of "n" because it has been previously informed of "n", because all such clients **102** have the same "n" value, and so forth. Otherwise, client **102** may inform server **104**, and thus search effectuator **414**, of the value of "n" in the initial search request **410** and optionally in each search request **410**.

[0063] Search effectuator **414** therefore produces search results **418** from a search of program titles index **416**. Search results **418** includes sparse subset **204(0)** that is based on the prefix information and that has bins **206** of a size that is established responsive to the number "n" of display entries of client **102**. Search effectuator **414** has search results **418** transmitted from server **104** to client **102** (e.g., over communication channel **120** via communication interfaces **106**(S) and **106**(C)). Search results cacher **404** receives search results **418** at client **102** from server **104**. Search results cacher **404** stores search results **418** until additional user input is detected. In an alternative implementation, the initial sparse subset **204(0)** may be constantly stored at client **102** (e.g., at memory **110**(C)).

[0064] Before, during, or after search results prefetcher **402** begins formulating and/or transmitting search request **410**, search input obtainer **406** causes search results presenter **408** to update program search screen **122** to prepare for accepting one or more user input characters and for presenting search results. Specifically, program search screen **122(1)** is presented on display screen **116** so that character input field **126** and search results field **128** are visible to the user.

[0065] When a user inputs a character at character input field **126** (e.g., the character "T" as illustrated), search input obtainer **406** detects the input character and forwards the input character to search results cacher **404**. Consequently, search results cacher **404** forwards the bin **206** identified by the input character (e.g., bin **206(0)**-T (not explicitly shown) in this example) of sparse subset **204(0)** to search results presenter **408**.

[0066] Search results presenter **408** then presents the titles included in the segments of the bin **206** identified by the input character at search results field **128**. In this example, there are not "n" titles starting with "TA", so some titles starting with "TB" and "TC" are also presented at search results field **128**. In short, the first "n""T" titles are presented from bin **206(0)**-T at search results field **128**. The presented titles can be in actuality or can be associated with the URIs corresponding to the segments of the bin **206**.

[0067] Before, during, or after when search input obtainer **406** causes search results cacher **404** and search results presenter **408** to present the identified "T" titles, search input obtainer **406** also notifies search results prefetcher **402** of the one-character prefix "T". This one-character prefix "T" is used as the prefix information in the formulation of a second search request **410**, which is transmitted to server **104**.

[0068] When search request handler **412** forwards the second search request **410** to search effectuator **414**, search effectuator **414** effectuates a search of program titles index **416** based on the one-character prefix "T". Thus, a search of index **202(1)**-T produces a sparse subset **204(1)**-T which is included as (at least part of) second search results **418**. This second search results **418** is transmitted to client **102** for storage at search results cacher **404**. Hence, when user input of a second character after the first "T" character is detected by search input obtainer **406**, search results cacher **404** and search results presenter **408** can cause presentation of titles for the identified two-character combination at search results field **128** without waiting for a response from server **104**.

[0069] The division of duties as described above may differ for different implementations. For example, search results cacher **404** may forward an entire sparse subset **204** to search results presenter **408**, and search results presenter **408** may extract the identified bin **206** therefrom in response to user input identifying the next character. Regardless, search results cacher **404** and search results presenter **408** jointly function to display a selected or identified bin **206** of

a sparse subset **204**. As another example, search request handler **412** may be responsible for transmitting a search request **410** to client **102** after search effectuator **414** has completed a search of program titles index **416**.

[**0070**] **FIG. 5** is a flow diagram **500** that illustrates an example of a method for performing an interactive client-server data search responsive to user input along with a search results presentation. Flow diagram **500** includes ten (10) blocks **502-514** and **518-522**. Although the actions of flow diagram **500** may be performed in other environments and with a variety of hardware and software implementations, **FIGS. 1-4** are used in particular to illustrate certain aspects and examples of the method. For example, a client **102** may perform the actions of blocks **502-514** and arrow **516**, and a server **104** may perform the actions of blocks **518-522**.

[**0071**] At block **502**, user input (UI) is accepted for a first prefix position. For example, search input obtainer **406** may obtain user input from program search screen **122**. At this point of this example, the user input of block **502** is considered to constitute a search activation. Thus, search input obtainer **406** may, for instance, detect that the user input is a search activation **420**.

[**0072**] At block **504**, an updated search screen is presented responsive to the user input. For example, search input obtainer **406** may cause a displayed screen to transition from a general menu screen, such as program search screen **122(0)**, to a specific search screen, such as program search screen **122(1)**.

[**0073**] At block **506**, a search request is formulated with prefix information and optionally a prefetch indicator. For example, search results prefetcher **402** may formulate an initial search request **410** that includes prefix information and a prefetch indicator. For instance, the prefix information may be a zero-character prefix responsive to the initial search activation. It should be noted that the actions of blocks **504** and **506/508** in particular may be performed in any order, including fully or partially simultaneously.

[**0074**] At block **508**, the formulated search request is transmitted. For example, search results prefetcher **402** of client **102** may transmit the initial search request **410** to server **104**. At block **518**, the search request is received. For example, search request handler **412** may receive the search request **410** at server **104**.

[**0075**] At block **520**, a search of a program titles index to produce a sparse subset based on the prefix information is effectuated. A bin size of the sparse subset is established responsive to a number of display entries of the requesting client. For example, search effectuator **414** may search program titles index **416** to produce a sparse subset **204(0)** based on a zero-character prefix of the prefix information. Sparse subset **204(0)** therefore includes multiple bins **206(0)**, with a size of each bin **206(0)** established responsive to a number of displayable entries at search results field **128** of client **102**. Each bin **206(0)** corresponds to a single character based on the zero-character prefix.

[**0076**] At block **522**, a search result including the sparse subset is transmitted. For example, search effectuator **414** of server **104** may transmit search result **418** to client **102**. At block **510**, the search result is received. For example, search results cacher **404** may receive search result **418** at client **102** and store it thereat.

[**0077**] At block **512**, additional user input is awaited and eventually accepted. The additional user input creates a subsequent prefix position. For example, search input obtainer **406** detects eventual subsequent user input. For instance, search input obtainer **406** obtains a first character from character input field **126**.

[**0078**] At block **514**, an updated search screen is presented responsive to the user input and using the sparse subset of the search result. For example, search results cacher **404** and search results presenter **408** extract from sparse subset **204(0)** a bin **206(0)** corresponding to the identified first character as input to character input field **126** and present the contents of the identified and extracted bin **206(0)** at search results field **128** of program search screen **122(1)**.

[**0079**] As indicated by arrow **516**, the method of flowchart **500** continues with block **506**. Again, the actions of blocks **514** and **506/508** in particular may be performed in any order, including fully or partially simultaneously. In this subsequent iteration, subsequent prefix information of a subsequent formulated search request is a one-character prefix that is based on the identified character as input at block **512**. Hence, the search effectuated at block **520** is based on this one input character and the resulting sparse subset **204(1)** includes multiple bins **206(1)** in which each bin corresponds to a two-character combination, the first of which is the identified first character.

[**0080**] An identified second subsequent character that is then input at block **512** is used to extract for presentation at block **514** the bin **206(1)** corresponding to the resulting two-character combination. As indicated by arrow **516**, the method of flowchart **500** may then continue for another iteration. Iterations may be repeated until a dense subset is transmitted to client **102** from server **104** (e.g., because such a dense subset has become sufficiently small) or until user input indicates that the user wishes to being scrolling manually through presented titles.

[**0081**] Although the description above is applicable to searching for any words in the titles of a program titles data structure **124**, the described interactive client-server data search may also be applied to searching for the first words of the titles. Furthermore, although the description above focuses on searching for words in titles, the described interactive client-server data search may also be applied to searching for words of program descriptions in general, possibly including titles, subject matter, story synopsis, creative contributors (e.g., director, produce, screenwriter, actors, actresses, etc.), and so forth. Closed captioning text of programs may also be searched.

[**0082**] As noted above, interactive client-server data search as described herein is also applicable to mobile phones, PDAs, console and portable gaming devices, and so forth. Consequently, the searching is not limited to television-program-related data structures. Instead, interactive client-server data searches may also be applied to searching words and characters of any elements of any data collection. For example, elements of "white pages" data collections may be searched as described herein. As another example, elements of a data collection of game descriptions and/or tips and cheats may be searched as described herein.

[**0083**] The devices, actions, aspects, features, procedures, components, etc. of **FIGS. 1-5** are illustrated in diagrams

that are divided into multiple blocks. However, the order, interconnections, interrelationships, layout, etc. in which **FIGS. 1-5** are described and/or shown is not intended to be construed as a limitation, and any number of the blocks can be modified, combined, rearranged, augmented, omitted, etc. in any manner to implement one or more systems, methods, devices, procedures, media, apparatuses, servers, clients, arrangements, etc. for interactive client-server data searches. Furthermore, although the description herein includes references to specific implementations, the illustrated and/or described implementations can be implemented in any suitable hardware, software, firmware, or combination thereof and using any suitable device architecture(s), television network element(s), data structure organization(s), network protocol(s), display screen format(s), and so forth.

[**0084**] Implementations for interactive client-server data searches may be described in the general context of processor-executable instructions. Generally, processor-executable instructions include routines, programs, protocols, objects, interfaces, components, data structures, etc. that perform and/or enable particular tasks and/or implement particular abstract data types. Interactive client-server data searches, as described in certain implementations herein, may also be practiced in distributed processing environments where tasks are performed by remotely-linked processing devices that are connected through a communications link and/or network. Especially but not exclusively in a distributed computing environment, processor-executable instructions may be located in separate storage media, executed by different processors, and/or propagated over transmission media.

[**0085**] Although systems, media, devices, methods, procedures, apparatuses, techniques, schemes, approaches, procedures, arrangements, and other implementations have been described in language specific to structural, logical, algorithmic, and functional features and/or diagrams, it is to be understood that the invention defined in the appended claims is not necessarily limited to the specific features or diagrams described. Rather, the specific features and diagrams are disclosed as exemplary forms of implementing the claimed invention.

1. One or more processor-accessible media comprising processor-executable instructions that, when executed, direct a device to perform actions comprising:

accepting a first user input for a first prefix position;

updating a search screen responsive to the first user input;

formulating a first search request having first prefix information responsive to the first user input;

storing a sparse subset of search results for the first search request;

accepting a second user input for a second prefix position; and

updating the search screen responsive to the second user input using the sparse subset of search results for the first search request.

2. The one or more processor-accessible media as recited in claim 1, wherein the action of updating the search screen responsive to the second user input comprises actions of:

extracting a portion of the sparse subset of search results for the first search request responsive to the second user input; and

presenting the extracted portion of the sparse subset of search results for the first search request on a display screen associated with the device.

3. The one or more processor-accessible media as recited in claim 1, wherein the processor-executable instructions, when executed, direct the device to perform further actions comprising:

formulating a second search request having second prefix information responsive to the second user input;

storing a sparse subset of search results for the second search request;

accepting a third user input for a third prefix position; and

updating the search screen responsive to the third user input using the sparse subset of search results for the second search request.

4. The one or more processor-accessible media as recited in claim 3, wherein the first prefix position comprises a zero-character prefix, the second prefix position comprises a one-character prefix, and the third prefix position comprises a two-character prefix.

5. The one or more processor-accessible media as recited in claim 1, wherein the sparse subset of search results for the first search request comprises multiple bins with each bin of the multiple bins corresponding to a single character.

6. The one or more processor-accessible media as recited in claim 1, wherein the sparse subset of search results for the first search request comprises multiple bins with each bin of the multiple bins corresponding to a two-character combination, a first character of the two-character combination comprising a previously-input character.

7. The one or more processor-accessible media as recited in claim 1, wherein the sparse subset of search results for the first search request comprises multiple bins with each bin having a number of segments established responsive to a number of displayable entries of the device.

8. The one or more processor-accessible media as recited in claim 1, wherein the first user input comprises a search activation, the first prefix information comprises a zero-character prefix, and the sparse subset of search results comprises an initial sparse subset.

9. The one or more processor-accessible media as recited in claim 1, wherein the processor-executable instructions, when executed, direct the device to perform further actions comprising:

sending the first search request to a server; and

receiving the sparse subset of search results for the first search request from the server, wherein the sparse subset of search results is based on the first prefix position of the first user input.

10. The one or more processor-accessible media as recited in claim 1, wherein the one or more processor-accessible media comprise at least one of (i) one or more storage media or (ii) one or more transmission media.

11. A server that is capable of receiving a search request having prefix information, the server adapted to perform a search of a data collection to produce a sparse subset of search results based on the prefix information; the sparse subset of search results including multiple bins, each bin of

the multiple bins corresponding to a character combination that begins with a prefix of the prefix information.

12. The server as recited in claim 11, wherein the server comprises at least part of a headend of television-based system; and wherein the data collection comprises a program description index.

13. The server as recited in claim 12, wherein the program description index comprises a program titles index; and wherein the search focuses on a first word of each title in the program titles index.

14. The server as recited in claim 11, wherein the sparse subset of search results includes a corresponding bin of the multiple bins for each existing character prefix of a relevant character set, each particular bin of the multiple bins including at least one matching segment without including all matching segments of a corresponding particular character prefix.

15. The server as recited in claim 11, wherein each bin of the multiple bins includes a number of segments that is established responsive to a number of display entries of a client that transmitted the search request.

16. The server as recited in claim 11, wherein each bin of the multiple bins includes multiple segments; and wherein each segment of the multiple segments is associated with one or more words of an element of multiple elements of the data collection.

17. The server as recited in claim 16, wherein each segment of the multiple segments corresponds to a universal resource identifier (URI) for the element having the associated one or more words.

18. A method comprising:

accepting search-related user input;

transmitting from a client, responsive to the accepting, a search request having prefix information based on the search-related user input;

receiving at a server the search request having the prefix information;

effectuating a search of a data collection to produce a sparse subset of search results based on the prefix information;

transmitting the sparse subset of search results from the server;

receiving the sparse subset of search results at the client; and

storing the sparse subset of search results.

19. The method as recited in claim 18, wherein the effectuating comprises:

effectuating the search of the data collection to produce the sparse subset of search results based on the prefix information, wherein the data collection comprises at least one of television programming information, telephone directory information, or game-related information.

20. The method as recited in claim 18, wherein the effectuating comprises:

effectuating the search of the data collection to produce the sparse subset of search results based on the prefix information; wherein the sparse subset of search results includes multiple bins, each bin corresponding to the prefix information plus one additional character.

21. The method as recited in claim 18, wherein the effectuating comprises:

effectuating the search of the data collection to produce the sparse subset of search results based on the prefix information; wherein the sparse subset of search results includes multiple bins, each bin including a number of segments that is established responsive to a number of display entries of the client.

22. The method as recited in claim 18, further comprising:

accepting subsequent search-related user input, the subsequent search-related user input comprising a subsequent character; and

presenting contents of a portion of the sparse subset of search results responsive to the subsequent character.

23. The method as recited in claim 22, further comprising:

transmitting from the client, responsive to the subsequent accepting, a subsequent search request having subsequent prefix information based on the subsequent search-related user input, the subsequent prefix information including a one-character prefix comprising the subsequent character.

24. The method as recited in claim 23, further comprising:

receiving at the server the subsequent search request having the subsequent prefix information;

effectuating a subsequent search of the data collection to produce a subsequent sparse subset of search results based on the subsequent prefix information;

transmitting the subsequent sparse subset of search results from the server;

receiving the subsequent sparse subset of search results at the client;

storing the subsequent sparse subset of search results;

accepting additional search-related user input, the additional search-related user input comprising an additional character; and

presenting contents of a portion of the subsequent sparse subset of search results responsive to the additional character.

25. A device comprising:

a search input obtainer that obtains a search-related user input, including a search activation or at least one character;

a search results prefetcher that formulates a search request having prefix information in response to the search-related user input obtained by the search input obtainer;

a search results cacher that caches a received sparse subset of search results, the sparse subset including multiple bins; and

a search results presenter that presents contents of an identified bin of the multiple bins responsive to additional user input.

26. The device as recited in claim 25, wherein the search-related user input comprises the search activation, the search request comprises an initial search request, the prefix information comprises a zero-character prefix, each bin of the multiple bins corresponds to a single character based on

the zero-character prefix, and a size of each bin of the multiple bins is established responsive to a number of display entries of the device.

27. The device as recited in claim 25, wherein the search-related user input comprises the at least one character, the search request comprises a second search request, the prefix information comprises a one-character prefix, each bin of the multiple bins corresponds to a two-character combination based on the one-character prefix, and a size of each bin of the multiple bins is established responsive to a number of display entries of the device.

28. The device as recited in claim 27, wherein the size of each bin of the multiple bins is established to be equal to the number of display entries of the device.

29. The device as recited in claim 28, further comprising:

an associated display screen;

wherein the search input obtainer obtains the at least one character from a character input field displayed on the associated display screen, and the search results presenter presents the contents of the identified bin of the multiple bins at a search results field displayed on the associated display screen; and

wherein the number of display entries of the device is determined, at least partially, by a size of the search results field.

30. The device as recited in claim 27, wherein the size of each bin of the multiple bins is established to be greater than the number of display entries of the device but less than a bin size of a dense subset of search results.

31. The device as recited in claim 27, wherein the additional user input comprises the at least one character, and the identified bin is identified by the at least one character.

32. The device as recited in claim 25, wherein the device is adapted to transmit the search request to a server that performs a search on an indexed database to produce the sparse subset of search results; and wherein the device is further adapted to receive the sparse subset from the server.

33. The device as recited in claim 25, wherein the device comprises at least one of a television-based device, a mobile phone, a personal digital assistant (PDA), or a console or portable gaming device.

34. An arrangement for interactive client-server data searches, the arrangement comprising:

prefetch means for prefetching search results based on prefix information; and

display means for displaying a portion of sparse subsets prefetched by the prefetch means; the sparse subsets based on the prefix information and having multiple bins, each bin of the multiple bins of a size that is established responsive to a number of display entries.

35. The arrangement as recited in claim 34, further comprising:

obtainer means for obtaining search input from a user, the search input including a search activation and/or one or more characters;

wherein the prefetch means formulates a search request including the prefix information responsive to the search input obtained from the user by the obtainer means.

36. The arrangement as recited in claim 34, wherein the display means comprises:

cache means for caching the sparse subsets until additional user input is detected; and

presentation means for presenting contents of a bin of the multiple bins, with the bin identified by the additional user input of a character that follows a prefix of the prefix information.

37. The arrangement as recited in claim 34, wherein each bin of the multiple bins corresponds to a character of multiple characters that may be input after a prefix of the prefix information.

38. The arrangement as recited in claim 34, wherein the arrangement is capable of operating in conjunction with at least one of (i) a television-based network or (ii) a wireless telephone and/or data network.

39. The arrangement as recited in claim 34, wherein the arrangement comprises at least one of (i) one or more processor-accessible media or (ii) at least one device.

40. The arrangement as recited in claim 34, further comprising: server means for providing the sparse subsets from searches of a program titles index in response to receiving search requests having the prefix information from the prefetch means over a communications channel.

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