

EXHIBIT F



US006298064B1

(12) **United States Patent**
Christie

(10) **Patent No.:** US 6,298,064 B1
(45) **Date of Patent:** Oct. 2, 2001

(54) **BROADBAND TELECOMMUNICATIONS SYSTEM**

- (75) Inventor: **Joseph Michael Christie**, San Bruno, CA (US)
- (73) Assignee: **Sprint Communications Company, L.P.**, Kansas City, MO (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

- (21) Appl. No.: **09/504,408**
- (22) Filed: **Feb. 15, 2000**

Related U.S. Application Data

- (63) Continuation of application No. 09/353,401, filed on Jul. 15, 1999, which is a continuation of application No. 08/525,897, filed on Sep. 8, 1995, now Pat. No. 5,991,301, which is a continuation-in-part of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

- (51) Int. Cl.⁷ **H04L 12/56; H04L 12/28**
- (52) U.S. Cl. **370/410; 370/466**
- (58) Field of Search **370/385, 386, 370/389, 395, 396, 397, 398, 399, 409, 410, 422, 426, 466, 467, 465; 379/229, 230, 231**

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 4,453,247 6/1984 Suzuki et al. .
- 4,720,850 1/1988 Oberlander et al. .
- 4,763,317 8/1988 Lehman et al. .

(List continued on next page.)

OTHER PUBLICATIONS

- McDysan, David E. and Spohn, Darren L., ATM Theory And Application, 1994, p. 256: 9.3.1; ATM Layer VPI/VCI Level Addressing.
- "Revised Draft Of Q.2650 (DSS2/B-ISUP Interworking Recommendation)," Study Group 11, Geneva, ITU—Telecommunication Standardization Sector, Nov. 29–Dec. 17, 1993.
- "Draft Broadband/Narrowband NNI Networking Recommendation," Study Group 11, Geneva, ITU—Telecommunication Standardization Sector, Dec. 1993.
- Yoshikai, N., et al., "General Arrangements for Interworking Between B-ISDN and 63kbit/s Based ISDN (Draft Recommendation I.580), Study Group 13," ITU–T Telecommunication Standardization Sector, pp. 1–51, (Mar. 7, 1994).
- "Interworking B-ISUP and Q.93B for DDI, MSN, TP and SUB", Study Group 11, Temporary Document 2/II–311, ITU–Telecommunication Standardization Sector, Nov. 29–Dec. 17, 1993.
- Minoli, Daniel/DVI Communications, Inc./Stevens Institute of Technology and Dobrowski, George/Bell Communications Research (Bellcore), Principles Of Signaling For Cell Relay And Frame Relay © pp. 1–2, 5–6 and 229, 1994.

(List continued on next page.)

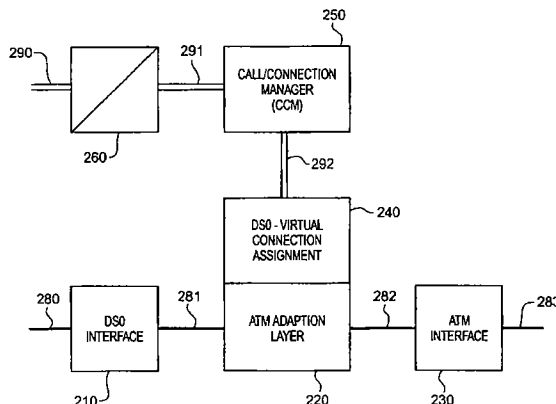
Primary Examiner—Ajit Patel

(74) *Attorney, Agent, or Firm*—Harley R. Ball; Steven J. Funk

(57) **ABSTRACT**

The invention is a system for providing virtual connections through an ATM interworking multiplexer on a call-by-call basis. A signaling processor receives signaling for a call and selects the virtual connection for the call. The signaling processor generates new signaling that identifies the selection and transfers the new signaling to the ATM interworking multiplexer that accepted the access connection for the call. The multiplexer converts user information from the access connection into ATM cells for transmission over the virtual connection in accord with the new signaling.

68 Claims, 12 Drawing Sheets



(12) **United States Patent**
Christie

(10) **Patent No.:** US 6,304,572 B1
 (45) **Date of Patent:** *Oct. 16, 2001

(54) **METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL**

(75) **Inventor:** Joseph Michael Christie, San Bruno, CA (US)

(73) **Assignee:** Sprint Communications Company, L.P., Kansas City, MO (US)

(* **Notice:** This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

4,683,563	7/1987	Rouse et al. .
4,720,850	1/1988	Oberlander et al. .
4,730,312	3/1988	Johnson .
4,736,364	4/1988	Basso et al. .
4,748,658	5/1988	Gopal et al. .
4,757,526	7/1988	Foster .
4,763,317	8/1988	Lehman et al. .
4,823,338	4/1989	Chan et al. .

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

B-23853/92	3/1993	(AU) .
4225203 A1	12/1992	(DE) .
0403414 A2	12/1990	(EP) .

(List continued on next page.)

OTHER PUBLICATIONS

ITU-T, "General Aspects of the Intelligent Network Application Protocol," ITU-T Recommendation Q.1208, ITU-T, p. 1, (Feb. 3, 1993).

David Giddy and Rob Palmer, "An Experimental ATM Network Featuring De-Coupled Modular Control," IEEE, p. 118-122, (Feb. 2, 1992).

CCITT, "Broadband Aspects of ISDN," Recommendation I.121, (1991).

(List continued on next page.)

(21) **Appl. No.:** 09/082,048

(22) **Filed:** May 20, 1998

Related U.S. Application Data

(63) Continuation of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

(51) **Int. Cl.⁷** H04L 12/28; H04L 12/56

(52) **U.S. Cl.** 370/400; 370/410

(58) **Field of Search** 370/351-360, 370/384, 385, 377, 395, 396, 397, 398, 399, 400, 409, 410, 389; 379/201, 207, 94, 220, 221, 112

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,201,889	5/1980	Lawrence et al. .
4,310,727	1/1982	Lawser .
4,348,554	9/1982	Asmuth .
4,453,247	6/1984	Suzuki et al. .
4,554,659	11/1985	Blood et al. .
4,565,903	1/1986	Riley .

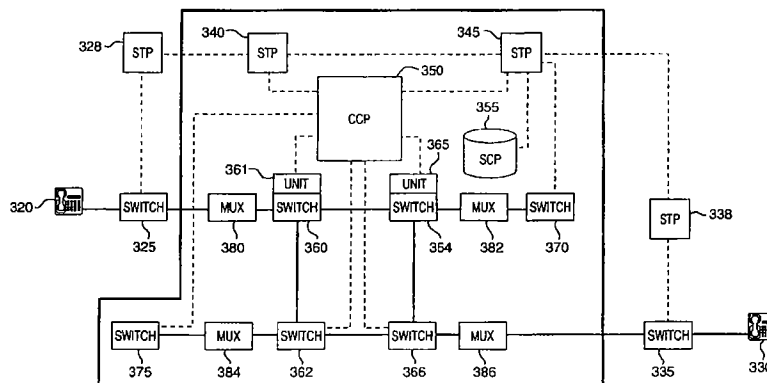
Primary Examiner—Ajit Patel

(74) *Attorney, Agent, or Firm*—Harley R. Ball; Steven J. Funk

(57) **ABSTRACT**

The present invention includes a method, system, and apparatus for providing communication control. The invention includes a method in which signaling is processed externally to a switch before it is applied by the network elements. The processor is able to select network characteristics and signal the network elements based the selections. A network employing the processing method is also included, as well as a signaling system that employs the processing method.

79 Claims, 8 Drawing Sheets





US006452932B1

(12) **United States Patent**
Christie

(10) **Patent No.:** US 6,452,932 B1
(45) **Date of Patent:** *Sep. 17, 2002

(54) **METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL**

4,853,955 A 8/1989 Thorn et al.
4,979,118 A 12/1990 Kheradpir
4,991,204 A 2/1991 Yamamoto et al.

(75) **Inventor:** Joseph Michael Christie, San Bruno, CA (US)

(List continued on next page.)

(73) **Assignee:** Sprint Communications Company, L.P., Overland Park, KS (US)

FOREIGN PATENT DOCUMENTS

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

CH 685033 A5 2/1995
DE 4225203 A1 12/1992
DE 4447230 A1 7/1995
EP 0403414 A2 12/1990
EP 0426911 A1 5/1991
EP 0442754 A2 8/1991

This patent is subject to a terminal disclaimer.

(List continued on next page.)

OTHER PUBLICATIONS

(21) **Appl. No.:** 09/499,874
(22) **Filed:** Feb. 7, 2000

Ohta, S., et al., A Dynamically Controllable ATM Transport Network Based On The Virtual Path Concept, pp. 1272-1276, Communications For The Information Age, Globecom '88, Conference Record, vol. III, Nov. 28-Dec. 1, 1988.
Barr, W.J., et al., The TINA Initiative, IEEE Communications Magazine, vol. 31, No. 3, New York (US), pp. 70-76, Mar. 1993.

Related U.S. Application Data

(63) Continuation of application No. 09/081,891, filed on May 20, 1998, which is a continuation of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

(List continued on next page.)

(51) **Int. Cl.⁷** H04L 12/28; H04L 12/56
(52) **U.S. Cl.** 370/410; 379/230
(58) **Field of Search** 370/395.1, 389, 370/396, 397, 398, 399, 400, 409, 410, 466, 467, 426, 422, 385, 386, 352-356; 379/229, 230, 231, 219, 221.1

Primary Examiner—Ajit Patel
(74) *Attorney, Agent, or Firm*—Harley R. Ball; Steven J. Funk; Kevin D. Robb

(57) **ABSTRACT**

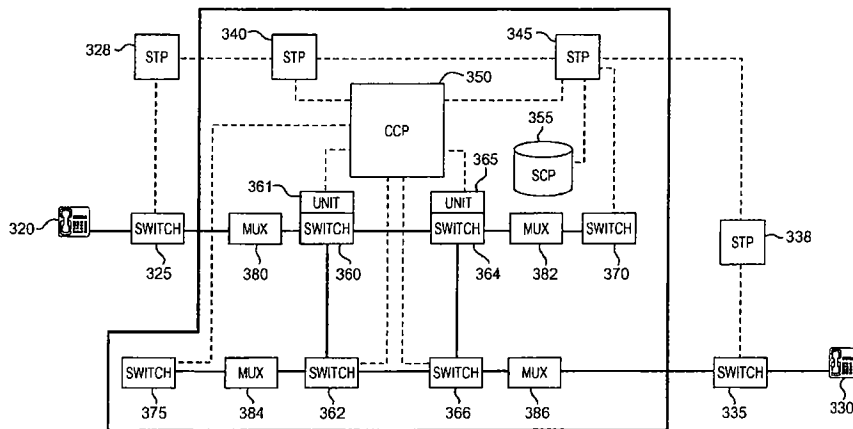
The present invention includes a method, system, and apparatus for providing communication control. The invention includes a method in which signaling is processed externally to a switch before it is applied by the network elements. The processor is able to select network characteristics and signal the network elements based the selections. A network employing the processing method is also included, as well as a signaling system that employs the processing method.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,201,889 A 5/1980 Lawrence et al.
4,348,554 A 9/1982 Asmuth
4,720,850 A 1/1988 Oberlander et al.
4,736,364 A 4/1988 Basso et al.
4,748,658 A 5/1988 Gopal et al.
4,763,317 A 8/1988 Lehman et al.

34 Claims, 8 Drawing Sheets





US006463052B1

(12) **United States Patent**
Christie

(10) **Patent No.:** US 6,463,052 B1
(45) **Date of Patent:** *Oct. 8, 2002

(54) **METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL**

4,310,727 A 1/1982 Lawser
4,348,554 A 9/1982 Asmuth
4,453,247 A 6/1984 Suzuki et al.
4,554,659 A 11/1985 Blood et al.
4,565,903 A 1/1986 Riley

(75) **Inventor:** Joseph Michael Christie, San Bruno, CA (US)

(List continued on next page.)

(73) **Assignee:** Sprint Communications Company L.P., Kansas City, MO (US)

FOREIGN PATENT DOCUMENTS

(*) **Notice:** This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

AU B-23853/92 3/1993
DE 4225203 A1 12/1992
EP 0403414 A2 12/1990

(List continued on next page.)

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

OTHER PUBLICATIONS

N/A, "Intelligent Network/2: A flexible framework for exchange services," Bell Communications Research Exchange, vol. 3 (No. 3), (May 23, 1987).

(21) **Appl. No.:** 09/082,182

(List continued on next page.)

(22) **Filed:** May 20, 1998

Related U.S. Application Data

(63) Continuation of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

Primary Examiner—Ajit Patel

(74) *Attorney, Agent, or Firm*—Harley R. Ball; Steven J. Funk; Kevin D. Robb

(51) **Int. Cl.⁷** H04L 12/66

(57) **ABSTRACT**

(52) **U.S. Cl.** 370/352; 379/234

The present invention includes a method, system, and apparatus for providing communication control. The invention includes a method in which signaling is processed externally to a switch before it is applied by the network elements. The processor is able to select network characteristics and signal the network elements based the selections. A network employing the processing method is also included, as well as a signaling system that employs the processing method.

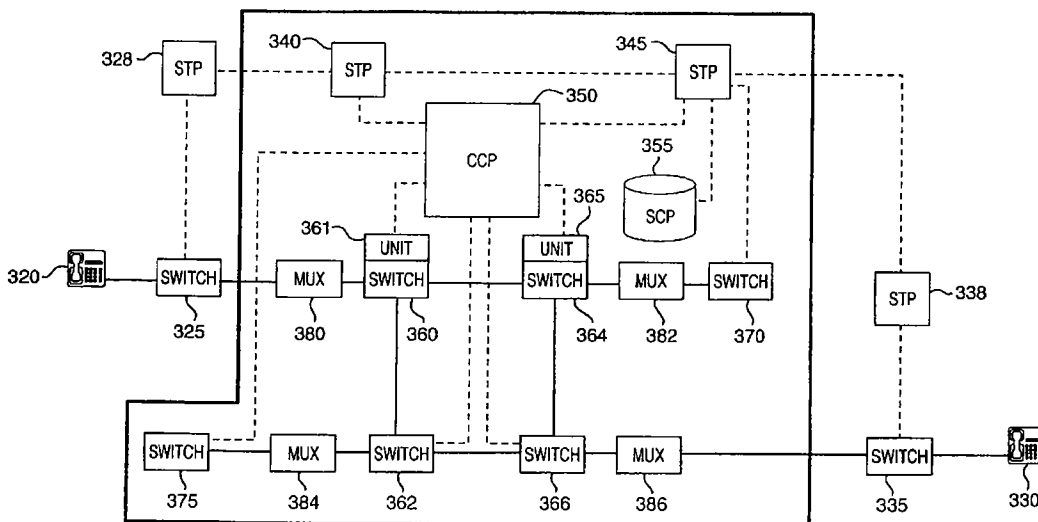
(58) **Field of Search** 370/351-360, 370/384, 385, 377, 395, 396, 397, 398, 399, 400, 409, 410; 379/201, 207, 94, 220, 221, 112, 234

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,201,889 A 5/1980 Lawrence et al.

24 Claims, 8 Drawing Sheets





US006473429B1

(12) **United States Patent**
Christie

(10) **Patent No.:** **US 6,473,429 B1**
(45) **Date of Patent:** **Oct. 29, 2002**

(54) **BROADBAND TELECOMMUNICATIONS SYSTEM**

(75) **Inventor:** **Joseph Michael Christie, San Bruno, CA (US)**

(73) **Assignee:** **Sprint Communications Company L.P., Overland Park, KS (US)**

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

4,720,850 A	1/1988	Oberlander et al.
4,763,317 A	8/1988	Lehman et al.
4,926,416 A	5/1990	Weik
5,051,983 A	9/1991	Kammerl
5,115,431 A	5/1992	Williams et al.
5,168,492 A	12/1992	Beshai et al.
5,204,857 A	4/1993	Obara
5,233,607 A	8/1993	Barwig et al.
5,274,680 A	12/1993	Sorton et al.
5,327,421 A	7/1994	Hiller et al.

(List continued on next page.)

OTHER PUBLICATIONS

McDysan, David E. and Spohn, Darren L., ATM Theory And Application, 1994, p. 256: 9.3.1; ATM Layer VPI/VCI Level Addressing.

(List continued on next page.)

(21) **Appl. No.:** **09/353,401**

(22) **Filed:** **Jul. 15, 1999**

Related U.S. Application Data

(63) Continuation of application No. 08/525,897, filed on Sep. 8, 1995, now Pat. No. 5,991,301, which is a continuation-in-part of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

(51) **Int. Cl.⁷** **H04L 12/56; H04L 12/28**

(52) **U.S. Cl.** **370/395.3; 370/410; 370/466**

(58) **Field of Search** **370/389, 395, 370/396, 397, 398, 399, 400, 410, 384, 385, 395.1, 395.3, 395.71, 466; 379/219, 229, 230**

Primary Examiner—Ajit Patel

(74) *Attorney, Agent, or Firm*—Harley R. Ball; Steven J. Funk; Kevin D. Robb

(57) **ABSTRACT**

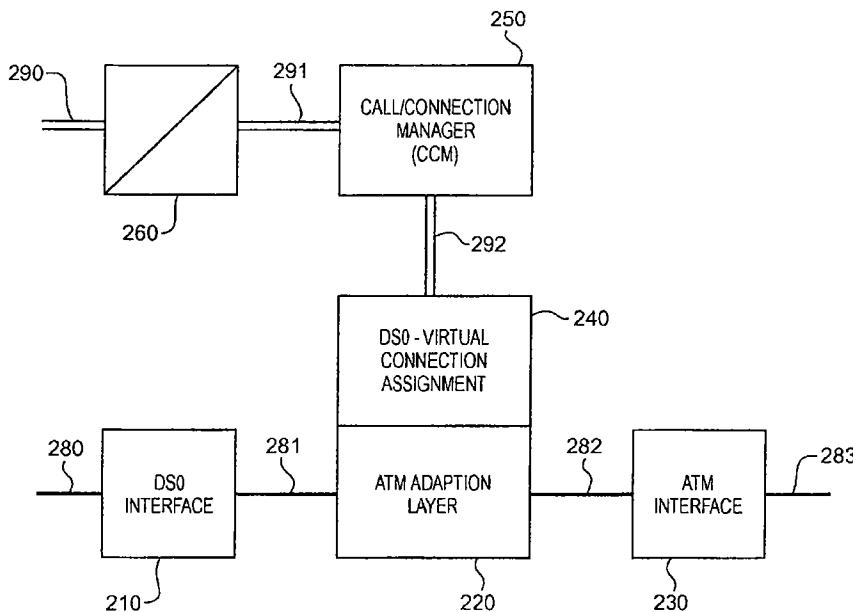
The invention is a system for providing virtual connections through an ATM interworking multiplexer on a call-by-call basis. A signaling processor receives signaling for a call and selects the virtual connection for the call. The signaling processor generates new signaling that identifies the selection and transfers the new signaling to the ATM interworking multiplexer that accepted the access connection for the call. The multiplexer converts user information from the access connection into ATM cells for transmission over the virtual connection in accord with the new signaling.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,453,247 A 6/1984 Suzuki et al.

44 Claims, 12 Drawing Sheets



(12) **United States Patent**
Christie

(10) **Patent No.:** US 6,633,561 B2
 (45) **Date of Patent:** *Oct. 14, 2003

(54) **METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL**

4,453,247 A 6/1984 Suzuki et al.
 4,554,659 A 11/1985 Blood et al.

(75) **Inventor:** Joseph Michael Christie, San Bruno, CA (US)

(List continued on next page.)

(73) **Assignee:** Sprint Communications Company, L.P., Overland Park, KS (US)

FOREIGN PATENT DOCUMENTS

AU	B-23853/92	3/1993
CH	685033 A5	2/1995
DE	4225203 A1	12/1992
DE	4327777 C1	2/1995
DE	4332824 C1	3/1995

(List continued on next page.)

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

OTHER PUBLICATIONS

Helen A. Bauer, John J. Kulzer, Edward G. Sable, "Designing Service-Independent Capabilities for Intelligent Networks," IEEE, Dec. 1988, pp. 31-41.
 ITU-T Q.1219, "Intelligent Network User's Guide For Capability Set 1," Apr. 1994.
 Thorner, "Intelligent Networks, Capter 2," 1994, Artech House, pp. 11-107.
 ITU-T, Recommendation Q.722, "Specifications of Signaling System No. 7, General Function of Telephone Messages and Signals," 1993.
 ANSI-T1.111-1992, American National Standard for Telecommunications, "Signaling System No. 7 (SS7)—Message Transfer Part (MTP)," New York, NY.

(List continued on next page.)

(21) **Appl. No.:** 10/002,850

(22) **Filed:** Nov. 14, 2001

(65) **Prior Publication Data**

US 2002/0039372 A1 Apr. 4, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/082,040, filed on May 20, 1998, which is a continuation of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

(51) **Int. Cl.⁷** H04L 12/66

(52) **U.S. Cl.** 370/352; 370/356; 370/410; 370/522; 379/230

(58) **Field of Search** 370/352-356, 370/401, 410, 389, 422, 426, 351, 360, 522; 379/221.08, 221.09, 221.12, 221.14, 228, 229, 230, 221.1, 219

(56) **References Cited**

U.S. PATENT DOCUMENTS

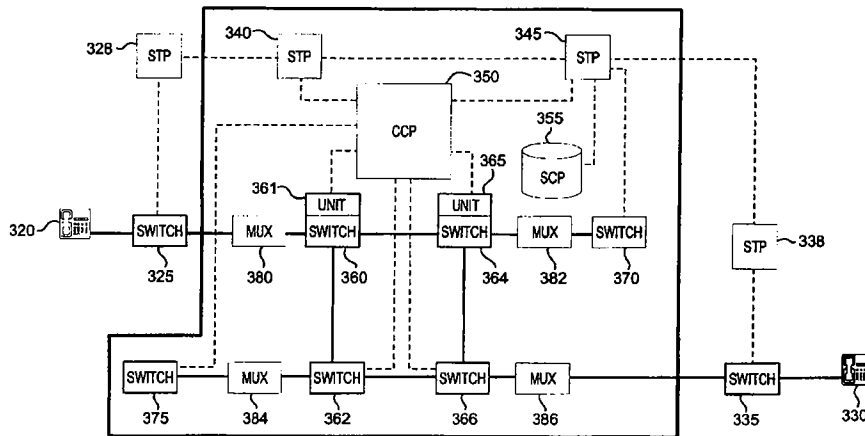
4,201,889 A	5/1980	Lawrence et al.
4,310,727 A	1/1982	Lawser
4,348,554 A	9/1982	Asmuth

Primary Examiner—Ajit Patel

(57) **ABSTRACT**

The present invention includes a method, system, and apparatus for providing communication control. The invention includes a method in which signaling is processed externally to a switch before it is applied by the network elements. The processor is able to select network characteristics and signal the network elements based the selections. A network employing the processing method is also included, as well as a signaling system that employs the processing method.

38 Claims, 8 Drawing Sheets



(12) **United States Patent**
Christie

(10) **Patent No.:** US 6,665,294 B2
 (45) **Date of Patent:** Dec. 16, 2003

- (54) **BROADBAND TELECOMMUNICATIONS SYSTEM**
- (75) **Inventor:** Joseph Michael Christie, San Bruno, CA (US)
- (73) **Assignee:** Sprint Communications Company, L.P., Overland Park, KS (US)
- (*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
- (21) **Appl. No.:** 10/212,503
- (22) **Filed:** Aug. 5, 2002
- (65) **Prior Publication Data**

5,051,983 A	9/1991	Kammerl
5,067,123 A	11/1991	Hyodo et al.
5,084,867 A	1/1992	Tachibana et al.
5,089,954 A	2/1992	Rago
5,115,427 A	5/1992	Johnson, Jr. et al.
5,179,556 A	1/1993	Turner
5,182,550 A	1/1993	Masuda et al.
5,204,857 A	4/1993	Obara
5,218,602 A	6/1993	Grant et al.
5,251,255 A	10/1993	Epley
5,255,266 A	10/1993	Watanabe et al.
5,289,536 A	2/1994	Hokari
5,291,492 A	3/1994	Andrews et al.
5,327,421 A	7/1994	Hiller et al.
5,339,318 A	8/1994	Tanaka et al.
5,345,445 A	9/1994	Hiller et al.
5,345,446 A	9/1994	Hiller et al.
5,365,524 A	11/1994	Hiller et al.
5,384,771 A	1/1995	Isidoro et al.

US 2003/0002491 A1 Jan. 2, 2003

(List continued on next page.)

Related U.S. Application Data

- (63) Continuation of application No. 09/438,669, filed on Nov. 12, 1999, now Pat. No. 6,452,928, which is a continuation-in-part of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, and a continuation of application No. 08/525,897, filed on Sep. 8, 1995, now Pat. No. 5,991,301, and a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

- (51) **Int. Cl.⁷** H04L 12/66
- (52) **U.S. Cl.** 370/352; 370/410; 370/466; 370/395.1
- (58) **Field of Search** 370/351-356, 370/395.1, 396, 397, 398, 399, 400, 401, 410, 426, 465, 466, 467; 379/219, 220.01

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,201,889 A	5/1980	Lawrence et al.
4,348,554 A	9/1982	Asmuth
4,453,247 A	6/1984	Suzuki et al.
4,720,850 A	1/1988	Oberlander et al.
4,748,658 A	5/1988	Gopal et al.
4,763,317 A	8/1988	Lehman et al.
4,926,416 A	5/1990	Weik

FOREIGN PATENT DOCUMENTS

JP	4154230	5/1992
JP	8149137	6/1996
JP	08-505988	6/1996
WO	WO 95/31057	11/1995

OTHER PUBLICATIONS

McDysan, David E. and Spohn, Darren L., ATM Theory And Application, 1994, p. 256: 9.3.1; ATM Layer VPI/VCI Level Addressing.

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Primary Examiner—Ajit Patel

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The invention is a system for providing virtual connections through an ATM interworking multiplexer on a call-by-call basis. A signaling processor receives signaling for a call and selects the virtual connection for the call. The signaling processor generates new signaling that identifies the selection and transfers the new signaling to the ATM interworking multiplexer that accepted the access connection for the call. The multiplexer converts user information from the access connection into ATM cells for transmission over the virtual connection in accord with the new signaling.

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