

CTI Interfaces

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Computer Telephony Revolution



 Using off-the-shelf computer technologies to implement telephone system components
Shift from Monolithic to Modular systems



CTI Defined



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Call Control

Monitoring and directing calls in a telephone system
Telephone Control

- Monitoring and controlling features of a telephone set
- Media Binding
 - Relating other communications/telephony functionality to calls in a telephone system

CT Media Access/Services



- Tone Detection and Generation
- Recording and Playback
- Text-to-Speech
- Speech Recognition
- Modulated Data (Modem/Fax)
- Digital Data (Compressed Video, etc.)
- Call Binding

Switching Fabric



- Establishes media stream channels between endpoints and conveys signaling information
- Traditional Switching Fabric
 - TDM bus backplanes connecting line cards
 - Analog (POTS) and digital (T-1, ISDN, proprietary) telephony circuits
- IP Telephony Switching Fabric
 - Packetized voice over conventional IP networking infrastructure
 - Typically based on off-the-shelf computer technology

Admin



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System configuration

 System customization
 Moves / Adds / Changes

Fault monitoring
Accounting
Performance management
Security





Telephone systems that are tailored to the specific needs and preferences of users

A series of disappointments



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mid-80s

- Partnering announcements
- late-80s
 - ► Early SBT products (Meridian Telecenter, etc.)
- early-90s
 - ► Mainstream APIs (MTA, TAPI, TSAPI, etc.)
- mid-90s
 - ► API-based products

What went wrong?



- The promise of CT/CTI is custom, modular solutions
- The lack of interoperability between products limits or prevents customization
- Standards and other interoperability specifications allow for modular systems
- Modularity is a measure of product maturity







Second Phase of CTI: APIs





Third Phase of CTI: CTI Protocols





CT Frameworks



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Everyone has to talk the same language before they can discuss interoperability



	CT Interface #1		CT Interface #2		CT Interface #3				
	Mapping to Interface #1		Mapping to Interface #2		Mapping to Interface #3				
Telephone System (e.g., PBX, CT Server, etc.)									

Facade Concept



- Implementations vary dramatically, but...
- The same abstraction can be applied universally



New Development Approach



- Universal abstraction simplifies and improves implementation of interfaces
- Delivers behaviorial consistency between interface implementations

	CT Interface #1		CT Interface #2		CT Interface #3					
	Mapping to Interface #1		Mapping to Interface #2		Mapping to Interface #3					
Universal Mapping										
Telephone System (e.g., PBX, CT Server, etc.)										



CT Messages: Events



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Messages that report changes in the state or status of monitored objects











Messages that request that a particular service be carried out













Scope of a CTI Interface



- Refers to the set of calls and devices in the switching domain and their visibility
- All devices are either:
 - ► visible in the switching domain,
 - ► in the switching domain but not visible, or
 - ► in an external network.



Security



- Security features of a CTI interface also determine what features, services, and resources a particular computer (and its users) can access.
- Certain individuals may have the ability to observe certain devices but not to control them.

Vendor Specific Extensions



- CTI interfaces generally support "escape mechanisms" that allow access to proprietary features that cannot be accessed through a standard abstraction.
- Use of these escape mechanisms requires that a given computer have specific knowledge of a particular telephone system's vendor specific extensions.





Specifications and Standards



- Standards Bodies
 - ≻ ITU
 - ► ECMA
- Individual Vendors
 - ≻ Microsoft
 - ► Lucent/Novell
 - ≻ Sun
- Industry Organizations
 - ≻ IETF
 - ► ECTF

ECTF Framework

CTI Expo



Architecture Framework

- Architecture for CT services
- ► ECTF view of CT systems evolution
- Framework for developing interoperability agreements

Drives ECTF technical working groups



Call Control Specifications



- Universal Call Control Model
 - ► ECTF C.001 / Versit CTIE / ECMA CSTA

Protocols

► Versit / CSTA

Interfaces

- ► TSAPI
- ► Java Telephony
- ► Windows Telephony

Universal CTI Model



- Everyone has to talk the same language before they can discuss interoperability
- A single model has emerged
 - ► ECTF C.001 / Versit CTIE / ECMA CSTA












C.001/Versit/CSTA



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Calls

- ► Used to associate devices within a telephone system
- Managed by call processing



Connections

- Represent the association between devices and calls
- Reflect state and utilization of resources



C.001/Versit/CSTA Graphical Notation Basic Calls





Conference Calls







Service representation



Described in terms of "before" and "after" application of switching service



Clear Connection service



Call routing



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Movement of a call from device to device by call processing



Event flows



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Consultation Call event flow example



C.001 Status



- Used by PBX/IP PBX/PX PBX developers as basis for new call control implementations
- Used by CTI provider developers as basis for API mappings
- Used by API developers as basis for functional requirements

Versit



- Initiative of Apple, AT&T, IBM, Siemens
- Versit CTI Encyclopedia (VCTIE)
 - Framework based on CSTA
 - Superset of all existing API functionality
 - Normalization of Behavior
 - Industrial Strength Protocols
 - Conformance Requirements
- Completed in 1996 and delivered to ECTF (C.001) and ECMA (CSTA phase III)

Versit CTI Protocols



- All protocols have the same functionality but vary in their encoding
- Protocol 1
 - Intended for switch-server streams
 - ► Superset of CSTA
- Protocol 2
 - Optimized for client-server streams
- Protocol 3
 - Optimized for direct-connect streams

ECMA CSTA



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CSTA Phase I

- ► Switch-Server CTI Framework
- ► CTI Protocol
- CSTA Phase II
 - ► Enhancements to Phase I
- CSTA Phase III
 - Universal CTI Framework, Service Definitions, Protocol
 - Rework based on Versit CTI Encyclopedia

CSTA Status



Phase III complete

For More Information



C.001 specifications and Versit CTIE: http://www.ectf.org



Lucent/Novell: TSAPI



- API for CTI only
- Corresponds to CSTA Phase I
- Supports private data for proprietary extensions





TSAPI Status



- Server software available for
 - Netware (Netware Telephony Services)
 - Windows NT (Lucent CenterVu server)
- Client software available for
 - ► Windows 3.x, Windows 95, Windows NT
 - ► Mac OS
 - ≻ OS/2
 - ► UnixWare
 - ≻ HP-UX
 - ► Netware
- Client-Server Protocol is closed

For More Information



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 Lucent TSAPI information at: http://www.lucent.com/bcs/solutions.main?p_id=33&p_keyword=
 Novell TSAPI information at:

http://www.novell.com/catalog/qr/sne24310.html

Java Community: JTAPI



- CTI API for Java
- JTAPI 1.0
 - Original version
 - Certain limitations and ommissions
- JTAPI 1.2
 - ► Revised version developed with ECTF
- JTAPI 1.3
 - ► Minor updates to 1.2
 - ► Media Services

JTAPI Architecture



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Designed to be layered over CTI APIs, or Protocols, or directly over implementations







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Using Java Remote Method Invocation (RMI) to access peer running on JTAPI logical server







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"Core plus Extensions"



JTAPI Core



- Core JTAPI supports very basic methods:
 - ➤ createCall(),
 - ➤ connect(),
 - ► answer(),
 - > disconnect()
- Capabilities for each of these methods.
 Simple state transitions with corresponding events.

Standard Extension Packages



- Call Control PBX Call Features (javax.telephony.callcontrol)
- Call Center Call Center Functions (javax.telephony.callcenter)
- Private Data Access to switch specific information. (javax.telephony.privatedata)
- Media Access to media streams (JTAPI 1.3) (javax.telephony.media)

JTAPI Terminology



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Standard

Switching Domain Physical Device Logical Device Call Connection

JTAPI

Provider Terminal Address Call Connection

The Provider Object



- Represents the switching domain accessible through the interface to the telephone system implemented by the JTAPI peer
- Parent of all objects
- Created through static methods









Events



- Events represented by objects
- Events generated by:
 - ► Providers
 - Calls (includes all associated connections)
 - ► Addresses
 - ► Terminals

Event Observers



- Event observer object corresponding to type of object to be monitored is created
- Observer object is attached to object for which events are desired
- Event objects are delivered to observer object
- JTAPI 2.0 will also support listener event model



Capabilities



- Every JTAPI call-model object has an associated capability object
- Capabilities objects are obtained from call model objects.
- Static and Dynamic Capabilities.

Example Application Flow



- Use Peer Factory to locate Peer
- Use Peer to instantiate Provider object
- Use Provider to locate Terminal object(s) of interest
- Create TerminalObserver object(s) and add them to the Terminal object(s)
- Wait for events to be delivered to TerminalObservers
- Handle events until application is terminated

JTAPI Status



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JTAPI 1.2

- > Warning: 1.2 Media Package should not be used
- Implementations shipping from various vendors
- Mapping software for TSAPI and CallPath implemented
- ► Mapping to CSTA Phase III in development
- JTAPI 1.3
 - Media Package is key new enhancement
 - ► 1.3 Media Package work, initiated 2/97
 - Core, call center, call control, and private data packages designated as ECTF C.100
- JTAPI 2.0
 - Definition being developed

For More Information



JTAPI information at:

http://java.sun.com/products/jtapi/index.html

Java information at:

http://java.sun.com/



Microsoft: Windows Telephony

■ TAPI 1.x

- ► Windows CTI API
- Client implementation
- **TAPI 2.1**
 - Additional telephony functionality
 - Server implementation
- TAPI 3.0
 - New media stream interfaces
 - Object-based (COM) implementation









TAPI Simplifications



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First party switching domain

TAPI Call State

Local Connection State

Accepted Busy Conferenced Connected Dialing Dialtone Disconnected Idle Offering Onhold OnholdPendingConference OnholdPending Transfer Proceeding Ringback SpecialInfo Alerting (Ringing Mode) Connected Connected (after Conferenced) Connected Initiated (after Digits Dialed) Initiated Connected Null Alerting (Offered Mode) Hold Hold (Purpose:Conference) Hold (Purpose:Transfer) Connected Connected

Remote Device Connection State
TAPI 1.x/2.x Terminology



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Standard

Switching Domain Physical Device Logical Device Call Connection

TAPI

Line Device Terminal or Phone Device Address N/R Call



CTI Protocol

To NT Server



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TAPI 3.0 Terminology



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Standard

Switching Domain Physical Device Logical Device Call Connection

TAPI 3.0

TAPI Object Terminal Address Call Hub Call





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TAPI Status



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TAPI 2.1 Shipping

- ► Server available for Windows NT 4
- Client software available for Windows 95, Windows NT 4 Workstation/Server
- TAPI 3.0 Under Development
 - ► Service providers for H.323 and IP-MC to be included
 - Continued support for existing service provider and "C" language application interfaces
 - New objects for call center applications
- Client-Server CTI Protocol is closed

For More Information



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TAPI information at:

http://www.microsoft.com/ntserver/commserv/exec/overview/tapiabout.asp

Windows information at:

http://www.microsoft.com/

High-Level Interfaces



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Windows

- DDE (implementation specific)
- ActiveX (implementation specific)
- Other proprietary mechanisms
- Mac OS
 - ► Telephony Apple Events

CTI Applications



- Screen-based Telephones (SBTs)
- Programmed Telephony
- Telephony-Aware applications

Maturity Checklist



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- Framework
- Published APIs
- Published Protocols
- Reference Implementations
- Plug & Play Products

Conclusions



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Call Control

- Universal framework has emerged
- Newest generation of APIs are/will be functionally rich
- CTI Plug & Play dependent upon adoption / completion of Versit / CSTA Phase III protocols



Q&A

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