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Performance from Experience

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SGCP - Simple Gateway Control Protocol

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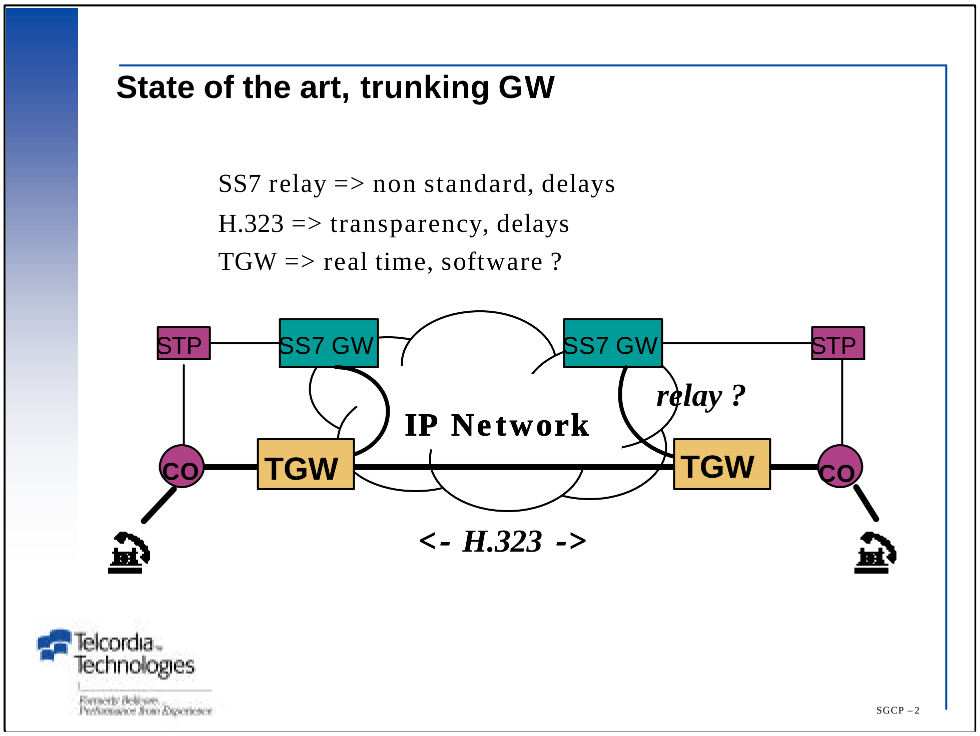
An SAIC Company

These slides contain an extensive presentation of SGCP. They are organized in three parts:

- An introduction, which presents our motivation for developing this protocol, and then goes on to present the protocol itself.
- The discussion of SGCP pros and cons.
- The status of SGCP standardization and industry support.

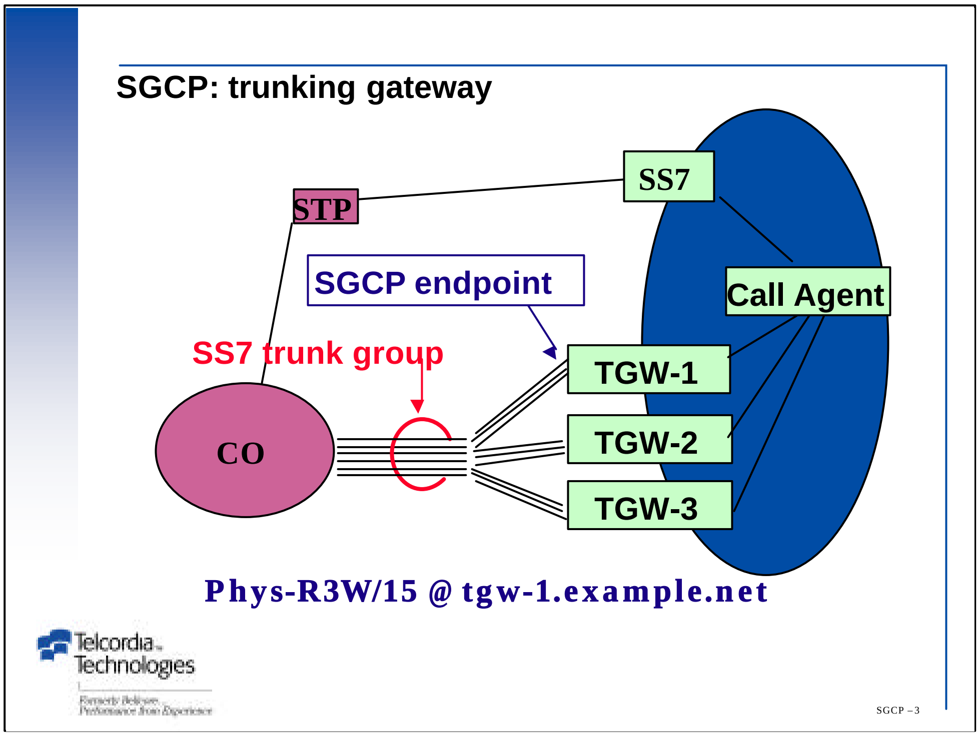


We started working on the Simple Gateway Control Protocol in January, 1998. At that time, we were mostly concerned with the management of “trunking gateways”, that enable calls to be relayed from the plain old telephone service to the Internet, or to an internet-technology network.

In 1997, the internet telephony gateways that were available were not designed for that application. There when mostly meant to be used in entreprises, and they would connect to the telephone network through ISDN interfaces, typically using Q.931 signaling.

The initial proposal, in 1997, was to somehow convert the SS7 signalling received from the CO switches into a variation of Q.931 that the gateway can handle, to set-up an H.323 call between the gateways, and to relay that call on the PSTN. That proposal was not very satisfactory:

> The conversion between SS7 and Q.931 looses information, such as, for example everything related to continuity tests. This can only be obviated by non-standard extensions
>
> The gateway implements a call model that prevents easy addition of intelligent services
>
> H.323, as defined in 1997, results in very long call establishment times.

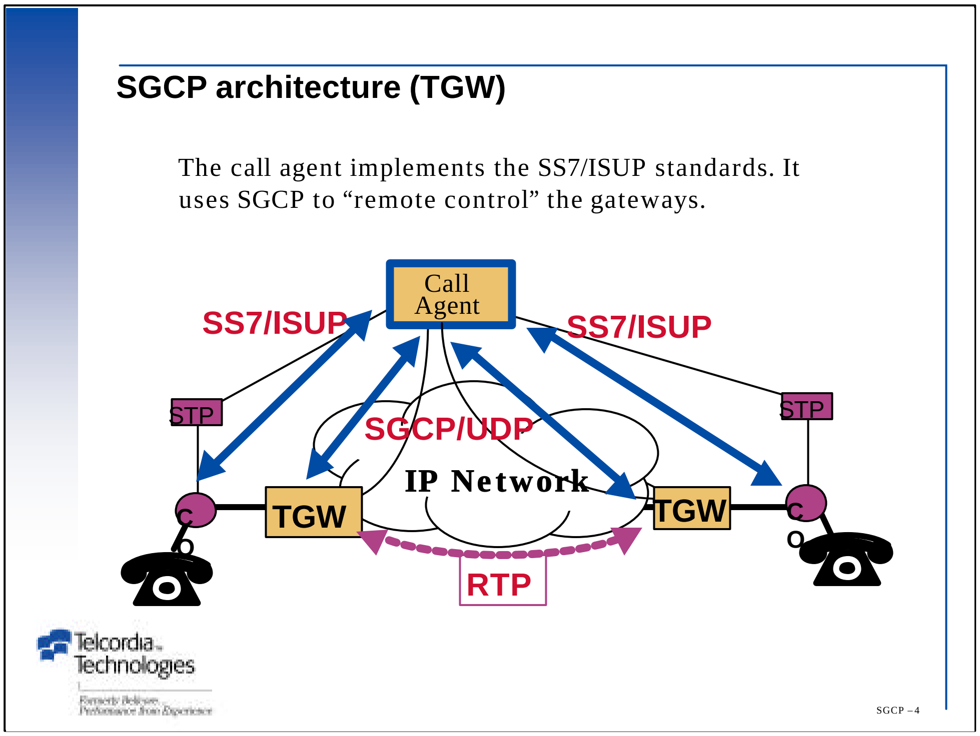


We decided instead to work on a new architecture, where the call control function will be exported from the gateway into a “call agent.” The call agent will exchange SS7 signaling with the CO switch through an SS7 “gateway.” The call agent will contain a full implementation of the ISUP call model, which will enable the easy introduction of value added telephony service on the Internet.

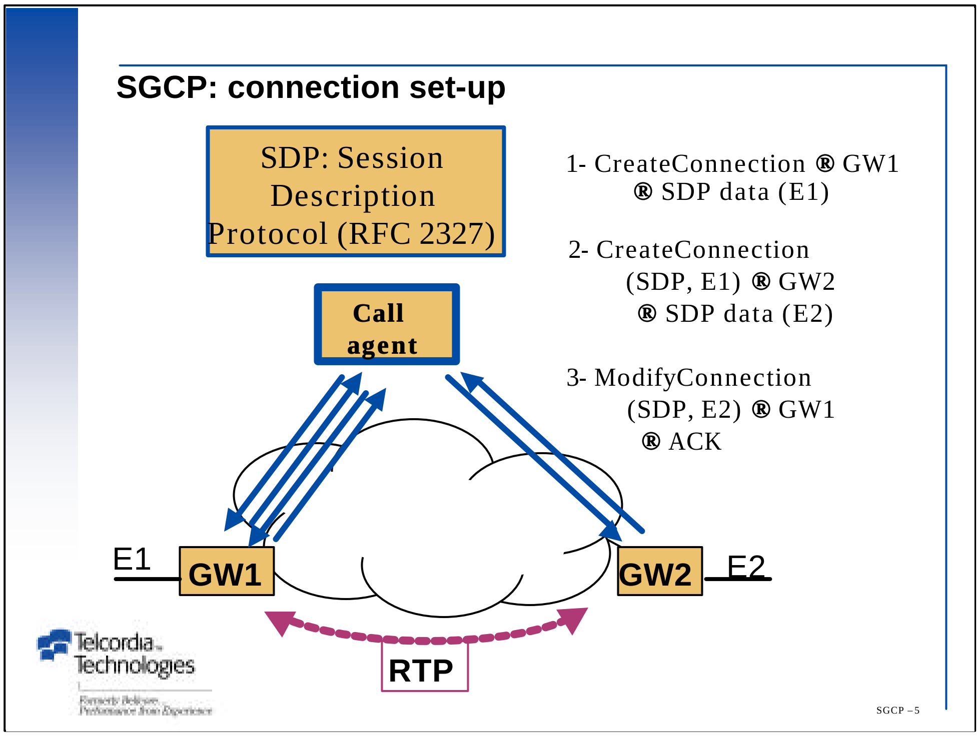
In the SS7 network, the whole set of SS7 gateways, trunking gateways and call agent is seen as just another switch, linked through the CO switch by a “trunk group.” That trunk group can be very large, and, in our model, can be served by several gateways.

The call agent uses SGCP to “remote control” the gateway, in accordance with the SS7 signaling.

Each DS0 trunk in the trunk group is identified in the SS7 protocols by a circuit number (CIC, Circuit Identification Code.) In SGCP, the DS0 trunk is an “endpoint”, represented by a name. The call agent uses configuration databases to match Circuit Identification Code and the name of the endpoint.



This diagram shows the global picture of an Internet exchange carrier. The call agent relays ISUP messages, and uses SGCP to set up an RTP association that connects the ingress and egress trunks.



The establishment of the connection takes place in three phases:

First, the call agent creates a connection on the ingress gateway. The gateway allocates resources to that connection, such as IP address, UDP port, DSP codes. The gateway returns a session description, as defined in the IETF session description protocol, which is now an IETF proposed standard.

Then, the call agent creates a connection on the egress gateway, providing the session description that it just learned. The second gateway performs its own resource allocation, and sends its own session description back to the call agent.

Finally, the call agent sends this second session description back to the first gateway.

At this point, both gateways have the other's session description. They can exchange audio packets over an RTP association.

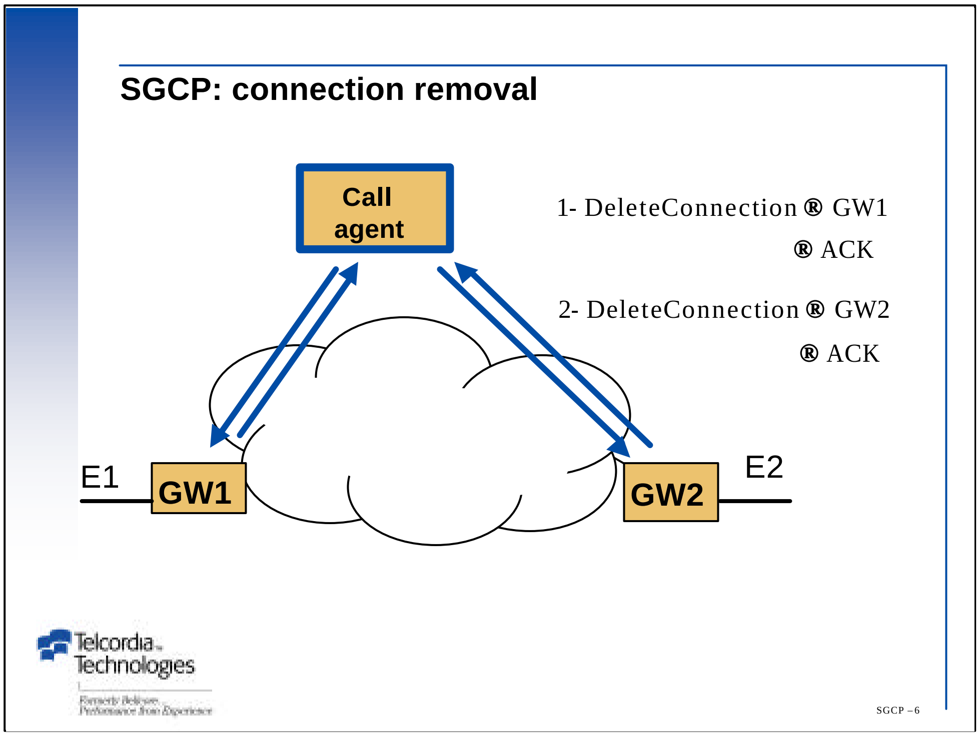
Each connection has several parameters:

Mode: inactive, recvonly, sendonly, sendrecv, loopback, conttest

Packetization period, bandwidth, compression algorithm

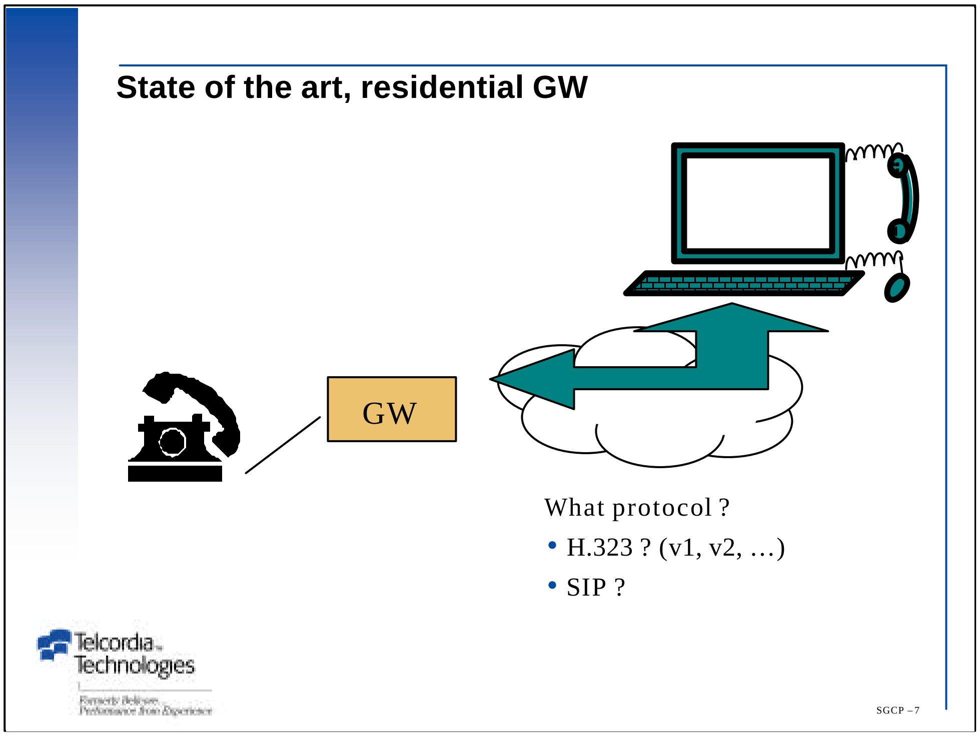
SDP: IP addresses, UDP port, compression algorithm, RTP parameters

These parameters can be updated at any time by the ModifyConnection command, which enable the design of innovative service.

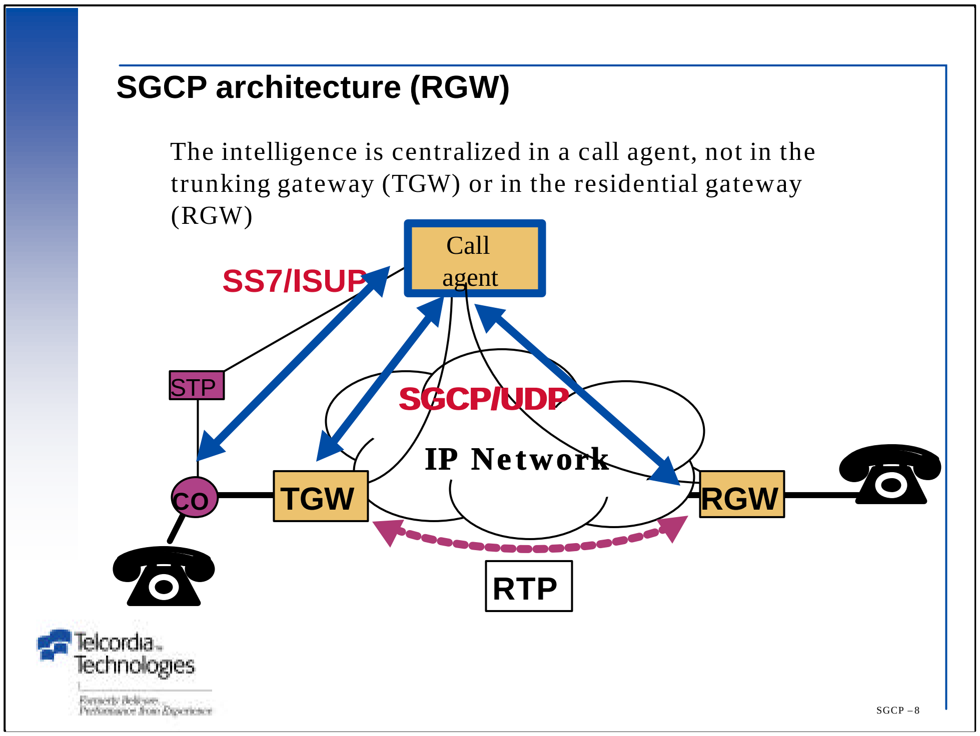


When the call agent decides to tear down the connection, for example after receiving an ISUP Release message, it issues “DeleteConnection” command to both gateways.

The responses (acknowledgement) returned by the gateways contain statistics on the connection, such as amount of data transferred, loss rate and delays.



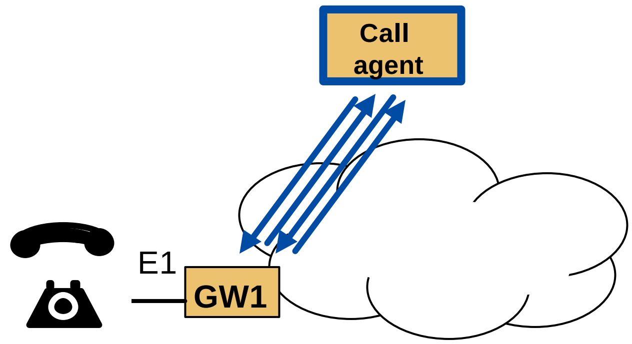
Shortly after designing a solution for trunking gateways, we had to study the case of residential gateways. Again, we looked at the existing standards, but we were not entirely convinced that they were adequate. H.323 is very large, SIP is not well accepted. Both place all the call control intelligence in the "terminal," in our case in a gateway. This may increase the price of the gateway somewhat, an important consideration in this market. It will also limit the introduction of new services, because the gateways will be wired to do calls "exactly one way."



In fact, we decided to reapply the same architecture that we had developed for the trunking gateways. One of the reason was that such networks have to include trunking gateways to interface with the POTS, and so we could have a lot of code in common. Another reason is that some functions specific to the residential gateways, such as acquisition of DTMF digits, may well be also needed in trunking gateways for additional services such as credit card calls.

SGCP: event notification

1- NotificationRequest (ring, off hook?) ® GW1
® ACK
2- Notify (off hook!) ® Call Agent
® ACK



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In SGCP, the local signaling is handled by a collection of events. The call agent programs the gateway with the list of events that it should watch, and with the list of signals that it should produce. When a requested event is detected, the gateway sends a Notify command to the call agent.

There is no call state in the gateway, just lists of events and signals, as well as connection. The call agent can construct arbitrary services. For example, if the users dials 911, the call agent will leave the connection open, even if the users hangs up.

We have defined a collection of events in the SGCP protocols:

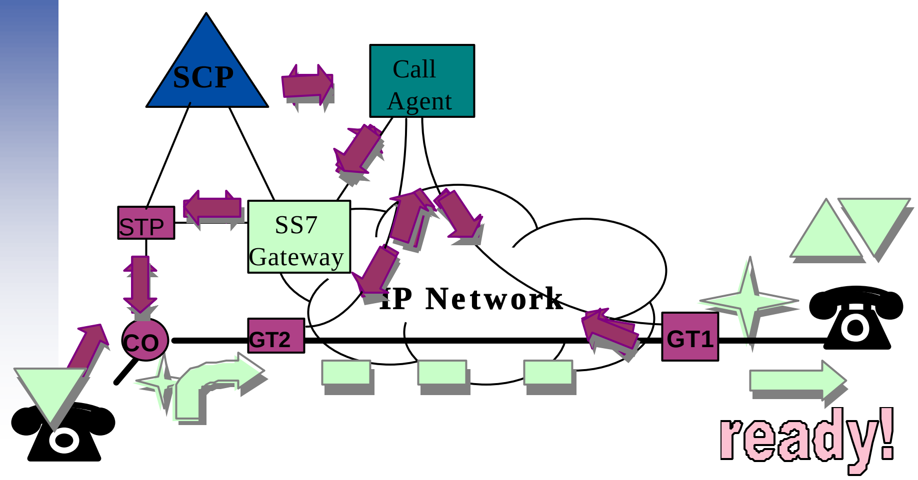
- Ringing, Dial tones, Busy Tones…
- On-hook, Off-hook, Flash-hook
- DTMF digits

Digit collection is managed through a “Digit Map”

- Regular expression, allows accumulation of strings
- Used for numbering plans as well as supplementary services.

Digit maps can be tailored centrally and on a per-user basis - not tied to features since intelligence is in CA.

Incoming Call (from PSTN)



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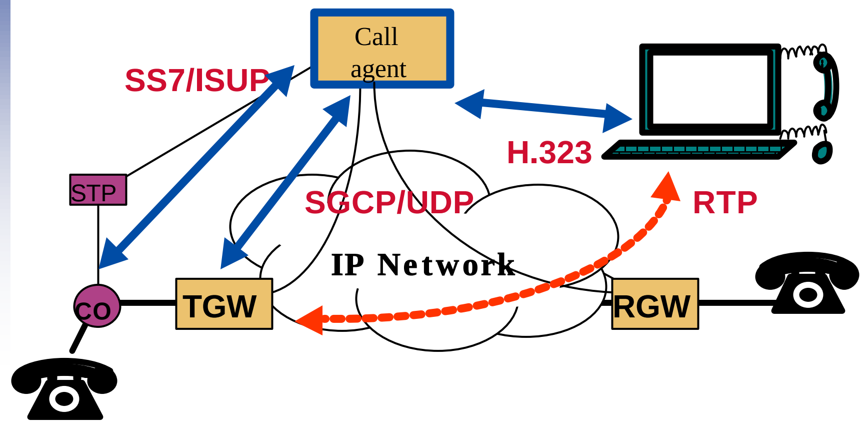
SGCP architecture (H.323)

The call agent implements multiple protocols, such as SS7 or H.323, uses SGCP to control the gateways



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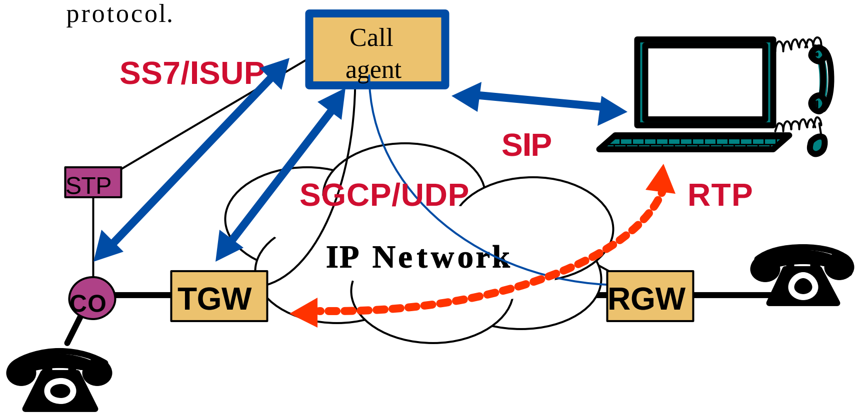
SGCP architecture (SIP)

The call agent can easily implement multiple protocols. Relaying to SIP is easy, because SGCP incorporates the SDP protocol.



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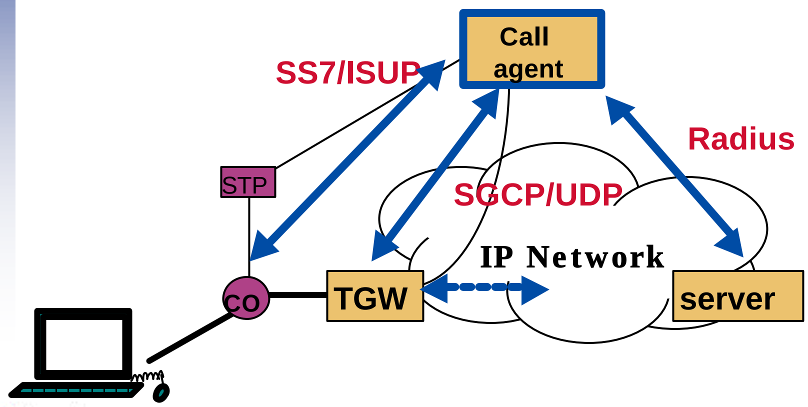
SGCP architecture (NAS)

The call agent receives a call to 1-800-INTERNET.
It uses SGCP to parameterize the gateway.



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SGCP -
Pros and Cons

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SGCP Pros

- SGCP is based on a Centralized Call Intelligence Architecture
- Centralized call intelligence can still rely on distributed systems to achieve high performance and reliability at an affordable price.

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SGCP Pros (Centralized Call Intelligence Architecture)

- Simple and stateless endpoints more reliable than complex and stateful.
- Call Agents with call intelligence and complexity under physical control by service provider.
- Large number of endpoints not a major OA&M concern.
- Services available strictly a function of Call Agents:
  - Different endpoint vendors not a concern
  - Different endpoint software version and vendor not a concern.

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SGCP Pros (Centralized Call Intelligence Architecture)

- A must for reliable billing.
- Feature change and software updates only needed on limited number of tightly controlled and centralized Call Agents.
- Total cost of ownership under control.
- Higher reliability and better service.

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SGCP Pros

- UDP based instead of TCP:
  - Support for failover
  - Scalable
  - Real-time
    - No connection setup delay
    - Avoid TCP retransmission strategy
- Small set of simple transactions:
  - Low CPU and memory requirement for endpoint
- No need for expensive and resource-hungry parsers.

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SGCP Pros

- Truly Interoperable endpoints can be developed cheaply.
- Simple to use and program
- Powerful enough to support/enable current:
  - Basic telephony services.
  - Enhanced telephony services, e.g. call
  - waiting, call transfer, conferencing, etc.
- Flexible enough to support future IP telephony services.

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SGCP Cons

- Centralized Call Intelligence is critical to system - if Call Agents are unavailable, service will be unavailable (but servers can be made highly robust, SGCP supports failover).
- Requires low-delay and low-loss network for optimal performance (but so does VoIP in general).
- SGCP is not yet widely deployed.
- No self-announcement, self-provisioning (could be added, probably outside of SGCP -- SGCP uses DNS names, appliance may well use DHCP).

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SGCP -
Industry Support

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Standardization

- SGCP is a completely open protocol.
- Telcordia Technologies will provide a reference implementation.
- SGCP Web site:

  http://www.argreenhouse.com/SGCP
- SGCP spec. publicly available at:
  http://www.ietf.org/internet-drafts/
  draft-huitema-sgcp-v1-00.txt
- SGCP reflector - subscription
  sgcp-request@research.telcordia.com

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Standards Bodies et. al.

- CableLabs
  First presentation of SGCP - May 13, 1998
- IETF
  Submitted as Internet Draft - May 15, 1998
- ETSI TIPHON
  Submitted for Helsinki meeting - May 26, 1998
- IMTC VoIP Forum
  SGCP to be presented in mid-July 1998

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Industry Support

- SGCP actively supported and currently being implemented by Cisco Systems and Telcordia Technologies.
- *Currently working with a cable TV company on an end-to-end SGCP based Voice over IP solution.*
- *Several Voice over IP vendors have admitted privately to be working with "something like SGCP"*
- Initial feedback from the industry has been mostly positive.
- Many VoIP vendors subscribe to the SGCP reflector to ensure an open and comprehensive protocol.

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