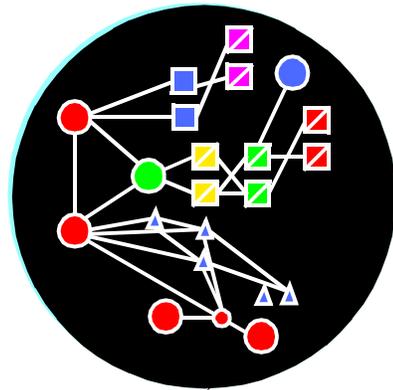


SS7 Tutorial



Network History

Why SS7?

Problems in the PSTN

For the first fifty years of telephone communications things moved at a fairly even pace. Demand for phones increased steadily, peaking at the time of the Stock Market collapse. The Great Depression applied the brakes to the demand for phone services while the technology continued to increase, albeit more slowly. With the advent of World War II, the demand for phone services began, once again, to rise sharply. Initially sparked by military requirements, this demand was further fueled by the needs of a multitude of industries gearing up for the war effort.

The problems of meeting this demand were harrowing. For one thing, not all nations were party to any standards agreements which would facilitate the handling of international telephone calls. In many nations, trying to make a telephone call was a lesson in handling frustration. That lesson was only compounded when a call originating in one nation had to be connected to a phone in another nation.

Telephone companies found it difficult to meet the demand in wartime. After the war meeting the demand would become impossible. During the two decades following World War II demand for telephone service reached astonishing proportions. New businesses popped up overnight like mushrooms. Existing businesses experienced growth spurts that would double or triple their demand for phones in a single year. Comfortably employed workers gained the confidence to have second and even third phones installed in their homes. Areas where there had been few phones before the war now pressed to be able to become a part of the emerging world of modern communications.

To answer this demand, telephone companies could do little more than add more wires. A thousand new telephones might result in ten thousand new conversations every day. Those ten thousand conversations would require new wires to carry them. To make matters worse, telephone traffic doesn't occur at an evenly paced rate. There are peaks and valleys in telephone usage. Those thousand new telephones might well result in four or five hundred new conversations occurring at the same time.

In the postwar period telephone industries around the world had attracted many of the best and brightest among those who had chosen to pursue careers in technology. Many of these now turned to thoughts of how telephone wires could be used more efficiently. The concept was both simple and obvious. If wires could become ten percent more efficient, each wire would carry ten percent more conversations. The need for new wiring would then decrease an equivalent amount.

The causes of the problem

One way to use wires more **efficiently** for conversations was to stop using **them** for anything other than conversations. **At the time**, the wire that was used for conversation was also used to carry all the information that was necessary to connect and manage that conversation. Such information was referred to as “signalling”. **In the postwar era** signalling consisted of analog electrical representations of sound. In exactly the same way that the voice was converted to an electrical current to be sent over the wire, these signals were sent over the wire in the form of an analog current which would be converted back to sound at the receiving end. In fact, both these signals and the electrical current representation of the voice were converted back to sound at the receiving end.

Most of us are familiar with at least some of these signals. Lift the phone off the hook and you hear what we refer to as “dialtone”. That sound tells the caller that the telephone line is connected to the local switch and that he/she may proceed to dial. At the telephone company end of **the** line, the completed circuit that allowed the telephone company to **send the** dialtone tells them **the** phone is “off-hook”. If someone **calls now**, the call won’t be connected. Today **with** call waiting, **a sound will be placed on the line to indicate an incoming call**. But in the post war era **someone trying to call through at such a time** would simply get a busy signal.

Now the phone **is dialed**. In most cases each digit **dialed** places two tones on the line. We call this “touch tone” dialing. **The phone company calls it** “Dual Tone Multifrequency” (DTMF). In the 40s and 50s this same information was conveyed by interrupting the line connection. The number of interruptions corresponded **to** the number dialed. A rotary dial on the phone accomplished these interruptions. But, **if it was timed just right** with pauses between the digits, **the phone could actually be dialed** just by clicking the button in the cradle of the phone.

Once you have finished dialing, the telephone company compares your dialed digits with a routing table that provides the switch with the information allowing it to choose another switch in the network to which it makes a voice circuit connection. That next switch also receives the dialed digit information so that it can consult its own routing table to determine where the next connection will be made. In the end, the switch which is connected to the line of the phone you are calling is connected into the circuit.

This switch now determines whether the call can be connected. If your party is talking, their line indicates an “off hook” condition. In the days before call waiting this always meant that you would be sent another signal that we call the “busy” signal. This signal was not the only problem associated with signalling in the voice circuitry; but it was a major problem which we can examine to help understand the reasons for wanting to eliminate voice circuit signalling.

With all of the circuit connections in place, the busy signal was sent from the local switch serving the party being called. No matter how far away you were, all of the connections had to remain in place just to carry the busy signal back to the caller. This same circuitry could not be used for any other phone call. The circuitry was lost for as long as the caller hung on to the phone. Very often, the caller would hang up and place the call again immediately. The result would usually be another busy signal. This wasn't stupidity on the part of the caller. It was simply that they knew they may have dialed incorrectly and that it might not really be their party that was busy. Sometimes it was because the party who was calling felt an urgent need to contact the other party. Sometimes these dialing compulsions led to the call being placed again and again and again. The resultant inefficient use of circuitry was one of the reasons that the phone companies could not keep up to the demand for new wiring.

The concepts of a solution

Digital concepts were already well enough advanced that Telephone company thinkers could envision turning the analog data into digital packets and sending them through the network using existing wiring set up for digital use. A single “channel” or individual circuit would only handle conversation and signalling for one phone call at a time. A digital packet could share a common channel with hundreds or thousands of other digital packets. Each packet could contain a signal.

Thus, thousands of signals could share a single channel and only one voice circuit was lost to remove the signalling from thousands of voice circuits. Because this was so, the approach became known as “Common Channel Signalling” (CCS).

The results of this Common Channel Signalling approach were almost immediately apparent. If the local switch could get the information back from the remote switch that the called party's line was busy, then the local switch could send the busy signal back to the caller. None of the circuitry between the local and remote switches would be required to carry the busy signal back. The only wiring being tied up would be the wire to the caller's phone.

Having a digital interface with the telephone network would evolve to a point where removing the signalling from the voice network would seem to be a minor advantage. Common Channel Signalling would pave the way for 800 numbers, 900 numbers, telephone credit cards, calling cards, the delivery of numerous services (such as short text messages) to cell phones, caller identification and a host of other intelligent (programmable) services available in the Common Channel network.

Nevertheless, having the concept fifty years ago was a long way from experiencing the reality. Everyone in the industry understood that such a system would be almost useless unless a telephone call could be connected from any phone in the world to any other phone in the world. It was time to develop a standard which would set the guidelines for all the details of how the new system would handle every situation. The standards organization which would do the work was the CCITT (Consultative Committee on International Telephone and Telegraph)

The history of the standards organizations

Telecommunications standards go all the way back to May of 1865 when the International Telegraph Convention was signed by 20 countries. Once the agreement was signed, the organization known as the International Telegraph Union was formed to perform the ongoing work of recommending changes to the first agreement because all parties recognized that time and technology would likely result in the need to make changes.

A mere ten years later, the invention and rapid deployment of telephone services led the Telegraph Union to begin recommending legislation for international use of telephony.

Wireless telegraphy joined the communications mix only twenty years later. The need for yet another set of standards prompted the calling of an International Radio Conference in 1906. The result was the signing of the first International Radiotelegraph Convention .

By 1927 there was a Consultative Committee for International Radio (CCIR), a Consultative Committee for International Telephone (CCIF), and a Consultative Committee for International Telegraph (CCIT). In 1932 the ITU decided to combine the Telegraph and Radiotelegraph Conventions and form the International Telecommunication Convention. In 1934 the ITU renamed itself as the International Telecommunication Union.

The creation of the standards

After World War II the ITU became a United Nations Treaty Organization. Finally (or almost) in 1956 the CCIF and CCIT were combined and became the CCITT (Consultative Committee for International Telephone and Telegraph)

To this group fell the task of making the recommendations which would collectively become known as Signalling System #7. In subsequent years the subcommittees were reorganized and CCITT was replaced with today's ITU-TS.

One question often asked is, "Were there six signalling systems before SS7?" The answer is that there were, but the earliest versions existed nowhere except on paper. The immediate predecessor to SS7 actually saw some limited deployment. It was not called "SS6" (though some call it that in hindsight) but, rather, Common Channel Interoffice Signalling Systems #6 (CCIOS6). It would be 1980 before a fully deployable version would be completed. Every four years beginning in 1976, the standards were grouped into collections which became identified with the colors used for the bound covers. In 1976 it was the Orange Book followed by the Yellow Book (1980), the Red Book (1984), the Blue Book (1988) and the White Book (1992).

Why SS7?

The answer is simply that the time had come for the world to begin its move into the high-tech, highly communicative world of the latter part of the Twentieth Century.

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