APCO REPORTS

ASSOCIATION OF PUBLIC-SAFETY COMMUNICATIONS OFFICIALS INTERNATIONAL, INC.

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Volume 8 • • 1993 • • Number 12

Future Vision II: The 9-1-1 Imperitive

By W. Clay Paxton • *Member, APCO 9-1-1 Committee*

• Our bubble gum and bailing wire approach to accommodating emerging technologies without our 9-1-1 systems and emergency telecommunications is ... pure folly.

• ... we could see the next wave of wireless (PCS) technologies in the marketplace before Christmas 1994.

• ... the FCC has no plans to mandate compliance of PCS/PCN systems, networks or equipment to any of the enhanced 9-1-1 protocols or user requirements.

When last we visited our crystal ball and gazed into the future of 9-1-1, we saw a developing scenario of grave concern:

A loose national network of emergency telecommunications systems that are rapidly deteriorating into a state of obsolescence.

The principle cause is that while technology continues to evolve, stakeholders have failed to consider the processes, systems and requirements of the embedded 9-1-1 infrastructure. Even now, as we are coming to realize the consequences and impact to our public safety responsibilities, technology continues to march forward with scarcely more than a glance back over the shoulder of "progress."

The Saga Continues

The lessons of history reveal much of the future. For example, the lessons learned from cellular technology should cause us grave concern as we look to the numerous other wireless technologies now taking shape on the near horizon. The explosion of the cellular telecommunication market has far exceeded any forecaster's dream.

So, too, the impact it has wrought on our enhanced 9-1-1 systems and the processes used to provide emergency response services. For example, in 1982

INSIDE:

9-1-1, PBXs and Washington State

In Washington State, several highly publicized events caused some local municipalities to enact legislation that required all new telephone system installations to have the capability to pass location information to the endhanced 9-1-1 system.

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the market forecast for cellular telephones projected one million units in service by the year 2002. In 1992, just halfway into the forecast period, the 10 millionth unit was placed into service.

Today, more than 7,000 new cellular telephones are installed daily in the United States, about 20 percent of those in California alone ... none of which is capable of enhanced 9-1-1 service. What had been thought to be a minor technological aberration, easily accommodated using a default logic, is now poised to bring many 9-1-1 telecommunications systems to their knees.

Witness January 1993. In that single month, one California Highway Patrol (CHP) communication facility (Golden Gate Communications Center) fielded 80,000 calls for emergency assistance, and 25,076 (or 31.3%) of those were from cellular phones. In 1987, the Massachusetts State Police fielded about 300 cellular calls a month.

By December 1992, that number had grown to more than 15,700, a growth of more than 1,000% per year! Compounding this phenomenon, cellular phones no longer are totally within the province of motor vehicle use. We now find them in pockets, purses and briefcases.

Calls to 9-1-1 regularly are reported from malls, golf courses, pleasure boats, airplanes, offices, convention centers (did you see all the cellular phones being used at APCO in New Orleans?) and schools. The cellular explosion fundamentally has transformed the very nature of telephonic communications; rather than being directed from place to place, we are coming to expect direct, dynamic person-to-person connectivity.

The cellular experience also has shown that people will adopt and use technology that improves their quality of life. The new, emerging technologies of today soon will become the commonly used tools and appliances of tomorrow. Our bubble gum and bailing wire approach to accommodating emerging technologies within our 9-1-1 systems and emergency telecommunications is, thus, pure folly.

Whether it's a plan to default-route cellular to a single emergency service provider, or a scheme to use cell-site location in lieu of actual station set location, these all are short-sighted fixes. They represent significant cost, and they offer little in terms of future value. We absolutely must anticipate the broadest application of emerging technologies and insist that provisions for our life-critical service be provided for in plans for their implementation.

So What's the Big Deal?

PCS is essentially the logical extension of existing cellular service. Personal Communications Services (PCS) is a family of wireless communications services and devices which operate over a wide range of radio frequencies assigned and authorized by the FCC. Early examples of PCS deployment are evident in car phones, pagers and wireless LANs and modems. PCS, too, is digital, RF-based wireless, but it utilizes lower-powered transmitters. Lower power allows re-utilization of frequencies within smaller geographical areas.

PCS transmitters, which may be dedicated to a single building, PBX or neighborhood, may then be networked to a larger cellular system or to the public-switched network through a PCN (Personal Communication Network).

While there are those who might underestimate the power of PCS because of its low-powered transmission characteristics, make no mistake, the power is limited only by the power of those other networks to which they have access.

APCO's Project 31, chartered to represent the board but specific interests of public safety communications relative to wireless technologies, has discovered some alarming information. The FCC concluded its report detailing specifics for PCS licensing on September 23, 1993, and expects to hold spectrum license auctions not later than May 2 of this year. It is fully possible that we could see the next wave of wireless (PCS) technologies in the marketplace before Christmas 1994.

Even by the most conservative forecasts, demand for PCS is anticipated to be phenomenal. More than 60 million subscribers are expected to the next generation of PCS services by the year 2002. Industry forecasts call for annual revenues in excess of $30 billion. Even if reality produces only half the current forecast, in comparison with the existing cellular market (presently greater than $7 billion annually), PCS is going to be BIG!

Who's In Charge Here?

Throughout our 9-1-1 industry community, there is no apparent national telecommunications policy champion actively pursuing the long-term interests of public safety.

Among the traditional "power players" in the communications market, there isn't an obvious candidate stepping forward to assume leadership for the need of new national public safety standards or addressing the social implications of emerging technology.

As we discussed in our initial Future Vision (APCO Bulletin, January 1993, Page 8), since divestiture of the Bell System, there is no longer a dominant market entity that holds the power, authority or incentive to assume the role of national systems architect. The recently announced alliance between AT&T and McCaw Com-munications could signal a change in the balance of power in this regard ... but don't hold your breath for a significant change in approach.

Major U.S. wireless switch manufacturers who might logically be seen as appropriate to driving a national strategy are, so far, focusing only on equipment manufacture and the development of a wireless inter-exchange network. An example of this is Motorola, Inc., which, working with federal subsidies, is pursuing a project called Iridium. This project will make it possible to connect wireless callers around the world through a networked system of 77 low-orbit satellites. From what's publicly known about this effort, there's no obvious specific public safety interest accommodated in the project.

A key finding of Project 31's work has been that the FCC has no plans to mandate compliance of PCS/PCN systems, networks or equipment to any of the enhanced 9-1-1 protocols or user requirements. Ironically, the precedent cited by FCC officials for not intervening by regulation is cellular.

Clearly, they are oblivious to the problems this approach has created; they don't see that there's any problem with the way it is now! Legislators and regulators have generally adopted an attitude of laissez faire. An approach which might be a sound economic approach to the creation of business and building gross national product, but it lacks sensitivity for the social responsibility to public safety owed by the stewards of technology.

Clearly, absent unilateral industry, regulatory or legislative action, the best hope for leadership lies with our professional organizations, APCO and NENA. But, here, too, we are faced with a serious shortcoming: we typically underestimate the strength of our membership, and we lack a collective bias to action. We simply don't realize what we can collectively accomplish because we've never before been challenged to singularly forge a public policy of such critical importance.

Images Emerging in the Mist

We identified three areas of focus for our efforts last year when we initially considered what 9-1-1 might look like in the next few years. We said that we needed to: a) consider the characteristics of the emerging technologies; b) persuade manufacturers toward product development consistent with the needs of public safety; and c) influence public policy in a way that gains recognition of 9-1-1 as an essential component of universal service.

One that significantly benefits the public welfare and safety and that warrants a national policy including standards for design, manufacture and funding.

Since that time, there have been numerous indications of concern and ample cause for encouragement. Many within our industry have come forward as interested, concerned and desiring to "do something." Un-fortunately, many of our colleagues have become entirely frustrated trying to address and resolve these issues on a local or regional basis when they are truly national in scope. Manufacturers, telephone companies and public safety service providers alike have brought forward ideas, thoughts and, yes, even some potential solutions.

First, on technology. There are sufficient technologies to allow us to do what needs to be done. GPS, the Global Positioning System, a federal network of 24 satellites principally used by the Defense Department for navigation and advanced weapons systems, alone does not provide a pure solution, but when used in conjunction with other technologies, it appears to be very viable. Satellite signals are passive; that is, they are in the environment and available for general usage.

Many commercial geographical and tracking systems use GPS for some or all of their tracking data. Signals available for general public use are degraded and require additional modulation to get accuracy to acceptable public safety requirements (within one meter).

Clearly, we cannot discard this GPS technology without examination of the full nature of its limitations. There seem to be ready solutions to intra-building signal transmission issues, range of accuracy and availability of data signal concerns. Additionally, software conversion programs to convert existing tabular 9-1-1 data bases to GPS-compatible graphic files are similarly available. Admittedly, not all is rosy; size and cost of manufacture continue to be important areas for improvement in the technology. Size of the boards which contain a microprocessor, multiple (six) satellite transponders, power supply and various other components are now down to about the size of two back-to-back silver dollars.

Cost of manufacture is currently about $112 for the full-component board. Further technological evolution could reduce this cost, as could a network design wherein additional data manipulation functions are performed on the public network or within the enhanced 9-1-1 data base system(s).

Second, there are numerous manufacturers, vendors and software houses ready, willing and able to advance the cause of public safety. Unfortunately, most of them are not major players in our market and lack appropriate capitalization.

The larger providers (generally speaking) have a significant investment in the existing systems and simply can't abandon the present market or their investment in embedded systems.

Also, while a few million dollars in incremental revenue might be "big bucks" to some businesses, they don't represent an opportunity of scale to multi-billion-dollar enterprises. Thus, we still need to find a way to induce those with the capability and desire to come forward and take an active role in transforming our national 9-1-1 platform.

And last, public policy remains the most challenging aspect of our mandate for change. Regulators and legislators have proceeded based on their perception of the needs of the public safety.

For good reason, they don't have an adequate understanding of the systems, the technology or what's required to provision an appropriate emergency service response. We need to provide them with appropriate information so that they might better understand our concerns and the implications of continued inaction.

The Path Ahead

The road stretched before us appears rocky and has a number of unmarked forks. The decisions we make as we try to move forward are based upon what we believe to be true in our vision of the future. And while this vision may not yet be final and, admittedly, it does not address all the issues, there are some faint images emerging from the mist.

Absent a compelling shift in circumstances as we now believe them to be, these are the activities we must pursue in the preservation of our enhanced 9-1-1 systems.

A. Telephone Company 9-1-1 Data Systems

1. Conversion of ALI flat files to graphic, GEO-based structure.

- Each existing fixed address requires assignment of an industry standard lat/long value (lat/long infers a GPS-type data format which includes latitude, longitude and elevation - X, Y & Z).
- Digital color GEO mapping data base built on standardized GPS data.

2. Provisioning of network facilities to accommodate transmission of a lat/long data stream.

- GPS utilizes a 24-bit digital data stream for X, Y & Z coordinates.
- High-speed, high-capacity digital or "fast packet" PSAP network.

B. PSAP Systems

1. Intelligent workstations to support multi-tasking user requirements.

- Micro-based systems (PCs) with a Windows©-type operating system.

2. Fiber optic LAN connectivity with a micro-based file server/controller.

3. Integrated (but not dependent) voice and data system applications.

4. Modular "off-the-shelf" hardware, open robust software architecture.

C. Wireless (PCS) Systems, Equip-ment and Devices

1. All wireless systems, equipment and devices must be technically capable of passing lat/long data on 9-1-1 dialed calls.

- Cellular, PCS and cordless handsets.

D. Other Benefits That Could Be Derived From GEO-Based Data Files

1. Emergency notification/evacuation systems.

- HazMat incidents.
- Hostage scene management.

2. Rural addressing.

3. Event management coordination.

4. Visual response data available to field units via MVTs.

E. Issues Requiring Near-Term Resolution

1. Industry standards.

- Location data source (GPS).
- Transmission protocol.
- GEOfile compatibility.

2. Systems development.

- Scope of effort and realistic volume implications have not yet been factored into feasibility.
- Cost of production and size cannot be considered a prohibitive factors, but they require considerable improvement.

(Cost of providing location data cannot be allowed to increase the price of wireless telecommunications beyond the reach of the mass market. Likewise, the size of PCS devices are rapidly being scaled down and are now available in units about the size of ordinary pagers and expected to be available in wristwatch size before the turn of the century. The size of requisite locator components must not threaten this market-driven evolution.).

3. Public policy.

- Regulatory definitions and requirements must be documented and enacted.
- Legislative mandates will compel policy and industry standards affecting public safety.
- Incentives to migration to standards conformance (e.g., charging for calls to 9-1-1 from non-conforming cellular and PCS units).

And The Last Word ... for Now

The challenge we face is real. There isn't anyone else who is going to come forward and save our systems, protect our investment or assure us of the tools we need to provide for the public safety. There is no substitute for our leadership and activism. We have to "make it happen!" ■

9-1-1, PBXs and Washington State

By Joe Blaschka Jr. • *Member, APCO Project 31 PCS/PCN Team*

A small child calls 9-1-1 because her mommy is sick and cannot talk. The call-taker answers the call and interrogates the child. The child does not know their address; but because the 9-1-1 system is enhanced, the address from which the child is calling shows on the call-taker's automatic location information (ALI) screen.

Using this information, a dispatcher can send emergency aid, and the mother's life is saved. Similar events are common throughout the United States where enhanced 9-1-1 systems are in place. In some cases, however, emergency units are sent to a wrong address because the caller is located in an apartment complex, at work or at a school where multiple separate locations are all served from the same private telephone system (PBX).

Incompatibility Between Systems

This problem is caused by an incompatibility between many private telephone systems and the existing enhanced 9-1-1 system. In Washington State, several highly publicized events caused some local municipalities to enact legislation that required all new telephone system installations to have the ability to pass location information to the enhanced 9-1-1 system. The Washington State E9-1-1 Advisory Board also became aware of the problem about the same time through its public safety representatives. The Board created a PBX work group to evaluate the problem and to report back with findings and recommendations.

The PBX work group was made up of representatives from the local exchange carriers (telcos), APCO, NENA, the Washington Utilities and Transportation Commission, and the business community. I was appointed to provide broad-based technical input.

The work group solicited input from equipment suppliers and manufacturers, PBX users, and public safety officials. An extensive technical evaluation of the telephone network and PBX equipment was undertaken.

The work group represented a wide variety of interests and technical knowledge. The group worked together to become better educated about all of the issues. During this process, many members modified the positions they came in with. This is a credit to the members of the work group who generally kept an open mind although there were several lively debates on some of the issues! The result was a good compromise that accomplished many of the goals of public safety without placing an unreasonable burden on the business community or private telephone service providers.

One of the first areas the work group needed to define was the degree of accuracy needed in the location information. Members of the public safety community were solicited for their input. The information necessary for an adequate response must do three things:

- Cause the selective routing of the E9-1-1 system to direct the call to the appropriate public safety answering point (PSAP) for the location of the caller.
- Direct the responding personnel to the location of the caller to a degree that the caller can be located rapidly.
- Provide a phone number that can be called back to verify assistance needs should the caller be disconnected.

The specific information, including location detail, recommended by the public safety community as adequate to ensure effective emergency response is:

A. Residential Settings

Single Family Dwellings. The correct street address and a phone number that can be answered at the dwelling.

Multiple Family Dwellings. The resident's name, correct street address, the complex name, building number, apartment number and a phone number that can be answered at the residential unit.

Hotels, Motels and Dormitories. The correct street address, complex name, building or annex name, floor, room number and a call-back phone number.

B. Commercial, School or Industrial Settings

The correct street address, company name, and the following additional information as applicable:

- If the address includes multiple buildings, a building identifier.
- If the building is more than three stories, the floor from which the call is placed.

• If the area of a floor is greater than 25,000 square feet or, if in the opinion of local authorities it cannot be searched in less than three minutes, identifiable areas not greater than 25,000 square feet or meeting search parameters.

• A valid call-back number at or near the caller's actual location or, in the alternative, a valid number for 24-hour security personnel who can assist the responding units in verifying the need for and providing assistance.

Through interviews with numerous large-system owners and operators, input from equipment and service suppliers, and technical investigations, we identified other key points:

• Many PBXs/KTSs require a caller to dial an outgoing trunk access code before dialing 9-1-1 (e.g., the digit 9 or 8).

• Many PBXs/KTSs are not capable of transmitting caller automatic number identification (ANI) over centralized automatic message accounting (CAMA) trunks using multi-frequency (MF) signaling.

• Modifying the network to accept caller ANI transmitted with dual-tone, multi-frequency (DTMF) signaling would be expensive and of limited use.

• Significant problems exist with respect to ANI assignment.

• The data fields of the existing ALI data management system (DMS) may be inadequate to accommodate the caller location and call-back number requirements identified by the public safety community.

• Most PBX users do not have extensive station location and assignment records that are routinely kept up to date.

• Wireless interfaces may present unique caller location problems.

In general, it quickly became clear that there were significant cost and technical limitations that meant it was not feasible to mandate 100 percent enhanced 9-1-1 interface capability for all PBXs. While all members of our PBX work group strongly support the deployment of enhanced 9-1-1 calling service, they believe there are significant impediments to mandating full, immediate compatibility for all PBX and KTS systems.

Significant Benefits

The Washington work group concluded that there are significant benefits to developing national standards and regulations for implementing enhanced 9-1-1 service and customer premise equipment support of that service. In fact, national standards are essential to avoid regional conflicts, incompatibilities and higher costs.

Without standards, equipment manufacturers will not know what to design to—no equipment manufacturer can reasonably be expected to design and build different equipment configurations for each state, county or municipality. Further, many end-users could be left with insurmountable difficulties in managing their networks for effective emergency response and enabling them to meet their primary business missions.

FCC Petitioned for a Rulemaking

To this end, Adcomm Engineering Company with the support of several of its public safety clients, petitioned the Federal Communications Commission (FCC) for a rulemaking to set technical interface standards for PBX equipment (RM-8143). FCC action has been slow since the period for comments has expired. I would encourage anyone interested to contact the FCC or its legislative representatives to move this issue along.

The Washington work group believes that it is important that such standards be developed for customer premise equipment, enhanced 9-1-1 network equipment and for the ALI DMS. Moreover, they should accommodate all existing implementations of enhanced 9-1-1 calling, eliminate unnecessary differences and allow evolution of that service to the use of new technology.

These standards should be developed in cooperation with the state utility regulatory commissions, the FCC, user groups and national groups that address 9-1-1 service and telecommunications equipment issues, including: APCO, ECSA (Exchange Carriers Standards Association), especially committees T1E1 (carrier-to-customer interfaces) and T1S1 (network signaling and services); NARUC (National Association of Regulatory Utilities Commission); NENA (National Emergency Number Association), and TIA (Telecommunications Industry Association).

Until uniform national standards have been adopted and equipment manufacturers have had a reasonable opportunity to incorporate them into their equipment designs and products, no requirements mandating widespread enhanced 9-1-1 network equipment changes or business customer premise equipment changes should be imposed. Once such standards are in place, laws or regulations could be adopted that (1) clearly define the responsibilities of all who are involved in making enhanced 9-1-1 service work properly (i.e., equipment vendors, end-users, LECs and public safety agencies) and (2) set reasonable deadlines for compliance.

In the meantime, the Washington work group does believe it is appropriate to take the limited step of mandating enhanced 9-1-1 compatibility for residential, shared-tenant services and school PBXs. This is because of the unique nature of the users of these facilities and systems. There was some dissension by a user group with members from the large business community regarding the shared-tenant service mandate.

The Washington work group also believes that local laws mandating enhanced 9-1-1 compatibility for PBX

and KTS systems should be pre-empted by state action. As of this writing, a number of local jurisdictions have passed, or are considering passing, ordinances concerning PBX and KTS support of enhanced 9-1-1 calling service.

The intent of these ordinances is basically to ensure that 9-1-1 callers who use phones connected to a PBX or KTS receive the full benefits of enhanced 9-1-1 calling service. But, as noted in this report, numerous significant technical, operational and cost difficulties are presented by efforts to mandate such action.

At a minimum, such mandates could be extremely disruptive to end-users and possibly to the enhanced 9-1-1 system itself.

Specific Recommendations

Therefore, based upon the findings and conclusions noted above, the Washington work group made the following specific recommendations:

1. No state or local laws or regulations mandating full enhanced 9-1-1 compatibility of business customer premise equipment should be imposed at this time. Once uniform national standards for the implementation of enhanced 9-1-1 service and CPE support of it have been developed, appropriate requirements, including reasonable deadlines for compliance, should be imposed.

2. Owners/providers of PBXs serving customers in a multi-family residential environment should be required to equip, by December 31, 1995, their PBXs with the capability of transmitting ANI for the phones in each separate residential unit in a format that is compatible with the existing enhanced 9-1-1 system.

They should also be required to provide to the ALI DMS manager, or its functional equivalent, the following information subject to the limits of the NENA data record standard for each residential unit served by the PBX: the resident's name, correct street address, complex name, building number, apartment number, and a phone number that can be answered at the residential unit.

3. Schools should be required to equip or install by December 31, 1995, telephones with the capability of transmitting ANI or its functional equivalent in each separate school building in a format that is compatible with the existing enhanced 9-1-1 system.

They should also be required to provide to the ALI DMS manager, or its functional equivalent, the following information subject to the limits of the NENA data-record standard for each building unit/complex served by the PBX: the correct street address, school name, building number/name, school office or school security telephone number, and a phone number that can be answered in the vicinity of the calling telephone.

4. PBX owners/providers that are providing communications service on a resale basis (commonly known as shared-tenant services) to multiple business users from a single PBX system over a physical area larger than 15,500 square feet, on more than one floor of a building, or in multiple buildings should be required to equip by December 31, 1995, their PBXs with the capability of transmitting ANI or its functional equivalent for the phones in each separate business unit/space in a format that is compatible with the existing enhanced 9-1-1 system.

They should also be required to provide to the ALI DMS manager, or its functional equivalent, the following information subject to the limits of the NENA data-record standard for each business unit/space served by the PBX: the correct street address, complex name, building number, office number, business name, and a phone number that can be answered in the business unit/space.

5. Local laws mandating full enhanced 9-1-1 compatibility for PBX and KTS installations should promptly be preempted by state action.

6. The state should work to support efforts on the federal level to establish national technical and performance standards for the interconnection of PBXs to the enhanced 9-1-1 system. In this regard, the PBX work group could be reconvened on a semiannual basis to assist and to monitor progress towards adoption of uniform national standards for enhanced 9-1-1 service and CPE support of it.

If national standards are not developed by December 31, 1995, the enhanced 9-1-1 Advisory Committee should direct the PBX work group to recommend performance standards for enhanced 9-1-1 compatibility.

7. Until national standards are adopted, the state should encourage PBX owners to deploy equipment and/or services that will provide accurate location information for 9-1-1 callers or work with local authorities to devise emergency response procedures that are mutually acceptable.

8. The state should encourage LECs to make services used specifically to facilitate PBX and KTS support of enhanced 9-1-1 available to users at the lowest practical prices.

9. The state should mandate that all telephone systems owners advise their users of the dialing procedures necessary to access 9-1-1 service.

10. The state should mandate that all telephone systems owners communicate to their users the extent of automatic location identification when using enhanced 9-1-1 service or the nature of the limitation of 9-1-1 service availability.

Accepted by the State Board

The recommendations were presented to the Washington State Enhanced 9-1-1 Advisory Board where they were accepted. The next process is for the state

office to develop legislation that places the recommendations in force.

The final results were not as all-encompassing as some in the public safety sector would like and were more than the business community wanted.

However, I believe the work of this group represented the best of both worlds. It represented a true effort by all parties to understand better the problems faced by the other.

I applaud the work of all of the members of the group for the many hours of work they contributed. I also urge PSAP managers and 9-1-1 directors and coordinators around the country to write your congressman and the FCC about moving forward on the PBX standards rulemaking (RM-8143).

I also urge all those who have not dealt with this problem yet to get on the bandwagon and develop state, county and local policies to deal with this problem.

Author's Note: I should make one disclaimer. While basically describing the work and the results of the Washington PBX work group, this article was not reviewed by the work group nor have they approved it. I have attempted to accurately reflect the results of the group's efforts. ■

Joe Blaschka Jr., P.E., is the President of Adcomm Engineering Co., which he started 14 years ago. He has worked in the telecommunication engineering field for more than 20 years. He was a member of the Washington State 9-1-1 Advisory Board's 9-1-1 Work Group.

APCO Reports is published 12 times a year by the Association of Public-Safety Communications Officials-International, Inc. Subscriptions are $24 a year for APCO members; $60 a year for non-members.

To subscribe, call the APCO Membership Department at (800) 949-2726 Ext. 238.

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