



## GACIAC Bulletin

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*The GACIAC Bulletin is the current awareness publication of the Guidance and Control Information Analysis Center (GACIAC). GACIAC, a Department of Defense (DoD) Information Analysis Center (IAC), is administratively managed by the Defense Technical Information Center (DTIC) under the DoD IAC Program and is sponsored by the Joint Service Guidance and Control Committee (JSGCC). The Contracting Officers Technical Representative (COTR) for GACIAC is Mr. Chalmer D. George, AMC Smart Weapons Management Office, ATTN: AMSMI-SW, Redstone Arsenal, Alabama 35898-5222, (205)876-3788. IIT Research Institute operates GACIAC, which services Government, industry, and academia as a Center of Excellence in Guidance and Control Technology*

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### IN THIS ISSUE

[GACIAC bids farewell to Dr. Heaston](#)

[Resources on the Internet](#)

[COTR Corner](#)

[TAT Notes](#)

[IAC Roundup](#)

[New State of the Art Report](#)

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## GACIAC bids farewell to Dr. Heaston

*Joseph J. Petrovic  
GACIAC Director*

Dr. Robert J Heaston departed as Director of GACIAC after 9 years in this position from 5 October 1987 to 5 January 1996. Primarily, he managed the core program, but he also worked on a number of Technical Area Tasks (TATs).

Dr. Heaston originated the idea of Field of View (FOV) editorials in the GACIAC Bulletin and wrote 41 of them. Two FOV articles were reprinted by DTIC and by the Defense System Management College. He conducted the first IAC-based seminar at the DTIC Annual Users Meeting and Training Conference. He developed a common format for the charters for all IACs and justified GACIAC, all IACs, and DTIC

to OSD and Congress.

There were many instances where other IACs called upon him for advice and assistance. He worked with the JSGCC to develop a national strategy for guidance and control technology that has been used as a model for all DoD technology. Dr. Heaston served on the BAST to assess Force XXI, the Army of the 21st Century. He was selected by the Army to organize, chair and document the efforts of the Regenerative Liquid Propellant Gun Blue Ribbon Panel which helped pass a major acquisition milestone.

The most significant legacy that Dr. Heaston leaves behind is the Heastograph, which provides a unique way to fingerprint precision guided munitions.

With his departure from GACIAC, Dr. Heaston brings to a close a distinguished 40-year career of serving the Department of Defense. Before joining IITRI, Dr. Heaston worked in the Office of the Secretary of Defense (OSD), specifically in the Office of the Deputy Under Secretary of Defense for Research and Advanced Technology, where he was responsible for all DoD technology programs on guidance and control, warheads, fuzes, and rocket propulsion. During this period, he either prepared or directed the preparation of the technology base sections of the first through third editions of the DoD Antiarmor Munitions Master Plan and the first edition of the DoD Theater Air Defense Master Plan. He was co-organizer of the DoD program on Microwave and Millimeter-Wave Monolithic Integrated Circuits (MIMIC).

Dr. Heaston also provided major assistance in organizing the Balanced Technology Initiative (BTI) by reviewing and assessing the proposals submitted to OSD. Earlier, Dr. Heaston held various positions with the Army Research Office (ARO), European Research Office (ERO), and Office of the Deputy Chief of Staff for Research Development and Acquisition (ODCSRDA). His responsibilities included 6.1 through 6.3A programs on energy conversion, organic materials, explosives, power supplies, ramjet and rocket propulsion, parachutes, helicopters, tanks, combat vehicles, guns, and ammunition. He was the Army Technology Manager for the transition of technology programs into the weapon modernization programs that resulted in the M-1 Abrams tank, UH-60 Blackhawk helicopter, AH-64 Apache helicopter, FIM-92 Stinger missile, Patriot missile, and numerous other product improvement programs. He was the Army representative to help organize Army participation in the following programs: pollution abatement; Joint Services Small Arms Program (JSSAP); Very High Speed Integrated Circuits (VHSIC); and DARPA efforts on fuel cells, assault breaker, HIMAG, and HSTV-L. At the Advanced Research Projects Agency, Dr. Heaston was responsible for programs on ramjets, interior ballistics, combustion instability, and defoliation. He established facilities for propellant research at Princeton University, the University of Utah, and the Jet Propulsion Laboratory. While with the Air Force Propulsion Laboratory at Wright-Patterson Air Force Base, Dr. Heaston was Senior Project Officer on slurry fuels, carborane fuels, and liquid hydrogen. He wrote the first open literature article naming the carborane family.

As befitting someone who produced a major presentation or publication every two weeks he was in the office, he will now pursue a career as a free lance writer.

We extend to Dr. Heaston our heartfelt thanks for his hard work, his leadership and his friendship, and wish him every happiness in the years to come.

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## Resources on the World Wide Web

*The December 1994 issue of the GACIAC Bulletin featured a Field of View (FOV) article on the Internet. It discussed the evolution of the Internet, as well as its structure and protocols. This feature is a follow-on, intended to demonstrate resources available on the World Wide Web that may prove useful to the G&C community.*

While a substantial segment of the research data and resources required by the G&C community are too sensitive for dissemination via a publicly accessible vehicle such as the Internet, the information resources described here are deemed useful as a support tools.

The resources are arranged topically and each is described in detail. In parentheses, immediately following each heading is the URL for that site. The Internet version of the GACIAC bulletin includes and active link for navigating to each site.

## DEPARTMENT OF DEFENSE

• [DefenseLink](http://www.dtic.dla.mil/defenselink/) (http://www.dtic.dla.mil/defenselink/) This is a WWW gateway to DoD resources. It is provided through the cooperative efforts of the Office of the Assistant to the Secretary of Defense (Public Affairs) and the Defense Technical Information Center. The main page provides direct links to the Office of the Secretary, the Joint Chiefs of Staff, Army, Navy, Air Force, Marine Corps, Coast Guard, Reserve, National Guard, Combatant Commands and Other Components (i.e. Inspector General of DoD, Defense Agencies and DoD Field Activities). Also on this page are links to Highlights (news and special interest Defense information sources), News (official Defense news releases), Questions (FAQ about the department), Defense Fact File (described below), Publications (including important speeches and DoD directives and instructions) and the Locator (a searchable database of Defense information resources).

• [DoD Guide to Organizations and Functions](http://www.dtic.dla.mil/defenselink/pubs/ofg.html): (http://www.dtic.dla.mil/defenselink/pubs/ofg.html) This guide outlines the functions of the Office of the Secretary of Defense, Defense Agencies, and DoD Field Activities. The functional statement cites the pertinent DoD directive which charters the organization and provides more detailed information on the authorities, responsibilities and functions of the organization. The guide also provides organizational charts, although, at the time of this writing, many of the org charts were not yet published.

• [Department of Defense Fact File](http://www.dtic.dla.mil/defenselink/factfile/): (http://www.dtic.dla.mil/defenselink/factfile/) The Fact File is an inter-service collection of important information. The menu on this page has entries such as Ships and Boats, Fixed Wing Aircraft, Helicopters, Tracked vehicles, Missiles Rockets and Torpedoes, etc. They link to pages that list and define equipment and systems.

• [Advanced Research Projects Agency\(ARPA\)](http://www.arpa.mil/): (http://www.arpa.mil/) ARPA is the central research and development organization for the Department of Defense. This website is divided into several tracks. Mission describes ARPA functions. Organization links to each of the technical and support offices. Info is a compendium of information available to the general public including points of contact. News contains current events at the Advanced Research Projects Agency. Solicitations is a listing of current solicitations for the technical offices of ARPA.

• [AirForceLINK](http://www.af.mil): (http://www.af.mil) This is the hierarchical USAF webserver listing and linking to each of the eight major commands and their components. Links are provided to the Air Combat Command, Air Education and Training Command, Air Force Materiel Command, Air Force Special Operations Command, Air Force Space Command, Air Mobility Command, Pacific Air Forces, and the United States Air Forces Europe. Within the Command structure are links to components at various Air Force facilities. For example, moving from the main menu to Eglin Air Force Base and down to the Armament Directorate there is a page entitled Technology Area: Advanced Guidance. This page contains a graphic representation of the ASARG operational concept, a discussion of current research on emerging seeker technologies as well as a description of the simulation and test capabilities. A telephone number and email address is provided for a point of contact.

• [Ballistic Missile Defense Organization](http://www.acq.osd.mil/bmdo): (http://www.acq.osd.mil/bmdo) This is the main page for ballistic missile defense news and information. From here there are links to Ballistic missile defense programs (included are executive briefings, program documents, images and videos), BMDO organization (a BMDO organization chart and information on key personnel), Additional information, Related BMD locations (a good selection of space science , atmospheric and celestial resources are listed), File libraries, Tips, tools and utilities. Many of the files at this site are in PDF format. An Adobe

Acrobat Reader is necessary to view these files. This and several image utilities are available at the Tips, tools and utilities section.

• [DoD Information Analysis Center Hub Page](http://www.dtic.dla.mil/iac/): (<http://www.dtic.dla.mil/iac/>) The primary mission for DoD IACs is to collect, analyze, synthesize, and disseminate worldwide scientific and technical information in clearly defined, specialized fields or subject areas. A secondary mission is to promote standardization within their respective fields. The IACs have a broad mission to improve the productivity of scientists, engineers, managers, and technicians in the Defense community through timely dissemination of evaluated information. This page provides links to sixteen DoD information analysis center home pages.

• [Defense Information Systems Agency](http://disa11.disa.atd.net/): (<http://disa11.disa.atd.net/>) This server is designed to provide the latest information on technology insertion activities for information systems within the Department of Defense. The main page provides links to DISA Organizations (organizational structure summary and the organizational chart, command staff, organizational staff and field and line organizations, an alphabetized key subject index locates major programs and subjects quickly), What is new at DISA (new announcements), DISA Services (Infoflash bulletins, procurement bulletin boards, customer service, current security issues) and DISA's Top Five Programs (information on GCCS, DMS, DISN, INFOSEC, EC/EDI).

• [NavyOnLine](http://www.ncts.navy.mil/): (<http://www.ncts.navy.mil/>) This is a central gateway for information by and about the Navy. The home page lists nearly 100 alphabetically arranged links to Navy sites. There is also a subject search capability for quick access. An example of the many Navy resources accessible from here is the IRStorm II page at the Naval Air Warfare Center Weapons Division. IRStorm II is a state of the art IIR seeker modeling program. The page offers links to a document describing the program capabilities in detail, several limited access sites for the technical manual and users guide, and links to individual points of contact. Another link from the NAWCWPN is the Pacific Ranges and Facilities page. There are graphics and short descriptions for the test ranges at Point Mugu: Sea range, Land range, Electronic combat range, Ordnance T&E facilities, Radar cross section measurement ranges, Sled tracks, Navy ship weapons test complex.

• [United States Army Home Page](http://www.army.mil/): (<http://www.army.mil/>) This is the starting point for approximately 200 Army home pages. The links are arranged alphabetically with an index for ease of access. For information on Force XXI, the Army's plan to re-engineer itself for the twenty first century, the Force XXI Home Page and the Force XXI InfoNet Home Page is recommended. This is a multifaceted hierarchy of information resources including Army Leader XXI, the Combat Training Center Warrior Information Network, Force XXI Training and Force XXI Per, Log & RDA. Members of the guidance and control R&D community can find a substantial amount of valuable data at the Team Redstone Web Consortium, including selected directives, instructions, regulations online as well as information on MICOM directorates and major programs.

• [United States Marine Corps](http://www.usmc.mil/): (<http://www.usmc.mil/>) The main page for the Marine Corps provides links to Frequently Asked Questions about the Marine Corps, the Mission, History and traditions, Concepts and Issues. There is a link to the Joint Warrior Interoperability Demonstration page. Also featured is an automated white letter library as well as full text M&RA's. A link to the Marine Corps Tactical Systems Support Activity and then to MCTSSA Projects displays a list of active projects directly supporting the current and future warfighting Command and Control requirements. Each of the projects is further described at another page including the operational concept, operational description, technical characteristics, and PIP enhancements. A point of contact is also provided.

## BACKGROUND

• [Background Data Center Home Page](http://bdc.nrl.navy.mil): (<http://bdc.nrl.navy.mil>) The BDC is supported by the Office of Strategic Phenomena and is part of the Space Science Division at the Naval Research Laboratory. Information available here includes data on the Far UV Cameras Mission, BMDO's Clementine Mission and Midcourse Space Experiment as well as the IBSS/BMDO Infrared Background Signature Survey.

Users may search either the public or restricted Data Summary Catalogs and there is an option for online product ordering.

## CLOUDS

### [Clouds from AVHRR \(CLAVR\) flags:](http://eostest2.gsfc.nasa.gov/CAMPAIGN_DOCS/LAND_BIO/clavr.html)

([http://eostest2.gsfc.nasa.gov/CAMPAIGN\\_DOCS/LAND\\_BIO/clavr.html](http://eostest2.gsfc.nasa.gov/CAMPAIGN_DOCS/LAND_BIO/clavr.html)) The following is a quote from the home page The Pathfinder data includes cloud flags produced by the NOAA Clouds from AVHRR (CLAVR) algorithm. The CLAVR algorithm performs a series of threshold and uniformity tests on a 2 x 2 array of pixels. If 1-3 pixels in the array are flagged as cloudy, all four pixels are flagged as mixed. Otherwise, the array is flagged as clear or cloudy. The CLAVR flags are calculated using top of atmosphere reflectances which are slightly different from the surface reflectances which are stored in the Daily and Composite Data Set layers. The website offers data search capability as well as archive and data access.

[Cloud catalog:](http://www.atmos.uiuc.edu/covis/modules/clouds/html/cloud.home.html) (<http://www.atmos.uiuc.edu/covis/modules/clouds/html/cloud.home.html>) The cloud catalog is presented by the Department of Atmospheric Sciences at the University of Illinois/Urbana-Champaign. Contains a variety of cloud images.

## EARTH RESOURCES AND REMOTE SENSING

[Canada centre for remote sensing:](http://www.ccrs.nrcan.gc.ca/ccrs/homepg.pl?e) (<http://www.ccrs.nrcan.gc.ca/ccrs/homepg.pl?e>) This site features a wide variety of remote sensing information. The center uses and develops earth-observation satellites and other sources to collect, produce and analyze data. There is a staff directory, a calendar of events, an online newsletter and an index for the Canadian Journal of Remote Sensing. A searchable database of about 500K Quicklook images (low resolution, limited size, images created to rapidly provide an assessment of the quality of the full resolution scene before ordering) is also available.

[SIR-C/X-SAR images:](http://www.jpl.nasa.gov/sircxsar/) (<http://www.jpl.nasa.gov/sircxsar/>) This page, presented by DLR in Germany, features information on data collected by the SIR-C/X imaging radar aboard the shuttle Endeavor. Images, Interferometric Results, and ScanSAR Results are available.

[Earth Observing System Home Page:](http://eos.nasa.gov/) (<http://eos.nasa.gov/>) This is a NASA page intended to provide convenient access to those interested in the EOS program. There are links to NASA EOS Servers, Distributed Active Archive Centers, and other project related servers. Telnet links are available for online browsing of image databases.

[Imaging Radar Home Page:](http://southport.jpl.nasa.gov) (<http://southport.jpl.nasa.gov>) This page features a wide spectrum of imaging radar related information. Radar images and mpeg files are available for downloading. There is an outreach program for images and data intended for scientific/technical applications, as well as a detailed list of commercial and non-commercial enterprises which distribute imaging radar data. An interactive bulletin board is available for questions/answers regarding data, software, methodology, etc. There is also an extensive imaging radar bibliography citing references arranged by topic, such as Interferometry, Polarimetry, Texture analysis and Modeling, to name just a few.

[National Earth Orientation Service:](http://maia.usno.navy.mil) (<http://maia.usno.navy.mil>) NEOS is a joint venture of the US Naval Observatory (USNO) and the Geosciences Laboratory of the National Oceanic and Atmospheric Administration (GL/NOAA), whose mission is to coordinate, collect, analyze and distribute data from various programs that monitor variations in the orientation of the earth. The IERS (International Earth Rotation Service) Bulletins A, B, C and D are available here, or a user may opt to subscribe for electronic delivery.

## NAVIGATION AND GPS

[USCG Navigation Center:](http://www.navcen.uscg.mil/) (<http://www.navcen.uscg.mil/>) This website is managed by the Coast Guard's Navigation Center, the central point for coordination of radionavigation management, operation

and information. The home page describes the center's mission and services and provides links to information on Global Positioning System (GPS), LORAN-C, Differential Global Positioning System (DGPS), OMEGA Navigation System, General Radionavigation Information, Latest Radionavigation System Status, and Local Notices to Mariners. The section on GPS , for example, provides the following data: Latest GPS Precise Ephemeris Data and Information, Latest GPS Almanac (both Yuma and SEM 3.5 format), Latest GPS Status Message, Latest Notice Advisory to Navstar Users, GPS reports and Publications, GPS Data Archives, GPS Week/Julian Date Conversion Calendar, GPS Outage Reports, and GPS General Information.

• [International GPS Service for Geodynamics](http://igsb.jpl.nasa.gov): (<http://igsb.jpl.nasa.gov>) The IGS supports researchers who use the DoD Global Positioning System(GPS). From this page there are links to information about 50 globally distributed tracking stations including location, GPS receiver/antenna descriptions, and points of contact. Links to the data centers provide information on telnet access to the data files available there.

• [Navstar GPS Internet Connections](http://gopher://unbmvs1.csd.unb.ca:70/hPUB.CANSPACE.GPS.INTERNET.SERVICES.HTML):

([gopher://unbmvs1.csd.unb.ca:70/hPUB.CANSPACE.GPS.INTERNET.SERVICES.HTML](http://gopher://unbmvs1.csd.unb.ca:70/hPUB.CANSPACE.GPS.INTERNET.SERVICES.HTML)) Located at the University of New Brunswick, this is a starting point for over 50 connections to GPS resources.

Links are available to GPS Receiver Manufacturers, NANU's, German Institute for Applied Geodesy, GPS World Magazine, The Institute of Navigation, the Royal Institute of Navigation, Solar Terrestrial Dispatch, USGS, NAWCWPN China Lake, USNO, University of Texas at Austin, to name just a few.

• [Global Navigation Satellite System \(GLONASS\)](http://mx.iki.rssi.ru/SFCSIC/SFCSIC_main.html): ([http://mx.iki.rssi.ru/SFCSIC/SFCSIC\\_main.html](http://mx.iki.rssi.ru/SFCSIC/SFCSIC_main.html))

This is the main page for GLONASS, the Russian satellite-based radionavigation systems. There are links to general descriptions of the system as well as daily status reports, notice advisories(NAGU's), and point of contact information.

## STANDARDS

• [Standardization Program Division WWW Home Page](http://www.acq.osd.mil/es/std/stdhome.html): (<http://www.acq.osd.mil/es/std/stdhome.html>)

This page features information about Military Standards and Specifications reform. There are links to Document Improvement Actions, Frequently asked questions, Points of contact, Policy memos. Two newsletters are published online: The Standardization Newsletter and Partnership in RMS Standards. Links to Policy Memos, Conferences are included, well as a link to the Department of Defense Single Stock Point (DODSSP) home page.

## TECHNOLOGY TRANSFER

• [National Technology Transfer Center \(NTTC\) Home Page](http://www.nttc.edu/): (<http://www.nttc.edu/>) The NTTC is the hub of a national network linking US companies with federal technologies. A guided tour describing the contents of each module of the website is available. A brief synopsis of the contents follows: NTTC projects, activities, conferences and shows, Government information sources (listing links to over 750 government homepages), NTTC databases (searchable online and including the Directory of Federal Labs and Technologies, Federally Funded Technologies available for Licensing and Small Business for Innovation Research), and Technology Gateways (Environmental technology, Health assistive and rehabilitation technology, Inventions and innovation, Law enforcement, Licensing and partnership opportunities, Manufacturing technology, Solicitations and opportunities, Technology transfer, and Technical, financial and business assistance).

## WEATHER

• [Weather Information Superhighway](http://www.nws.fsu.edu/wxhwy.html): (<http://www.nws.fsu.edu/wxhwy.html>) There is a vast number of weather related sites on the Internet. This page contains a comprehensive collection of the meteorological data, information and image sites worldwide. The arrangement of this area is as follows:

Government Weather Information Services, University Weather Services, Regional Climate Centers, Interactive Weather Browser, Satellite Images, Weather Maps and Movies, World Weather, Tropical Weather Links, Other Meteorological Information. This site is updated frequently and the hyperlinks are accurate.

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## Announcing.....

### GACIAC SOAR 95-01 Modern Control Theory

Table of contents:

- Introduction
- Classical control theory
- Modern control theory
- Dynamic systems
- System identification
- The Kalman filter
- Adaptive control
- Mathematical optimization
- Optimal control theory
- Singular perturbation methods
- Stochastic control
- Differential game theory
- Robustness and sensitivity
- Precision guided munitions
- Applications of control theory to PGMs
- Gun fire control
- An assessment of modern control theory

This volume is approved for public release and will be sold for \$150.00. If you are interested in purchasing a copy, kindly FAX your request with complete mailing information to Product distribution at 312.567.4889.

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## COTR corner

*Chalmer D. George*  
GACIAC COTR

I would like to extend my warmest wishes for a happy and gratifying retirement to Dr. Robert Heaston, Director of GACIAC for 8 1/2 years (1987-1996). Bob was a prolific writer, and his contributions to the

Center and the entire G&C community are valuable and enduring. Before he left, Bob completed the final revision to the State of the Art Report on Modern Control Theory. This is a substantial volume addressing a high interest, high potential technology. It focuses on the application of selected concepts and mathematical tools drawn from modern control theory to the design and development of tactical weapon guidance and control systems. These tools include state-variable modeling and analysis, system identification, state and parameter estimation, optimization and optimal control, stochastic control, differential games and adaptive control. The SOAR covers basic concepts, present applications and future potential.

## TAT Notes - BIPS Future Potential

*Kent Kogler*  
*Science Advisor*

In a previous issue of this Bulletin (Vol.17, No.4, Oct-Dec 1994) simulation of an innovative approach to battlefield reconnaissance being explored by U.S. Army ARDEC was discussed. In this approach, a TV camera suspended from a parafoil delivered by a gun launched projectile transmits imagery to a remote monitor. The Battlefield Imagery Projectiles (BIPS) concept may be viewed as being in competition with other Unmanned Air Vehicle (UAV) programs. Both the Hunter and Maneuver UAV's are intended to perform reconnaissance, surveillance, target acquisition and other military missions by flying over enemy territory and transmitting imagery back to ground stations for use by commanders. Maneuver is smaller and has less range than Hunter. Recently both of these systems have come under the scrutiny of the US. General Accounting Office. Criticism is that the Joint Tactical UAV Project Office plans initiating production of the Maneuver system without adequate assurance that it can meet operational performance requirements. This presents the possibility that DoD risks a commitment to acquiring an unsatisfactory system requiring costly redesigns as has occurred on past UAV programs (Pioneer and Hunter).

In spite of this history of costly redesigns, low rate production of the Maneuver System is scheduled to begin in fiscal year 1997 prior to adequate operational testing. If the General Accounting Office is successful in convincing the Secretary of Defense to change the acquisition strategy, opportunities may arise to replace the Maneuver UAV with a much more cost effective close range UAV such as BIPS.

## IAC ROUNDUP

*Gerri Koclanis*  
*DTIC Users Council*

The DTIC Users Council meets twice a year at one of the DTIC Regional Users Training Conferences and also at the DTIC Annual Users Training Conference held the first week in November in Crystal City Virginia. Regional conferences this year will be held at the following locations:

March 12-13	Southern Regional Conference	Stennis Space Center, MS

April 23-24	Western Regional Conference Hughes Aircraft Company	El Segundo, CA
May 7-8	Midwestern Regional Conference Argonne National Laboratories	Argonne, IL
May 22-23	Northern Regional Conference Lincoln Laboratories	Lexington, MA
July 9	Eastern Regional Conference Holiday Inn	Alexandria, VA

## DTIC Regional Meetings

For further information on the above conferences, please contact Ms. Cheryl Hunter, Directorate of User Services: 703.7676.8247 or DSN 4247; FAX: 703.767.8228 or DSN 427.8228; Email: [chunter@dtic.mil](mailto:chunter@dtic.mil)

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