



Australian Government

Department of Defence

Defence Science and Technology Group

Adaptive Computing Through Strategic Service Deployment

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DST
GROUP

Science and Technology for Safeguarding Australia

What is Adaptive Computing?

- The capability of a computing system to adapt one or more of its properties (e.g. performance) during runtime^[1]
- Also known as “Reconfigurable Computing”
- Usually reconfigurable hardware (e.g. FPGAs) but my focus is on Software Engineering techniques
 - Abstraction
 - Platform independence (from hardware and the operating system)
 - Supporting different vendor implementations of communication protocols

DST group's LASAGNE framework

- “Layered Approach to Service Architectures for a Global Networked Environment”^[2]
 - Adaptive foundations
 - Adaptive Communications Environment (ACE)^[3] & The ACE ORB (TAO)^[4]
 - Platform independence from both the hardware architecture and the operating system through abstraction
 - A library of known solutions to recurrent problems through Pattern Oriented Software Architecture (POSA)^[5]
 - TAO provides a CORBA implementation
 - DST engineered metaprogramming layer to support multiple Data Distribution Service (DDS)^[6] implementations
 - Goal: Develop a library of reusable components/services

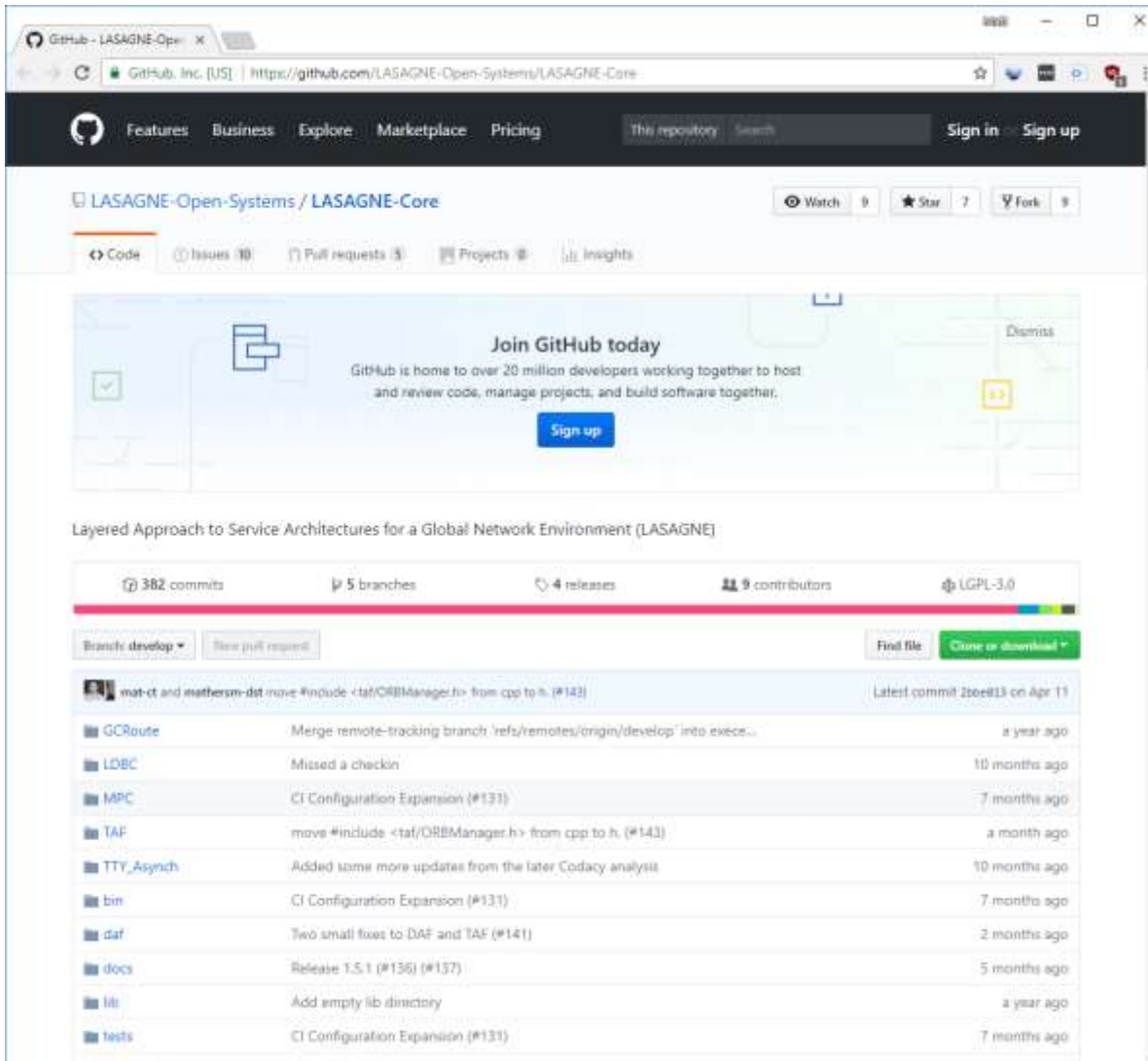
DST group's LASAGNE framework



VORTEX



LASAGNE has now been open sourced



The screenshot shows the GitHub repository page for LASAGNE-Core. The repository is titled "LASAGNE-Open-Systems / LASAGNE-Core" and has 9 watchers, 7 stars, and 9 forks. The page displays a "Join GitHub today" banner, a "Sign up" button, and a list of commits. The repository is licensed under LGPL-3.0 and has 382 commits, 5 branches, 4 releases, and 9 contributors. The commit list includes:

Commit	Description	Time
mat-ct and mattersm-dst move #include <taf/ORBManager.h> from cpp to h. (#143)	Latest commit 2b6e813 on Apr 11	
GCRRoute	Merge remote-tracking branch 'refs/remotes/origin/develop' into exec...	a year ago
LDBC	Missed a checkin	10 months ago
MPC	CI Configuration Expansion (#131)	7 months ago
TAF	move #include <taf/ORBManager.h> from cpp to h. (#143)	a month ago
TTY_Asynch	Added some more updates from the later Codacy analysis	10 months ago
bin	CI Configuration Expansion (#131)	7 months ago
daf	Two small fixes to DAF and TAF (#141)	2 months ago
docs	Release T.S.1 (#136) (#137)	5 months ago
lib	Add empty lib directory	a year ago
tests	CI Configuration Expansion (#131)	7 months ago

<https://github.com/LASAGNE-Open-Systems/LASAGNE-Core>

Data Distribution Service (DDS)

- An **Object Management Group (OMG)**^[7] standard
- **Data Centric Publish Subscribe (DCPS)**
 - “Data Centric” as opposed to “Object Centric”
 - Publish to a Data Cloud instead of Point to Point communication to other already known objects
- **Real-Time Publish Subscribe (RTPS)** transport
- Useful for highly scalable **Internet of Things (IoT)** style applications (multiple publishers & subscribers)
- LASAGNE supports 3+ vendor DDS implementations

LASAGNE adaptive computing scenario

- Distributed sensor network of many **Unmanned Aerial Vehicles (UAV)**
 - Visual and/or hyperspectral surveillance of a hostile area
- UAVs carry only simple models of objects of interest
 - Reduced object identification/tracking processing
 - Sensitive data is not revealed in case of capture of a UAV
- A UAV will signal base when object is identified
- Base subscribes to DDS video feed to confirm

LASAGNE adaptive computing scenario (cont)



LASAGNE adaptive computing scenario (cont)

- Base orders a mobile secure facility into the area (air or land vehicle)
- Secure facility subscribes to video feed to perform higher fidelity processing with sensitive models
 - Verify valid object of interest and keep tracking it to support whatever action may be taken

LASAGNE adaptive computing scenario (cont)



How does LASAGNE enable this application?

- Platform agnostic allows heterogeneous collection of UAVs of differing capabilities (inc. allied forces UAVs)
- UAVs publish video feeds via DDS-Security spec
- Multiple video feed subscribers
 - On UAV video processing
 - Base video processing
 - Secure facility video processing
- Multiple, specialised instances of the object detection and tracking component/service

References

- [1]: Henkel, Joerg, and Lars Bauer. “What Is Adaptive Computing?” *SIGDA Newsl.* 40, no. 5 (May 2010): 1–1.
<https://doi.org/10.1145/1866966.1866967>.
- [2]: *LASAGNE-Core: Layered Approach to Service Architectures for a Global Network Environment (LASAGNE)*. C++. 2017. Reprint, LASAGNE Open Systems, 2018. <https://github.com/LASAGNE-Open-Systems/LASAGNE-Core>.
- [3]: “The ADAPTIVE Communication Environment (ACE).” Accessed May 16, 2018. <http://www.dre.vanderbilt.edu/~schmidt/ACE.html>.
- [4]: “Real-Time CORBA with TAO (The ACE ORB).” Accessed May 16, 2018. <http://www.dre.vanderbilt.edu/~schmidt/TAO.html>.
- [5]: “Design Pattern.” *Wikipedia*, January 9, 2018.
https://en.wikipedia.org/w/index.php?title=Design_pattern&oldid=819480240.

References (cont)

- [6]: “DDS Portal – Data Distribution Services.” Accessed May 16, 2018.
<http://portals.omg.org/dds/>.
- [7]: “OMG | Object Management Group.” Accessed May 16, 2018.
<https://www.omg.org/>.

