Introducing OpenDDS Version 3.14

An Object Computing, Inc. (OCI) Webinar

March 17, 2020

Adam Mitz - mitza@objectcomputing.com

Principal Software Engineer, OpenDDS Tech Lead

Agenda

- What is OpenDDS?
- Features that improve the developer experience
- Features that extend platform support and integration
- Features for deploying on the internet
- Features that enhance performance and scalability
- Other changes in 3.14
- Next steps

What is OpenDDS?

- OpenDDS is an open source and widely adopted standards-based real-time publish/subscribe solution for distributed systems.
- Project website: https://opendds.org
  Repository: https://github.com/objectcomputing/OpenDDS
- OpenDDS implements the Object Management Group's standard: Data Distribution Service (DDS).
- Interoperability with other DDS products is achieved through an implementation of the OMG's DDSI-RTPS.
- OpenDDS also has support for DDS Security and version 3.14 adds some of Extensible Types (XTypes).

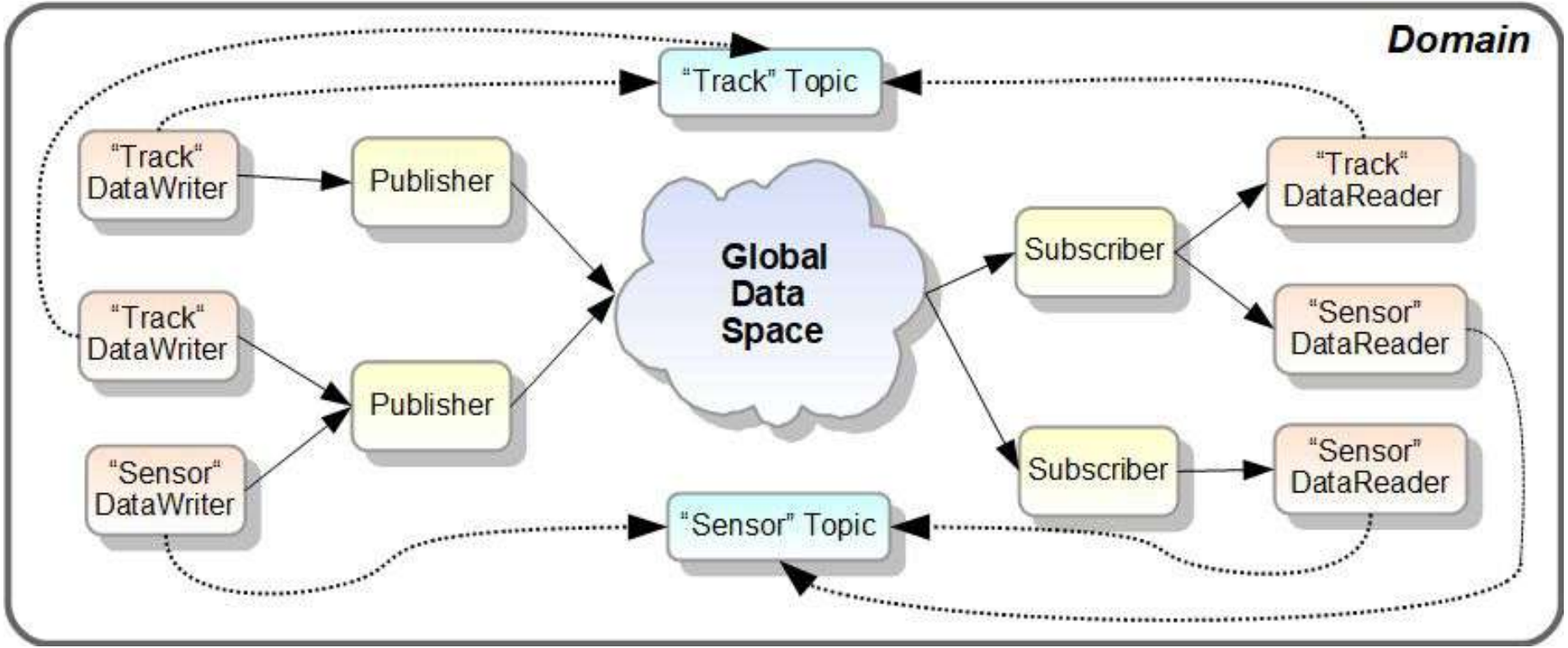
The OpenDDS Project

- Development started at OCI in 2005
- Version 1.0 (debut of the name "OpenDDS"): July 2007
- Version 1.2 added Java bindings: November 2008
- > 17K commits in git: OCI and community contributors
- GitHub repository is active development, not snapshots
- CI builds automate testing on many platforms/compilers
- Community support: GitHub-hosted site (opendds.org), Issues and Pull Requests, plus SourceForge mailing lists
- Commercial support, custom development, training/consulting provided by OCI

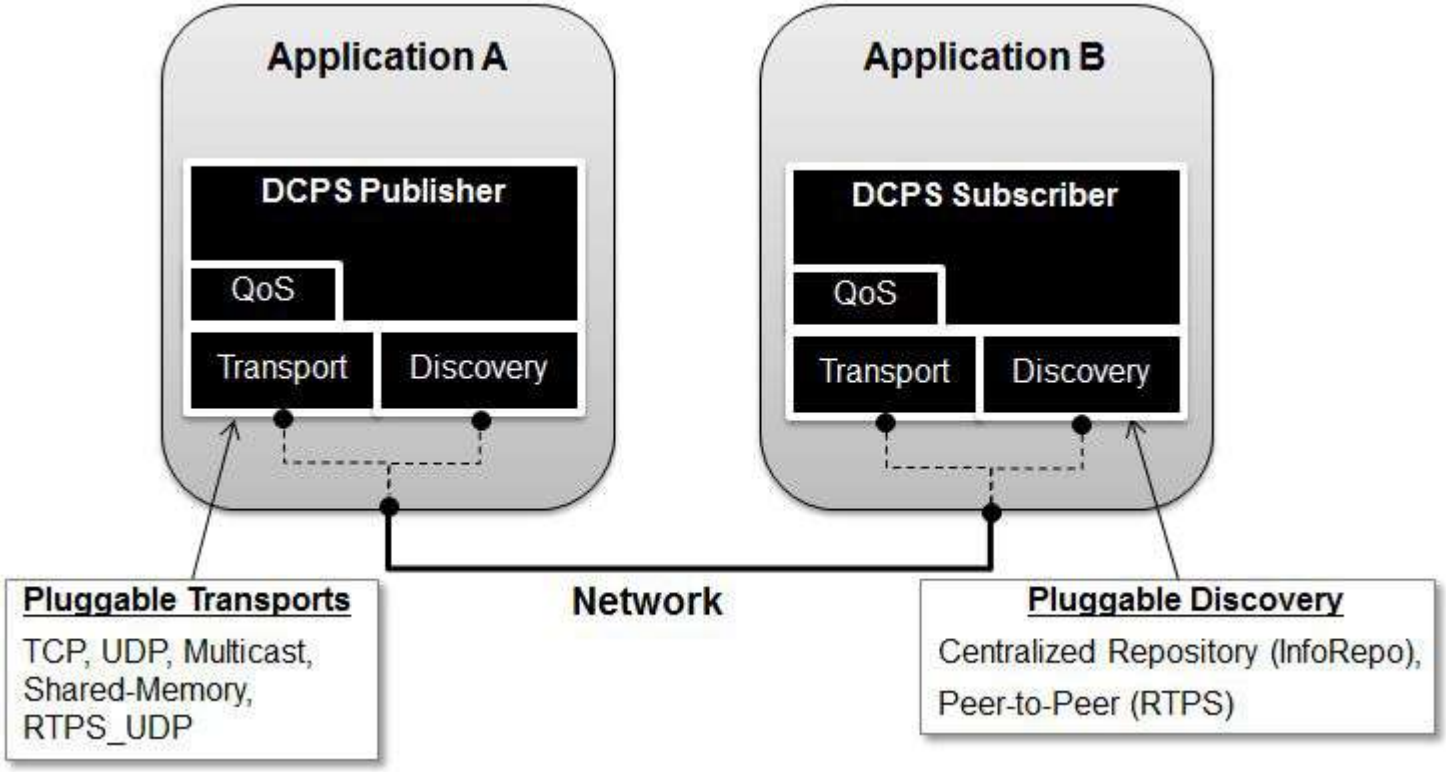
Complementary Projects

- Node.js module ("npm install opendds")
  - https://github.com/oci-labs/node-opendds
- C# wrapper
  - https://github.com/jmmorato/openddsharp
- Yocto / Open Embedded Layer
  - https://github.com/oci-labs/meta-opendds
- Python Bindings (in development)
  - https://github.com/oci-labs/pyopendds
- ROS2 Support (in development)
  - https://github.com/oci-labs/rmw_opendds
  - https://github.com/oci-labs/rosidl_typesupport_opendds

Review of DDS Terms and Concepts



Review of OpenDDS Architecture



Improving the Developer Experience

- XTypes IDL Annotations
  - Use IDL files across DDS implementations
- IDL-to-C++11 Language Mapping
  - Use C++ standard library (vector, string)
- CMake Module
  - Build projects using OpenDDS with CMake
- RapidJSON codegen from IDL
  - Easily convert JSON documents to/from corresponding IDL-generated types

XTypes IDL Annotations

Before

```
module Messenger {

#pragma DCPS_DATA_TYPE "Messenger::Message"
#pragma DCPS_DATA_KEY "Messenger::Message subject_id"

  struct Message {
    string from;
    string subject;
    long subject_id;
    string text;
    long count;
  };
};
```

After

```
module Messenger {


  @topic
  struct Message {
    string from;
    string subject;
    @key long subject_id;
    string text;
    long count;
  };
};
```

IDL-to-C++11 Language Mapping

IDL

```
enum Color { red, green, blue, yellow };

const Color c = green;

typedef sequence<short> ShortSeq;

struct S {
  string str;
  // ...
};

union U switch (Color) {
  // ...
};
```

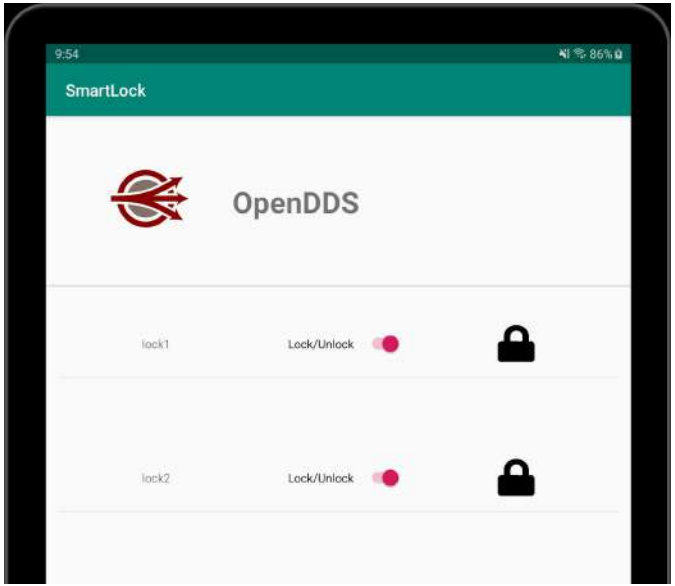
C++11

```
enum class Color {...};

constexpr Color c = Color::green;

using ShortSeq = std::vector<int16_t>;

class S {
public:                          // + constructors
  void str(const std::string&);    // + move
  const std::string& str() const;
  std::string& str();                ...  };

class U {
public:          // + construct, assign, move
  Color _d() const;
  void _d(Color);
  // accessors/mutators per branch      };
```

Extending Platform Support and Integration

- Responsiveness to network interface changes
  - On supported platforms
- New Built-in Topic reports location/connection info
- Android and iOS
- Java
  - JDK12
  - Java bindings on Android
  - equals() and hashCode()
  - Build system improvements
- Qt updated from v4 to v5
- Wireshark v3

Mobile Platform Support (Android and iOS)

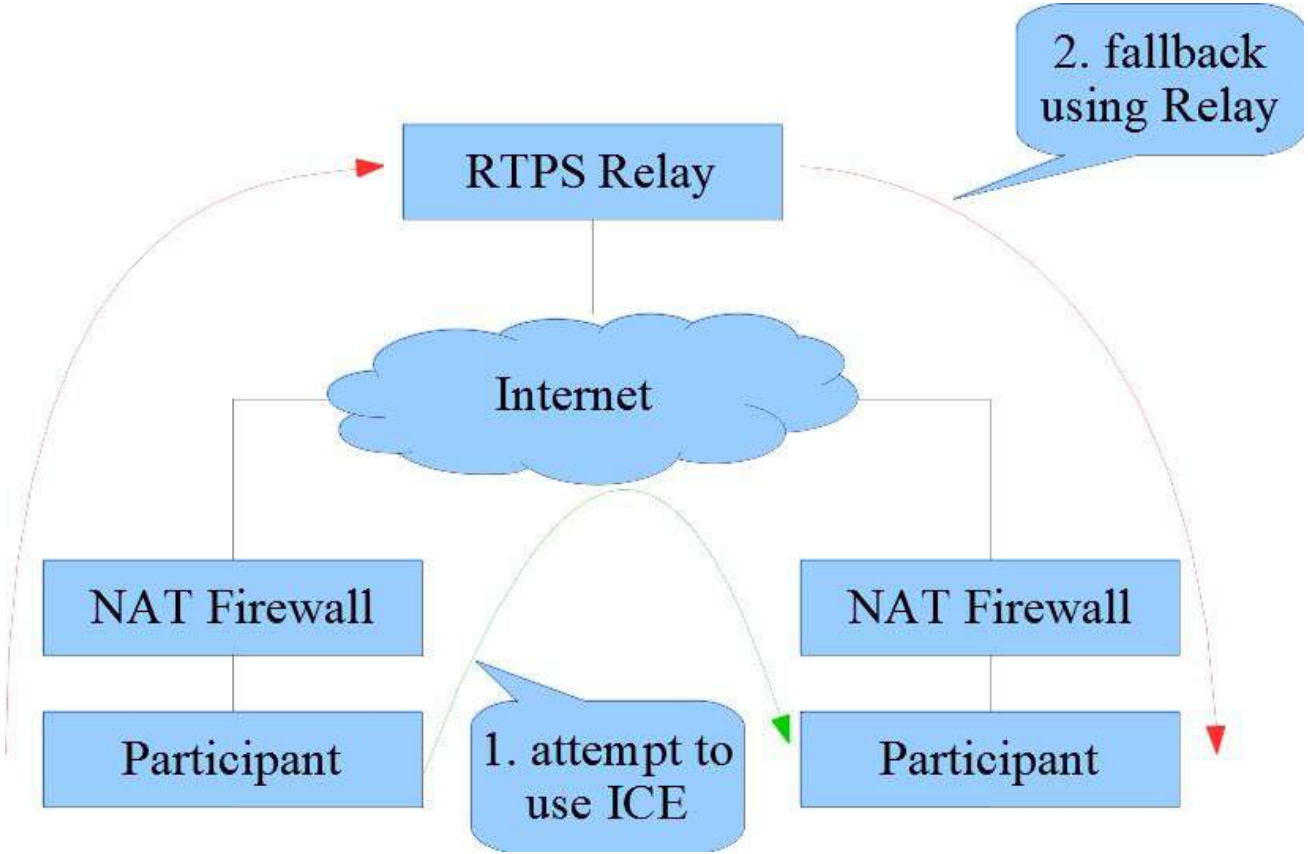


- Includes DDS Security
- Porting/Cross-compiling
  - ACE
  - OpenSSL
  - Xerces-C++
- Platform-specific bits in OpenDDS
- Background/UI integration in example app
- github.com/oci-labs/opendds-smart-lock

Deploying on the Internet

- DDS Security enhancements
  - Full-message protection (encrypt/sign)
- RTPS Relay Server
  - Scalable cloud-based helper for peer discovery
- IETF ICE (RFC 8445) and STUN (RFC 5389)
  - NAT firewall traversal and multi-path resolution
  - STUN for public IP address discovery and ICE messaging

Combining Security, RTPS Relay, and ICE/STUN



Enhanced Performance and Scalability

- Improvements focused on RTPS Discovery and rtps_udp transport
  - Discovery reader/writer association latency
  - More efficient use of RTPS messages
  - Adaptive timing of reply messages
- Bench 2 performance and scalability framework
  - Declarative modeling of DDS systems (JSON)
  - Distributed execution coordination
  - Results aggregation and reporting

RTPS Efficiency / Performance

- 1-to-1 test: from 21 SEDP messages to 16 (-24%)
- Previous version may need n^2 messages for n participants
- Many improvements impact all reliable readers, not just discovery
- Example: Bundling of control submessages into fewer messages

90	4.724016	192.168.1.70	55498	239.255.0.1	7402	RTPS	164	01030a0027000015123840ed INFO_DST, HEARTBEAT, HEARTBEAT, HEARTBEAT
99	4.724560	192.168.1.70	55503	239.255.0.1	7402	RTPS	164	01030a002700001503a863bd INFO_DST, HEARTBEAT, HEARTBEAT, HEARTBEAT
104	4.774747	192.168.1.70	55498	239.255.0.1	7402	RTPS	152	01030a0027000015123840ed INFO_DST, ACKNACK, ACKNACK, ACKNACK
105	4.774909	192.168.1.70	55503	239.255.0.1	7402	RTPS	152	01030a002700001503a863bd INFO_DST, ACKNACK, ACKNACK, ACKNACK

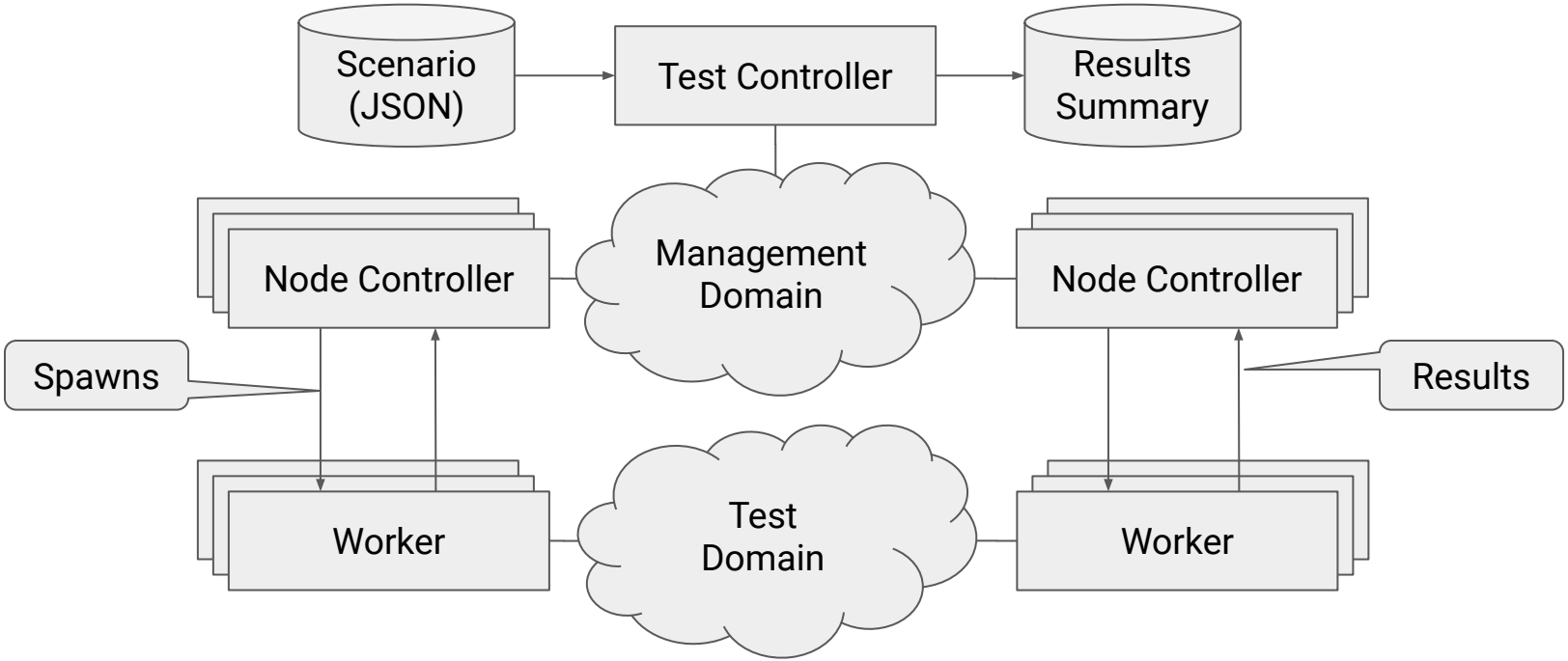
3.13 may send these separately

- Example: Fewer discovery data samples

17	4.441076	192.168.1.70	58134	239.255.0.1	7402	RTPS	296	01030a002700001521ac0000 INFO_TS, INFO_DST, DATA(r)
21	5.533075	192.168.1.70	52620	239.255.0.1	7402	RTPS	280	01030a0027000015234c0000 INFO_TS, DATA(w)
22	5.546191	192.168.1.70	58134	239.255.0.1	7402	RTPS	300	01030a002700001521ac0000 INFO_TS, DATA(r)
189	12.224441	192.168.1.70	58134	239.255.0.1	7402	RTPS	148	01030a002700001521ac0000 INFO_TS, DATA(r[UD])

Not in 3.14

Bench 2



Other Features / Bug fixes (not a complete list)

- RTPS Protocol Version 2.4
- QueryCondition and ContentFilteredTopic with dispose/unregister
- Multiple transport instances supported
- TCP transport async re/connects and timeout
- Publishing via Node.js module
- InconsistentTopicStatus with RTPS Discovery
- Large samples (fragmentation) improvements
- Presentation QoS with coherent_access fixes
- Improved "make install"

What's Next?

- Additional XTypes features are already in development for 3.15
- As a completely open-source project, OpenDDS evolves based on the needs of its stakeholders:
  - Users who sponsor development efforts at OCI
  - OCI's own investments
  - Contributors submitting code on GitHub
- Community support
  - Post on mailing lists, add to FAQ, submit GitHub Issues & PRs
- Commercial support
  - Design and architecture support
  - Custom development in the middleware or application layers
  - Testing, analysis, and integration support
  - Training and consulting

Where to Find More Information

- OpenDDS project: opendds.org
- Source repository: github.com/objectcomputing/OpenDDS
- Shapes Demo (code, binaries, video): opendds.org/quickstart/GettingStartedShapesDemo.html
- Community support: opendds.org/support.html
- OCI commercial support, training, consulting, development: objectcomputing.com/products/opendds
- Webinar: DDS Security in OpenDDS objectcomputing.com/products/opendds/resources/opendds-security
- Webinar: Designing a Distributed Application using DDS QoS: www.brighttalk.com/webcast/12231/281491

Upcoming Events

- Object Management Group's (OMG) Quarterly Meeting
  - Online only, March 23-27, 2020
  - https://www.omg.org/events/va-20/index.htm
  - DDS-focused public events will be rescheduled (online)
  - https://www.omg.org/events/va-20/special-events/DDS.htm
- "Introduction to OpenDDS" online training
  - Two 3-hour sessions
  - Exercises in C++ or Java using browser-based IDE
  - April 14-15, 2020
  - https://objectcomputing.com/products/opendds/training
- Interested in other training topics? Please complete our survey:
  - https://objectcomputing.typeform.com/to/r280uS

THANK YOU!

LET'S CONNECT

+1 (314) 579.0066

info@objectcomputing.com

objectcomputing.com