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RAIN in Action

RCI Introduction

S1 Reader Introduction

Demonstration

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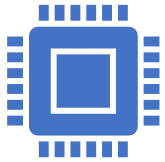
RFID



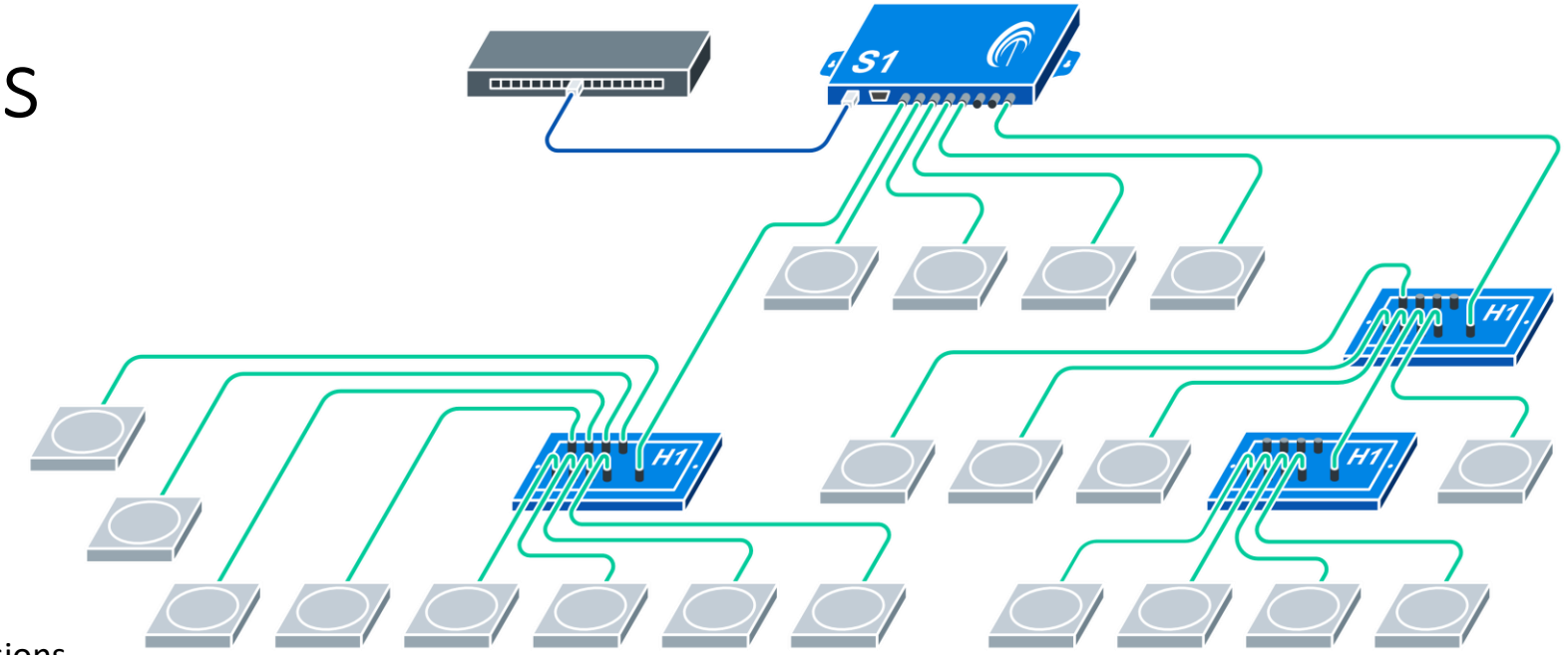
RAIN Communication Interface (RCI) Introduction

- ASCII JSON based protocol
  - Command/Response
  - Asynchronous Events
- Base RCI High Level Operations
  - Reader Configuration
    - DHCP, Event fields, Heartbeat, …
  - Reader Info
    - Version, Model, Serial Number, …
  - Read Zones (akin to LLRP AISpec)
    - Antennas, Triggers, Duty Cycle, Power, …
  - Spot Profiles (akin to LLRP AccessSpec)
    - Tag Operations, Read Zone Targets, …

S1 Interfaces

- RCI v4
- Web / Web Sockets
- Discovery
  - Bonjour and S1 Specific Multicast
- MQTT Publisher
- Reader Management SNMP
- Other Licensable Interfaces / Capabilities
  - LLRP
  - Binary applications running on S1
  - …
- Contact
  - info@clair-tech.com

S1 RCI v4 Features



- Out of Box
  - 2 Read Zones
  - 2 Spot Profiles
  - 1 MQTT or Publish Point Connection
- Licensable Max (Arbitrary):
  - 16 Read Zones
  - 8 Spot Profiles
  - 8 MQTT or Publish Point Connections
- SetConnection Object
  - Simultaneous connections with permissions
  - Events are filterable
- Custom MQTT / Publish Point Object
- Custom Crypto Reader / Tag Security Object
  - Supports “Sames” (tags with “Same” observable EPC because of Untraceable)
- Custom Tag Database
- Custom Logging
- Custom Events
  - _ReaderLogEvent, _ChangeEvent, _StatusEvent, _UserEvent

S1 RCI Features

Connectivity

RCI Ports (Configurable)

- TCP Port 51000 (Insecure), 51100 (TLS)
- Web Sockets
  - http://<reader_ip>/rci (Insecure)
  - https://<reader_ip>/rci (TLS)

Import File (Configurable)

- TCP Port 3034 (Insecure), 30034 (TLS)
- Imports key files, license files, certificate files, root CA files

MQTT or Publish Point

- Reader Starts Connection (Not Listening Port)

Java Host GUI with RCI Command Builder

- Uses Secure Reader Port (Or Selectable)
- RCI Learning Menus
  - Command Builder
  - Menus for Profiles, Read Zones, Info, Configuration, MQTT/Publish Point
  - Menus display JSON used by the GUI to configure and get information from the reader to help learn

RCI SDKs

- Java, .NET, Python, C (intended for licensable ability to run binary applications on S1)

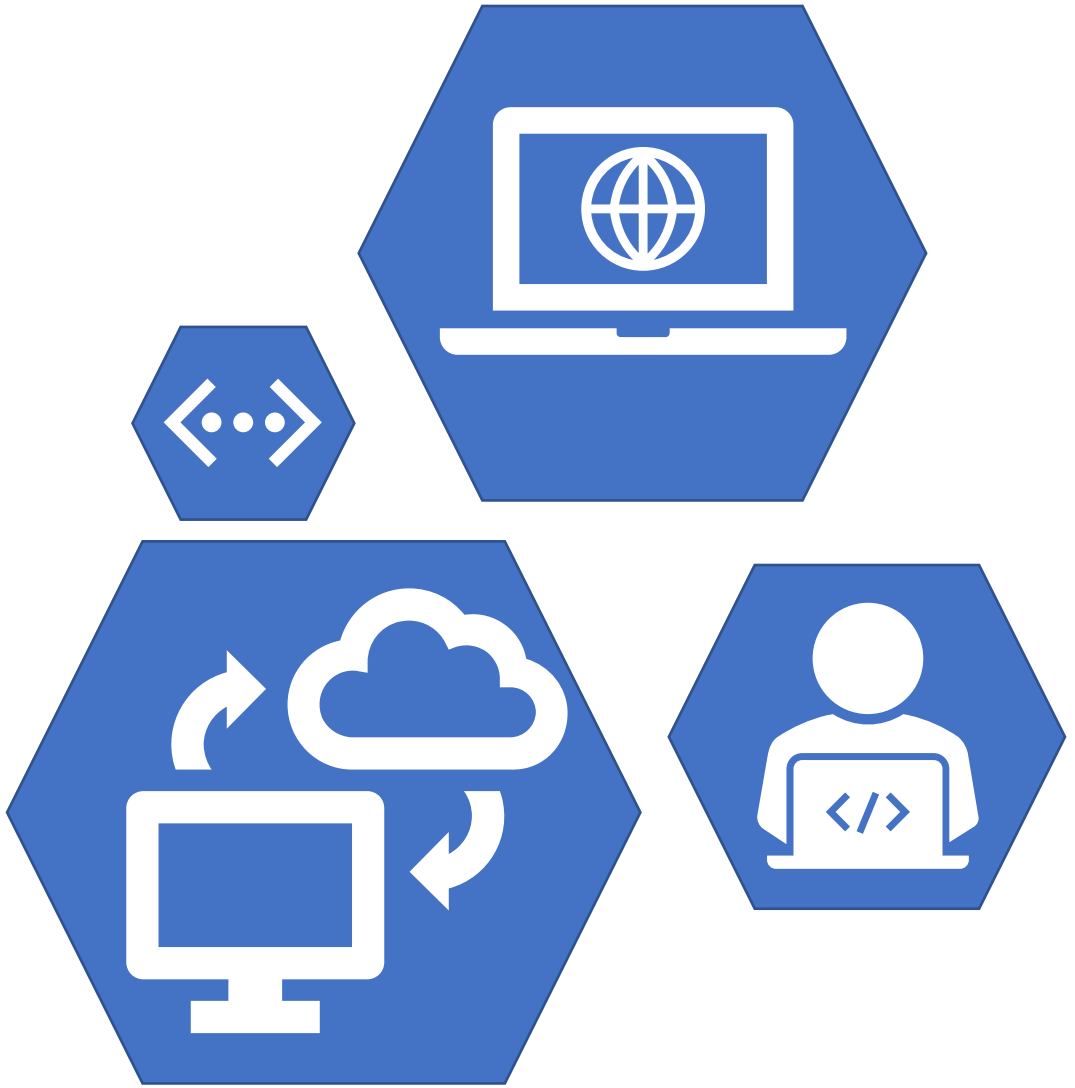
S1 Custom RCI Features

MQTT

- Setup S1 to publish to MQTT broker
- AWS and Google IoT tutorials available
- Choose types of events to publish and names to publish to
- Supports 8 simultaneous MQTT or Simple Publish connections

Simple Publish Protocol

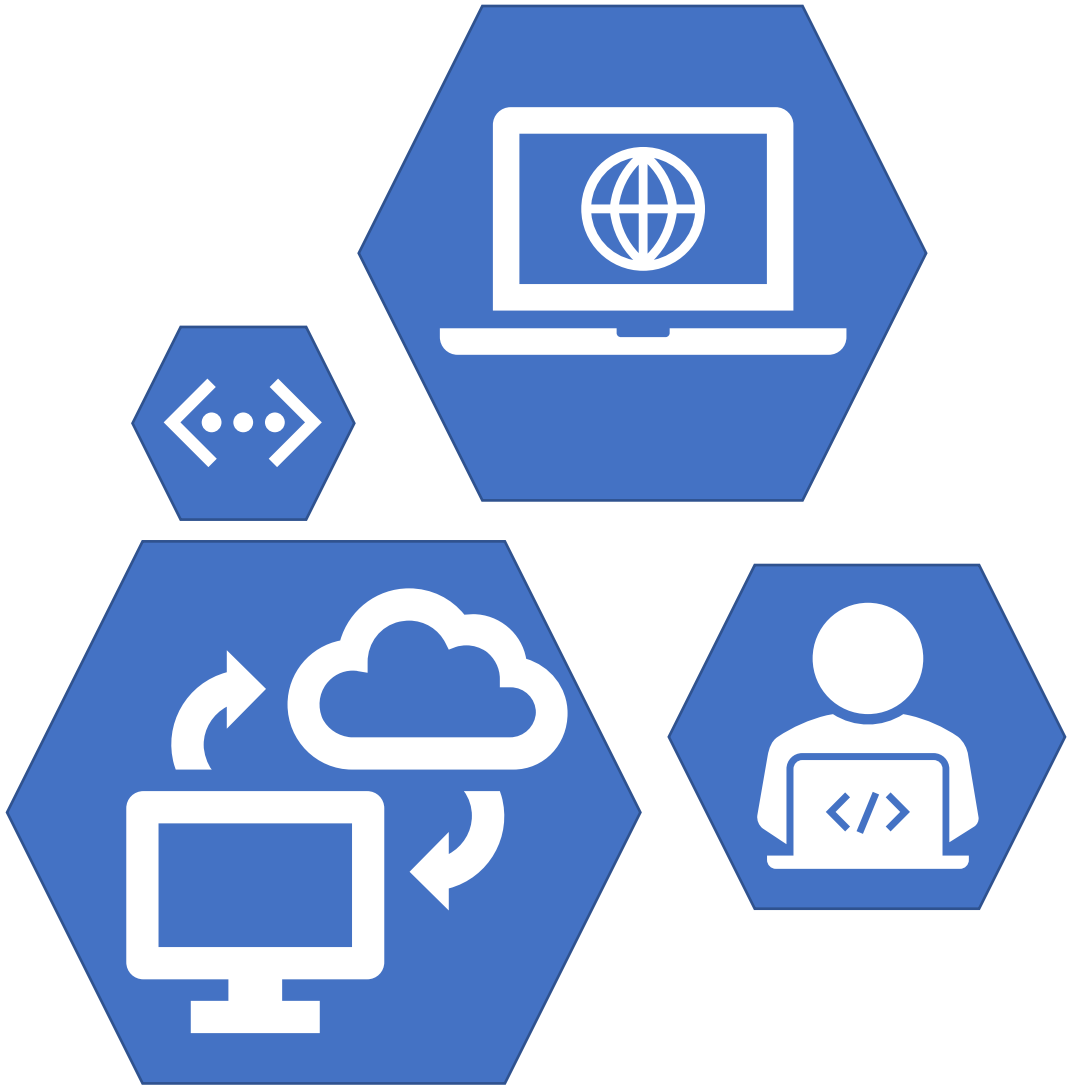
- Setup S1 to publish RCI events to TCP server
- Choose types of events to publish
- Specify “broker” via IP address and port (optional SSL/TLS)



S1 RCI Features

Crypto Reader / Tag Security

- Supports TAM1 and TAM2 Authentication
- Supports Handling Untraceable EPC
- Reports “Sames”



S1: Secure RFID Edge Server

- Real-time, on-board, secure RAIN authentication and traceability
- S1 Chain of Trust
  - Hardware authenticated secure boot loader
  - Secure boot loader authenticates operating system before loading
  - Operating system authenticates applications & data before loading
- Key management (secure key insertion, use, and storage)
- Tamper-evident, tamper-detecting, and tamper-responsive design
- Based on Analog Devices' Lockbox™ and Microchip, Inc. Trust Platform™
- Current International Standards
  - FIPS 140-3
  - ANSI X9.24-1-2017
  - ISO 13491

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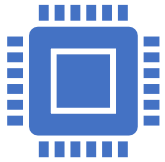

Crypto Reader Key Storage

- Keys never stored in nonvolatile or L3 memory unencrypted
  - Keys only available through on chip L1/L2 memory which is protected using Analog Devices Lockbox technology (https://www.analog.com/en/design-center/processors-and-dsp/lockbox-secure-technology.html)
- Keys generated using ECDH premaster secrets and random numbers
  - Customer holds their own private key and provides the reader with their public key
  - Reader holds its own private key and provides customer with public key
    - Private key held in Microchip secure crypto chip that the reader can only write to, but not read and can only write encrypted
    - https://www.microchip.com/wwwproducts/en/ATECC608A
- Tag specific key derivation through a SHA hash function with the EPC and secret master key
  - Use two keys (Key ID 0 and 1) generated from two master keys and EPC

List of Examples

- Connect to RCI port using Teraterm and GUI
  - Send commands through teraterm
  - Receive events through teraterm
- Examples of Configuring Profiles, Read Zones and JSON send and received
  - Run different examples of Reading and Writing User Data
- Examples of Using MQTT
  - Send to public MQTT broker anyone watching can subscribe
  - Allow audience to observe events locally on their own devices
- Examples of Sames and Crypto Reader Tag Security
  - Anyone subscribed via MQTT can continue to observe
  - Show “Sames” with tag security turned off
  - Show “Sames” getting properly expanded to unique EPCs when tag security turned on

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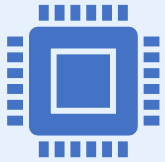

Tutorials Available

- Introduction to RCI Tutorial
- Introduction to RCI Publish Points Tutorial
- Introduction to MQTT Publish Points Tutorial
  - Amazon AWS Example
  - Google IoT Example
- Additional Tutorials (Help with Tutorials Used Above)
  - Host Software Tutorial
  - Setting Up TLS Security Tutorial

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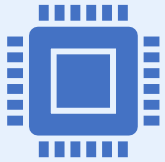

S1 RCI Java SDK

- Uses JSON library from org.json.simple (json-simple-1.1.1)
- Java Object For Every RCI Command and Report
  - E.g. SetCfgCmd, SetCfgReport, HBReport, GetInfoCmd, GetInfoReport
- Java Objects For Managing Connections / Asynchronous Events
  - RciConnect
  - RciEventHandling
  - RciEvent
- .NET, Python, and C Have Similar Behavior / Capabilities

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S1 RCI SDK Event Handling Objects 1

```
public interface RciEventHandling
{
    public void RciEventHandlingCallback(RciEvent rciEvent);
    public List<String> RciGetReportFilter();
}
```

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S1 RCI SDK Event Handling Objects 2

```
public class RciEvent
{
    public JSONObject reportObject;
    public String reportString;

    public RciEvent(JSONObject reportObject, String reportString) {
        this.reportObject = reportObject;
        this.reportString = reportString;
    }
}
```

org.json.simple.JSONObject

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S1 RCI SDK HB Event Handler Example 1

```
class HBEventHandler implements RciEventHandling {
        boolean hbSeen = false;
        HBReport report = null;
        int hbCount = 0;

        ArrayList<String> desiredReports = new ArrayList<String>() {
            {                   add("HB");              }
        };

        @Override
        public List<String> RciGetReportFilter() {
            return desiredReports;
        }
```

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S1 RCI SDK HB Event Handler Example 2

```
    @Override
    public void RciEventHandlingCallback(RciEvent rciEvent) {
        String reportString = (String) rciEvent.reportObject.get("Report");
        if (reportString != null) {
            if (reportString.compareTo("HB") == 0) {
                report = new HBReport(rciEvent.reportObject);
                hbSeen = true;
                hbCount++;
            }
        }
    }
}
```

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S1 RCI SDK Connect Example

```
String ipAddress = “10.172.0.124”;
HBEventHandler hbHandler = new HBEventHandler();
RciConnect testConn = new RciConnect( ipAddress, hbHandler);
try {
    testConn.Connect(5000);
} catch (Exception e) {
    fail("Can't connect");
}
```

User Defined Event Handler

Connection Timeout (5000 ms)

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S1 RCI SDK GetCfg Example

```
GetCfgCmd getCfgCmd = new GetCfgCmd(rciConnect);
getCfgCmd.setFields(getCfgCmd.FIELDS_HBFIELDS);
getCfgCmd.setFields(getCfgCmd.FIELDS_HBPeriod);
GetCfgReport getCfgReport = getCfgCmd.sendObject(5000);
if (getCfgReport.getErrorCode() != 0) {
    getCfgReport.printErrors(“   “);
    fail("Failed sending cfg report");
}

Long hbPeriod = getCfgReport.getFieldsHBPeriod();
JSONArray hbFields = getCfgReport.getFieldsHBFields();
for (int i=0; i< hbFields.size(); i++) {
    String field = (String) hbFields.get(i);
}
```

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Presentations will be available on-line soon. You will receive an email with a link when they are available.