

Raport z zadania I4

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1 Informacje ogólne

Korzystamy z dwóch technologii — Zeroc ICE oraz gRPC. W ramach tego pierwszego użyjemy gotowych przykładów z tego repozytorium, a konkretnie z tego interfejsu IDL, tego serwera napisanego w języku Java oraz tego klienta napisanego w C++. Do drugiej części wykorzystam zadanie A2.

2 Zeroc ICE

Na *overhead* związany z używaniem *optional* wpływają według dokumentacji dwie rzeczy: typ oraz tag. Typ od 1 do 5 bajtów tag od 0 do 5 bajtów. W przypadku tagów o wartości mniejszej niż 30 osiągamy dolny pułap, dlatego też ich będziemy używać.

Overhead większości typów możemy zobaczyć tutaj:

The table below describes the overhead associated with several common Slice types:

| Type | Overhead (bytes) |
|------------------------------|------------------|
| Primitive (including string) | 1 |
| Proxy | 5 |
| Object | 1 |
| Sequence of byte, bool | 1 |
| Sequence | 2-5 |
| Enumerator | 1 |
| Structure | 2-5 |
| Dictionary | 2-5 |

Rysunek 1: Tabela z wartościami *overhead*

Interfejs IDL wygląda następująco:

```
//  
// Copyright (c) ZeroC, Inc. All rights reserved.  
//  
#pragma once
```

```

["java:package:com.zeroc.demos.Ice.optional"]
module Demo
{
    enum NumberType
    {
        HOME,
        OFFICE,
        CELL
    }

    class Contact
    {
        string name;
        optional(1) NumberType type = HOME;
        optional(2) string number;
        optional(3) int dialGroup;
    }

    interface ContactDB
    {
        void addContact(string name, optional(1) NumberType type, optional(2) string number, optional(3) int dialGroup);
        void updateContact(string name, optional(1) NumberType type, optional(2) string number, optional(3) int dialGroup);

        Contact query(string name);
        optional(1) string queryNumber(string name);
        void queryDialgroup(string name, out optional(1) int dialGroup);

        void shutdown();
    }
}

```

Mamy więc klasę Contact z trzema opcjonalnymi polami oraz pięć funkcji, które je wykorzystują. Ponadto funkcja queryNumber zwraca opcjonalny string.

Serwer ma bardzo prostą strukturę:

```

// Copyright (c) ZeroC, Inc. All rights reserved.

public class Server
{
    public static void main(String[] args)
    {
        int status = 0;
        java.util.List<String> extraArgs = new java.util.ArrayList<String>();

        // Try with resources block - communicator is automatically destroyed
        // at the end of this try block
        //
        try(com.zeroc.Ice.Communicator communicator = com.zeroc.Ice.Util.initialize(args, "config.server", extraArgs))
        {
            communicator.getProperties().setProperty("Ice.Default.Package", "com.zeroc.demos.Ice.optional");
            //
            // Install shutdown hook to (also) destroy communicator during JVM shutdown.
            // This ensures the communicator gets destroyed when the user interrupts the application with Ctrl-C.
            //
            Runtime.getRuntime().addShutdownHook(new Thread(() -> communicator.destroy()));

            if(!extraArgs.isEmpty())
            {
                System.err.println("too many arguments");
                status = 1;
            }
            else
            {
                com.zeroc.Ice.ObjectAdapter adapter = communicator.createObjectAdapter("ContactDB");
                adapter.add(new ContactDBI(), com.zeroc.Ice.Util.stringToIdentity("contactdb"));
                adapter.activate();

                communicator.waitForShutdown();
            }
        }
    }
}

```

```

        System.exit(status);
    }
}

```

O wiele ciekawszy jest klient, bo to w nim dzieje się w tym przypadku cała akcja. Przejdźmy po kolejnych jego wywołaniach.

W pierwszym uzupełniamy wszystkie pola:

```

//  

// Add a contact for "john". All parameters are provided.  

//  

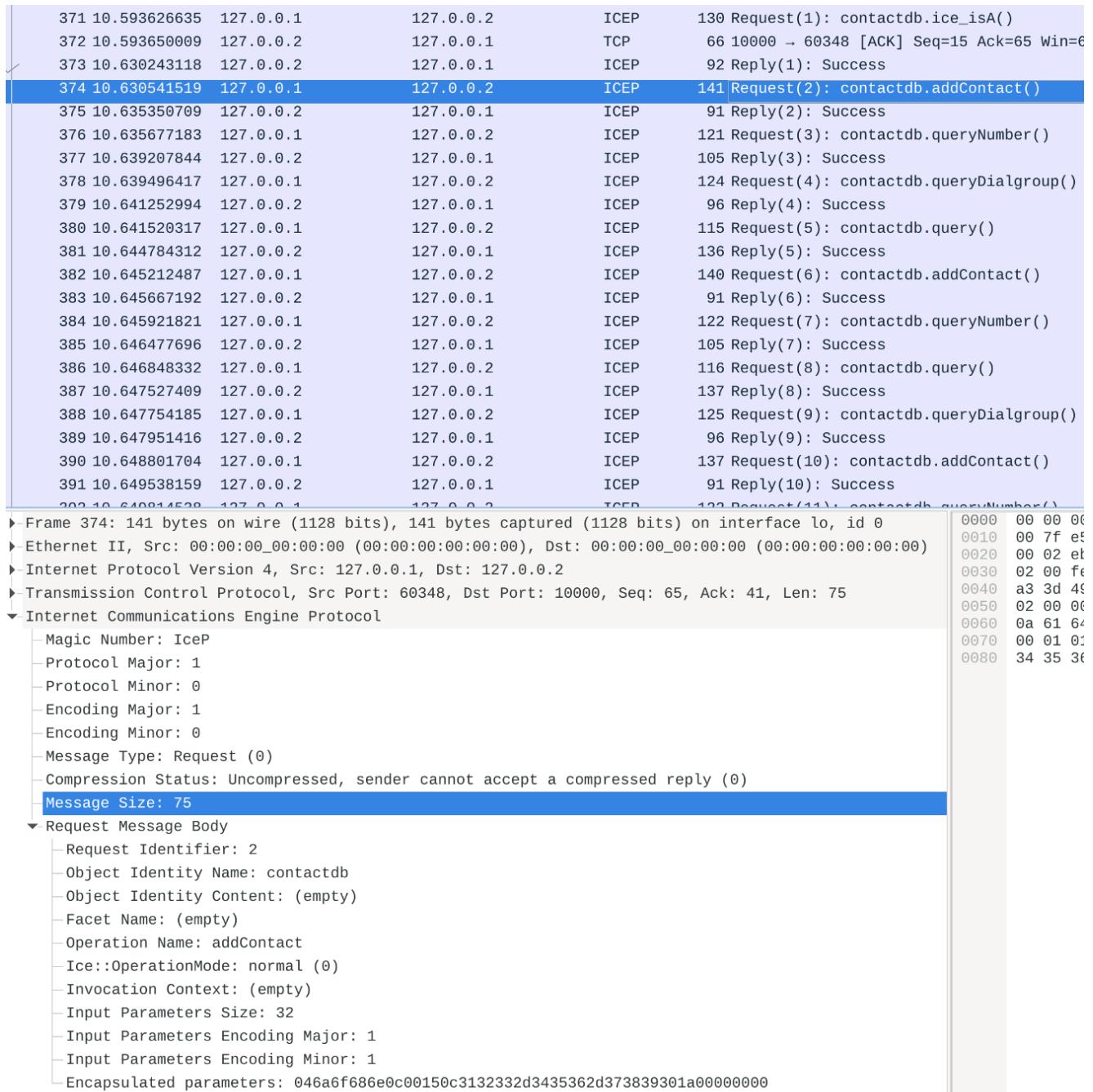
const string johnNumber = "123-456-7890";  

contactdb->addContact("john", NumberType::HOME, johnNumber, 0);  

cout << "Checking john... " << flush;

```



Rysunek 2: Dodanie kontaktu Johna ze wszystkimi polami

Spróbujmy znaleźć numer Johna:

```
auto number = contactdb->queryNumber("john");
```

| | | | | |
|------------------|-----------|-----------|------|---|
| 371 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=655: |
| 373 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |

Frame 377: 105 bytes on wire (840 bits), 105 bytes captured (840 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 66, Ack: 195, Len: 39

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 39**

Reply Message Body

- Request Identifier: 3
- Reply Status: Success (0)
- Reported reply data: 1400000001010d0c3132332d3435362d37383930

| | |
|------|------------|
| 0000 | 00 00 00 0 |
| 0010 | 00 5b 40 c |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 5 |
| 0040 | 5c 0a 49 6 |
| 0050 | 03 00 00 0 |
| 0060 | 2d 34 35 3 |

Rysunek 3: Wynik zapytania o numer Johna

Następnie grupa:

```
Ice::optional<int> dialgroup;
contactdb->queryDialgroup("john", dialgroup);
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 371 | 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 | 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=655: |
| 373 | 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 | 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 | 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 | 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 | 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 | 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 | 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 | 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 | 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 | 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 | 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 | 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 | 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 | 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 | 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 | 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 | 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 | 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |

Frame 379: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 105, Ack: 253, Len: 30

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 30**

Reply Message Body

- Request Identifier: 4
- Reply Status: Success (0)
- Reported reply data: 0b00000001010a00000000

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 52 40 c |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 4 |
| 0040 | 5c 0e 49 6 |
| 0050 | 04 00 00 0 |

Rysunek 4: Wynik zapytania o grupę

A teraz wszystkie dane:

```
auto info = contactdb->query("john");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 371 | 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 | 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=655: |
| 373 | 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 | 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 | 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 | 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 | 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 | 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 | 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 | 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 | 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 | 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 | 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 | 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 | 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 | 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 | 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 | 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 | 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 | 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |

| | |
|---|-----------------|
| ▶ Frame 381: 136 bytes on wire (1088 bits), 136 bytes captured (1088 bits) on interface lo, id 0 | 0000 00 00 00 0 |
| ▶ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00) | 0010 00 7a 40 d |
| ▶ Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1 | 0020 00 01 27 1 |
| ▶ Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 135, Ack: 302, Len: 70 | 0030 02 00 fe 6 |
| ▼ Internet Communications Engine Protocol | 0040 5c 10 49 6 |
| └ Magic Number: IceP | 0050 05 00 00 0 |
| └ Protocol Major: 1 | 0060 44 65 6d 6 |
| └ Protocol Minor: 0 | 0070 68 6e 0c 0 |
| └ Encoding Major: 1 | 0080 39 30 1a 0 |
| └ Encoding Minor: 0 | |
| └ Message Type: Reply (2) | |
| └ Compression Status: Uncompressed, sender cannot accept a compressed reply (0) | |
| └ Message Size: 70 | |
| ▼ Reply Message Body | |
| └ Request Identifier: 5 | |
| └ Reply Status: Success (0) | |
| └ Reported reply data: 33000000010101250f3a3a44656d6f3a3a436f6e74616374046a6f686e0c00150c313233... | |

Rysunek 5: Wynik zapytania o wszystkie dane Johna

Teraz dodamy Steve'a, lecz w jego przypadku zmienna `NumberType` będzie pusta. Należy jednak pamiętać, że ma ono przypisaną domyślną wartość `HOME`:

```
const string steveNumber = "234-567-8901";
contactdb->addContact("steve", Ice::nullopt, steveNumber, 1);

cout << "Checking steve..." << flush;
```

| | | | | | |
|---|--------------|-----------|-----------|------|--|
| 371 | 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 | 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=6 |
| 373 | 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 | 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 | 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 | 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 | 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 | 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 | 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 | 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 | 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 | 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 | 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 | 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 | 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 | 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 | 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 | 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 | 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 | 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |
| 392 | 10.649814520 | 127.0.0.1 | 127.0.0.2 | TCP | 122 Request(11): contactdb.queryNumber() |
| ► Frame 382: 140 bytes on wire (1120 bits), 140 bytes captured (1120 bits) on interface lo, id 0 | | | | | |
| ► Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00) | | | | | |
| ► Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.2 | | | | | |
| ► Transmission Control Protocol, Src Port: 60348, Dst Port: 10000, Seq: 302, Ack: 205, Len: 74 | | | | | |
| ▼ Internet Communications Engine Protocol | | | | | |
| Magic Number: IceP | | | | | |
| Protocol Major: 1 | | | | | |
| Protocol Minor: 0 | | | | | |
| Encoding Major: 1 | | | | | |
| Encoding Minor: 0 | | | | | |
| Message Type: Request (0) | | | | | |
| Compression Status: Uncompressed, sender cannot accept a compressed reply (0) | | | | | |
| Message Size: 74 | | | | | |
| ▼ Request Message Body | | | | | |
| Request Identifier: 6 | | | | | |
| Object Identity Name: contactdb | | | | | |
| Object Identity Content: (empty) | | | | | |
| Facet Name: (empty) | | | | | |
| Operation Name: addContact | | | | | |
| Ice::OperationMode: normal (0) | | | | | |
| Invocation Context: (empty) | | | | | |
| Input Parameters Size: 31 | | | | | |
| Input Parameters Encoding Major: 1 | | | | | |
| Input Parameters Encoding Minor: 1 | | | | | |
| Encapsulated parameters: 057374657665150c3233342d3536372d383930311a01000000 | | | | | |

Rysunek 6: Dodanie kontaktu Steve'a bez numeru typu

Wiadomość jest o jeden bajt mniejsza niż w przypadku Johna, mimo że imię jest o jedną literę dłuższe.

Zapytanie o numer:

```
number = contactdb->queryNumber("steve");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 371 | 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 | 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=655: |
| 373 | 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 | 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 | 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 | 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 | 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 | 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 | 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 | 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 | 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 | 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 | 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 | 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 | 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 | 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 | 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 | 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 | 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 | 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |

Frame 385: 105 bytes on wire (840 bits), 105 bytes captured (840 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 230, Ack: 432, Len: 39

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 39**

Reply Message Body

- Request Identifier: 7
- Reply Status: Success (0)
- Reported reply data: 1400000001010d0c3233342d3536372d38393031

| | |
|------|------------|
| 0000 | 00 00 00 0 |
| 0010 | 00 5b 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 5 |
| 0040 | 5c 15 49 6 |
| 0050 | 07 00 00 0 |
| 0060 | 2d 35 36 3 |

Rysunek 7: Wynik zapytania o numer Steve'a

Tu oczywiście bez zmian.

Wynik zapytania o wszystkie dane:

```
info = contactdb->query("steve");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 371 | 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 | 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=655: |
| 373 | 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 | 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 | 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 | 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 | 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 | 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 | 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 | 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 | 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 | 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 | 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 | 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 | 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 | 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 | 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 | 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 | 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 | 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |

Frame 387: 137 bytes on wire (1096 bits), 137 bytes captured (1096 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 269, Ack: 482, Len: 71

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 71**

Reply Message Body

- Request Identifier: 8
- Reply Status: Success (0)
- Reported reply data: 34000000010101250f3a3a44656d6f3a3a436f6e746163740573746576650c00150c3233...

| | |
|------|-------------------|
| 0000 | 00 00 00 00 00 00 |
| 0010 | 00 7b 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 7 |
| 0040 | 5c 16 49 6 |
| 0050 | 08 00 00 00 |
| 0060 | 44 65 6d 6 |
| 0070 | 65 76 65 0 |
| 0080 | 39 30 31 1 |

Rysunek 8: Wynik zapytania o wszystkie dane Steve'a

Jest o jeden bajt większa od Johna ze względu na dłuższe imię i ustawienie domyślnej wartości.

Zapytanie o grupę:

```
contactdb->queryDialgroup("steve", dialgroup);
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 371 | 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 | 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=655: |
| 373 | 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 | 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 | 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 | 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 | 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 | 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 | 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 | 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 | 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 | 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 | 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 | 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 | 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 | 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 | 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 | 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 | 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 | 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |

Frame 389: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 340, Ack: 541, Len: 30

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 30**

Reply Message Body

- Request Identifier: 9
- Reply Status: Success (0)
- Reported reply data: 0b00000001010a01000000

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 52 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 4 |
| 0040 | 5c 16 49 6 |
| 0050 | 09 00 00 0 |

Rysunek 9: Wynik zapytania o grupę Steve'a

Ponownie, tyle samo, bez zaskoczenia.

Teraz dodamy Franka. On z kolei nie będzie miał uzupełnionej grupy. To pole jednak nie ma już domyślnej wartości:

```
const string frankNumber = "345-678-9012";
contactdb->addContact("frank", NumberType::CELL, frankNumber, Ice::nullopt);
```

| | | | | | |
|---|--------------|-----------|-----------|------|--|
| 371 | 10.593626635 | 127.0.0.1 | 127.0.0.2 | ICEP | 130 Request(1): contactdb.ice_isA() |
| 372 | 10.593650009 | 127.0.0.2 | 127.0.0.1 | TCP | 66 10000 → 60348 [ACK] Seq=15 Ack=65 Win=6 |
| 373 | 10.630243118 | 127.0.0.2 | 127.0.0.1 | ICEP | 92 Reply(1): Success |
| 374 | 10.630541519 | 127.0.0.1 | 127.0.0.2 | ICEP | 141 Request(2): contactdb.addContact() |
| 375 | 10.635350709 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(2): Success |
| 376 | 10.635677183 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(3): contactdb.queryNumber() |
| 377 | 10.639207844 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(3): Success |
| 378 | 10.639496417 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(4): contactdb.queryDialgroup() |
| 379 | 10.641252994 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(4): Success |
| 380 | 10.641520317 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(5): contactdb.query() |
| 381 | 10.644784312 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(5): Success |
| 382 | 10.645212487 | 127.0.0.1 | 127.0.0.2 | ICEP | 140 Request(6): contactdb.addContact() |
| 383 | 10.645667192 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(6): Success |
| 384 | 10.645921821 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(7): contactdb.queryNumber() |
| 385 | 10.646477696 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(7): Success |
| 386 | 10.646848332 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(8): contactdb.query() |
| 387 | 10.647527409 | 127.0.0.2 | 127.0.0.1 | ICEP | 137 Reply(8): Success |
| 388 | 10.647754185 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(9): contactdb.queryDialgroup() |
| 389 | 10.647951416 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(9): Success |
| 390 | 10.648801704 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(10): contactdb.addContact() |
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |
| 392 | 10.649814520 | 127.0.0.1 | 127.0.0.2 | TCP | 122 Request(11): contactdb.queryNumber() |
| ► Frame 390: 137 bytes on wire (1096 bits), 137 bytes captured (1096 bits) on interface lo, id 0 | | | | | |
| ► Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00) | | | | | |
| ► Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.2 | | | | | |
| ► Transmission Control Protocol, Src Port: 60348, Dst Port: 10000, Seq: 541, Ack: 370, Len: 71 | | | | | |
| ▼ Internet Communications Engine Protocol | | | | | |
| Magic Number: IceP | | | | | |
| Protocol Major: 1 | | | | | |
| Protocol Minor: 0 | | | | | |
| Encoding Major: 1 | | | | | |
| Encoding Minor: 0 | | | | | |
| Message Type: Request (0) | | | | | |
| Compression Status: Uncompressed, sender cannot accept a compressed reply (0) | | | | | |
| Message Size: 71 | | | | | |
| ▼ Request Message Body | | | | | |
| Request Identifier: 10 | | | | | |
| Object Identity Name: contactdb | | | | | |
| Object Identity Content: (empty) | | | | | |
| Facet Name: (empty) | | | | | |
| Operation Name: addContact | | | | | |
| Ice::OperationMode: normal (0) | | | | | |
| Invocation Context: (empty) | | | | | |
| Input Parameters Size: 28 | | | | | |
| Input Parameters Encoding Major: 1 | | | | | |
| Input Parameters Encoding Minor: 1 | | | | | |
| Encapsulated parameters: 056672616e6b0c02150c3334352d3637382d39303132 | | | | | |

Rysunek 10: Dodanie kontaktu Franka bez grupy

Zapytanie o numer:

```
number = contactdb->queryNumber("frank");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 393: 105 bytes on wire (840 bits), 105 bytes captured (840 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 395, Ack: 668, Len: 39

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 39**

Reply Message Body

- Request Identifier: 11
- Reply Status: Success (0)
- Reported reply data: 1400000001010d0c3334352d3637382d39303132

| | |
|------|------------|
| 0000 | 00 00 00 0 |
| 0010 | 00 5b 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 5 |
| 0040 | 5c 19 49 6 |
| 0050 | 0b 00 00 0 |
| 0060 | 2d 36 37 3 |

Rysunek 11: Zapytanie o numer Franka

Oczywiście rozmiar jak poprzednio.

Zapytanie o wszystkie dane:

```
info = contactdb->query("frank");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 395: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 434, Ack: 718, Len: 66

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 66**

Reply Message Body

- Request Identifier: 12
- Reply Status: Success (0)
- Reported reply data: 2f000000010101250f3a3a44656d6f3a3a436f6e74616374056672616e6b0c02150c3334...

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 76 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 6 |
| 0040 | 5c 19 49 6 |
| 0050 | 0c 00 00 0 |
| 0060 | 44 65 6d 6 |
| 0070 | 61 6e 6b 0 |
| 0080 | 30 31 32 f |

Rysunek 12: Wynik zapytania o wszystkie dane Franka

Jest to najoszczędniejsze zapytanie do tej pory o wszystkie dane, gdyż typ pola `dialGroup` to `int`, którego rozmiar jest większy od pola enuma.

Zapytajmy o samą grupę, która jest pusta w tym przypadku:

```
contactdb->queryDialgroup("frank", dialgroup);
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 397: 91 bytes on wire (728 bits), 91 bytes captured (728 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 500, Ack: 777, Len: 25

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 25**

Reply Message Body

- Request Identifier: 13
- Reply Status: Success (0)
- Reported reply data: 060000000101

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 4d 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 4 |
| 0040 | 5c 1b 49 6 |
| 0050 | 0d 00 00 0 |

Rysunek 13: Wynik zapytania o grupę Franka

Tutaj wynik też bez zaskoczenia.

Pora na ostatnią osobę, Anię, która nie będzie miała ustawionego „najcięższego” pola, czyli numeru telefonu:

```
contactdb->addContact("anne", NumberType::OFFICE, Ice::nullopt, 2);
cout << "Checking anne... " << flush;
```

| | | | | | |
|---|--------------|-----------|-----------|------|---|
| 391 | 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |
| 413 | 10.670407008 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(21): Success |
| ► Frame 398: 127 bytes on wire (1016 bits), 127 bytes captured (1016 bits) on interface lo, id 0 | | | | | |
| ► Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00) | | | | | |
| ► Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.2 | | | | | |
| ► Transmission Control Protocol, Src Port: 60348, Dst Port: 10000, Seq: 777, Ack: 525, Len: 61 | | | | | |
| ► Internet Communications Engine Protocol | | | | | |
| └ Magic Number: IceP | | | | | |
| └ Protocol Major: 1 | | | | | |
| └ Protocol Minor: 0 | | | | | |
| └ Encoding Major: 1 | | | | | |
| └ Encoding Minor: 0 | | | | | |
| └ Message Type: Request (0) | | | | | |
| └ Compression Status: Uncompressed, sender cannot accept a compressed reply (0) | | | | | |
| └ Message Size: 61 | | | | | |
| └ Request Message Body | | | | | |
| └ Request Identifier: 14 | | | | | |
| └ Object Identity Name: contactdb | | | | | |
| └ Object Identity Content: (empty) | | | | | |
| └ Facet Name: (empty) | | | | | |
| └ Operation Name: addContact | | | | | |
| └ Ice::OperationMode: normal (0) | | | | | |
| └ Invocation Context: (empty) | | | | | |
| └ Input Parameters Size: 18 | | | | | |
| └ Input Parameters Encoding Major: 1 | | | | | |
| └ Input Parameters Encoding Minor: 1 | | | | | |
| └ Encapsulated parameters: 04616e6e650c011a02000000 | | | | | |
| └ 0000 00 00 00 | | | | | |
| └ 0010 00 71 e5 | | | | | |
| └ 0020 00 02 eb | | | | | |
| └ 0030 02 00 fe | | | | | |
| └ 0040 a3 53 49 | | | | | |
| └ 0050 0e 00 00 | | | | | |
| └ 0060 0a 61 64 | | | | | |
| └ 0070 00 01 01 | | | | | |

Rysunek 14: Dodanie kontaktu Anne bez numeru

Zapytanie o numer:

```
number = contactdb->queryNumber("anne");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 401: 91 bytes on wire (728 bits), 91 bytes captured (728 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 550, Ack: 893, Len: 25

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 25**

Reply Message Body

- Request Identifier: 15
- Reply Status: Success (0)
- Reported reply data: 060000000101

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 4d 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 4 |
| 0040 | 5c 1c 49 6 |
| 0050 | 0f 00 00 0 |

Rysunek 15: Zapytanie o numer Anne

Zaoszczędziliśmy aż 14 bajtów!

Zapytanie o wszystkie dane:

```
info = contactdb->query("anne");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 403: 122 bytes on wire (976 bits), 122 bytes captured (976 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 575, Ack: 942, Len: 56

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 56**

Reply Message Body

- Request Identifier: 16
- Reply Status: Success (0)
- Reported reply data: 25000000010101250f3a3a44656d6f3a3a436f6e7461637404616e6e650c011a02000000...

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 6c 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 6 |
| 0040 | 5c 1c 49 6 |
| 0050 | 10 00 00 0 |
| 0060 | 44 65 6d 6 |
| 0070 | 6e 65 0c 0 |

Rysunek 16: Wynik zapytania o wszystkie dane Anne

Tu tak samo. Największa oszczędność, gdyż numer telefonu był największą zmienną ze wszystkich.

Zapytanie o grupę:

```
contactdb->queryDialgroup("frank", dialgroup);
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 405: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 631, Ack: 1000, Len: 30

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 30**

Reply Message Body

- Request Identifier: 17
- Reply Status: Success (0)
- Reported reply data: 0b00000001010a02000000

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 52 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 4 |
| 0040 | 5c 1d 49 6 |
| 0050 | 11 00 00 0 |

Rysunek 17: Wynik zapytania o grupę Anne

Tu rzecz jasna bez zmian.

Ostatnią rzeczą jest aktualizacja danych, a konkretnie w tym przypadku numeru telefonu. Resztę pozostawiamy bez zmian:

```
const string anneNumber = "456-789-0123";
contactdb->updateContact("anne", Ice::nullopt, anneNumber, Ice::nullopt);
```

| | | | | |
|---|-----------|-----------|------|---|
| 391 10.649538159 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(10): Success |
| 392 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |
| 415 10.670407008 | 127.0.0.2 | 127.0.0.1 | ICEP | 01 Reply(21): Success |
| ► Frame 406: 137 bytes on wire (1096 bits), 137 bytes captured (1096 bits) on interface lo, id 0 | | | | |
| ► Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00) | | | | |
| ► Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.2 | | | | |
| ► Transmission Control Protocol, Src Port: 60348, Dst Port: 10000, Seq: 1000, Ack: 661, Len: 71 | | | | |
| ► Internet Communications Engine Protocol | | | | |
| └ Magic Number: IceP | | | | |
| └ Protocol Major: 1 | | | | |
| └ Protocol Minor: 0 | | | | |
| └ Encoding Major: 1 | | | | |
| └ Encoding Minor: 0 | | | | |
| └ Message Type: Request (0) | | | | |
| └ Compression Status: Uncompressed, sender cannot accept a compressed reply (0) | | | | |
| └ Message Size: 71 | | | | |
| └ Request Message Body | | | | |
| └ Request Identifier: 18 | | | | |
| └ Object Identity Name: contactdb | | | | |
| └ Object Identity Content: (empty) | | | | |
| └ Facet Name: (empty) | | | | |
| └ Operation Name: updateContact | | | | |
| └ Ice::OperationMode: normal (0) | | | | |
| └ Invocation Context: (empty) | | | | |
| └ Input Parameters Size: 25 | | | | |
| └ Input Parameters Encoding Major: 1 | | | | |
| └ Input Parameters Encoding Minor: 1 | | | | |
| └ Encapsulated parameters: 04616e6e65150c3435362d3738392d30313233 | | | | |
| └ 0000 00 00 00 | | | | |
| └ 0010 00 7b e5 | | | | |
| └ 0020 00 02 eb | | | | |
| └ 0030 02 00 fe | | | | |
| └ 0040 a3 56 49 | | | | |
| └ 0050 12 00 00 | | | | |
| └ 0060 0d 75 70 | | | | |
| └ 0070 19 00 00 | | | | |
| └ 0080 2d 37 38 | | | | |

Rysunek 18: Aktualizacja danych Anne

Tym samym wszystko wróciło do normy.

Zapytanie o numer po aktualizacji:

```
number = contactdb->queryNumber("anne");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 409: 105 bytes on wire (840 bits), 105 bytes captured (840 bits) on interface lo, id 0
 Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)
 Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1
 Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 686, Ack: 1126, Len: 39
 Internet Communications Engine Protocol
 Magic Number: IceP
 Protocol Major: 1
 Protocol Minor: 0
 Encoding Major: 1
 Encoding Minor: 0
 Message Type: Reply (2)
 Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
 Message Size: 39
 Reply Message Body
 Request Identifier: 19
 Reply Status: Success (0)
 Reported reply data: 1400000001010d0c3435362d3738392d30313233

| | |
|------|-------------|
| 0000 | 00 00 00 00 |
| 0010 | 00 5b 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 5 |
| 0040 | 5c 1f 49 6 |
| 0050 | 13 00 00 0 |
| 0060 | 2d 37 38 3 |

Rysunek 19: Zapytanie o numer Anne po aktualizacji

Tutaj podobnie, osiągamy stare wartości. Zapytanie o wszystkie dane po aktualizacji:

```
info = contactdb->query("anne");
```

| | | | | | |
|-----|--------------|-----------|-----------|------|---|
| 392 | 10.649814538 | 127.0.0.1 | 127.0.0.2 | ICEP | 122 Request(11): contactdb.queryNumber() |
| 393 | 10.650484758 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(11): Success |
| 394 | 10.650626194 | 127.0.0.1 | 127.0.0.2 | ICEP | 116 Request(12): contactdb.query() |
| 395 | 10.651972996 | 127.0.0.2 | 127.0.0.1 | ICEP | 132 Reply(12): Success |
| 396 | 10.652239036 | 127.0.0.1 | 127.0.0.2 | ICEP | 125 Request(13): contactdb.queryDialgroup() |
| 397 | 10.652573304 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(13): Success |
| 398 | 10.652823434 | 127.0.0.1 | 127.0.0.2 | ICEP | 127 Request(14): contactdb.addContact() |
| 399 | 10.653083433 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(14): Success |
| 400 | 10.653182690 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(15): contactdb.queryNumber() |
| 401 | 10.653447177 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(15): Success |
| 402 | 10.653522979 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(16): contactdb.query() |
| 403 | 10.654014243 | 127.0.0.2 | 127.0.0.1 | ICEP | 122 Reply(16): Success |
| 404 | 10.654149667 | 127.0.0.1 | 127.0.0.2 | ICEP | 124 Request(17): contactdb.queryDialgroup() |
| 405 | 10.655525153 | 127.0.0.2 | 127.0.0.1 | ICEP | 96 Reply(17): Success |
| 406 | 10.655762469 | 127.0.0.1 | 127.0.0.2 | ICEP | 137 Request(18): contactdb.updateContact() |
| 407 | 10.656187799 | 127.0.0.2 | 127.0.0.1 | ICEP | 91 Reply(18): Success |
| 408 | 10.656298687 | 127.0.0.1 | 127.0.0.2 | ICEP | 121 Request(19): contactdb.queryNumber() |
| 409 | 10.657203198 | 127.0.0.2 | 127.0.0.1 | ICEP | 105 Reply(19): Success |
| 410 | 10.657482593 | 127.0.0.1 | 127.0.0.2 | ICEP | 115 Request(20): contactdb.query() |
| 411 | 10.658602518 | 127.0.0.2 | 127.0.0.1 | ICEP | 136 Reply(20): Success |
| 412 | 10.658996048 | 127.0.0.1 | 127.0.0.2 | ICEP | 113 Request(21): contactdb.shutdown() |

Frame 411: 136 bytes on wire (1088 bits), 136 bytes captured (1088 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.2, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 10000, Dst Port: 60348, Seq: 725, Ack: 1175, Len: 70

Internet Communications Engine Protocol

- Magic Number: IceP
- Protocol Major: 1
- Protocol Minor: 0
- Encoding Major: 1
- Encoding Minor: 0
- Message Type: Reply (2)
- Compression Status: Uncompressed, sender cannot accept a compressed reply (0)
- **Message Size: 70**

Reply Message Body

- Request Identifier: 20
- Reply Status: Success (0)
- Reported reply data: 33000000010101250f3a3a44656d6f3a3a436f6e7461637404616e6e650c01150c343536...

| | |
|------|-------------------|
| 0000 | 00 00 00 00 00 00 |
| 0010 | 00 7a 40 d |
| 0020 | 00 01 27 1 |
| 0030 | 02 00 fe 6 |
| 0040 | 5c 20 49 6 |
| 0050 | 14 00 00 00 |
| 0060 | 44 65 6d 6 |
| 0070 | 6e 65 0c 0 |
| 0080 | 32 33 1a 0 |

Rysunek 20: Wynik zapytania o wszystkie dane Anne po aktualizacji

I tutaj nie ma zmian, czyli wszystko działa poprawnie.

3 gRPC

W przypadku *protobuf* w wersji 3 wszystkie pola są opcjonalne (w wersji 2 dzieliły się na *optional* oraz *required*). Jednak modyfikator pola ten nadal istnieje i pozwala na sprawdzenie, czy wartość została explicitely ustawiiona. Dzięki dodaniu go do pola wygeneruje nam się funkcja sprawdzającą typu *hasFieldName*. Dodatkowo, jeśli nie ustawimy wartości tego pola, to będzie ono zwracało domyślną wartość i nie będzie serializowane.

Nasz interfejs IDL wygląda identycznie jak w zadaniu A2:

```
syntax = "proto3";

option java_multiple_files = true;
option java_package = "io.grpc.examples.weather";
option java_outer_classname = "WeatherProto";
option objc_class_prefix = "WTH";

package weather;

service WeatherSubscription {
    rpc subscribe(SubscriptionRequest) returns (stream SubscriptionResponse) {}
}

enum WeatherInformation {
    Temperature = 0;
    Humidity = 1;
}
```

```

message SubscriptionRequest {
    repeated WeatherInformation weather_information = 1;
    optional sint32 min_temperature = 2;
    optional sint32 max_temperature = 3;
    optional int32 min_humidity = 4;
    optional int32 max_humidity = 5;
}

message SubscriptionResponse {
    repeated WeatherInformation weather_information = 1;
    string country = 2;
    optional sint32 temperature = 3;
    optional int32 humidity = 4;
}

```

Serwer też wygląda identycznie z tą różnicą, że na potrzeby tego dema z danych Polski usuniemy temperaturę, z Niemiec usuniemy wilgotność powietrza, z Hiszpanii nazwę kraju (która nie jest oznaczona jako *optional*):

```

package io.grpc.examples.weather;

import io.grpc.*;
import io.grpc.stub.StreamObserver;

import java.io.IOException;
import java.util.*;
import java.util.concurrent.TimeUnit;
import java.util.logging.Logger;
import java.util.concurrent.ThreadLocalRandom;

public class WeatherServer {
    private static final Logger logger = Logger.getLogger(WeatherServer.class.getName());

    private final int port;
    private final Server server;

    /** Create a Weather server using serverBuilder as a base and features as data. */
    public WeatherServer(int port) {
        ServerBuilder<?> serverBuilder = Grpc.newServerBuilderForPort(port, InsecureServerCredentials.create());
        this.port = port;
        server = serverBuilder.addService(new WeatherService(new LinkedList<>()))
            .build();
    }

    /** Start serving requests. */
    public void start() throws IOException {
        server.start();
        logger.info("Server started, listening on " + port);
        Runtime.getRuntime().addShutdownHook(new Thread(() -> {
            // Use stderr here since the logger may have been reset by its JVM shutdown hook.
            System.err.println("*** shutting down gRPC server since JVM is shutting down");
            try {
                WeatherServer.this.stop();
            } catch (InterruptedException e) {
                e.printStackTrace(System.err);
            }
            System.err.println("*** server shut down");
        }));
    }

    /** Stop serving requests and shutdown resources. */
    public void stop() throws InterruptedException {
        if (server != null) {
            server.shutdown().awaitTermination(30, TimeUnit.SECONDS);
        }
    }

    /**
     * Await termination on the main thread since the grpc library uses daemon threads.
     */
    private void blockUntilShutdown() throws InterruptedException {
        if (server != null) {
            server.awaitTermination();
        }
    }
}

```

```

/**
 * Main method. This comment makes the linter happy.
 */
public static void main(String[] args) throws Exception {
    WeatherServer server = new WeatherServer(50051);
    server.start();
    server.blockUntilShutdown();
}

private static class WeatherService extends WeatherSubscriptionGrpc.WeatherSubscriptionImplBase {
    private final Collection<SubscriptionResponse> subscriptionResponses;

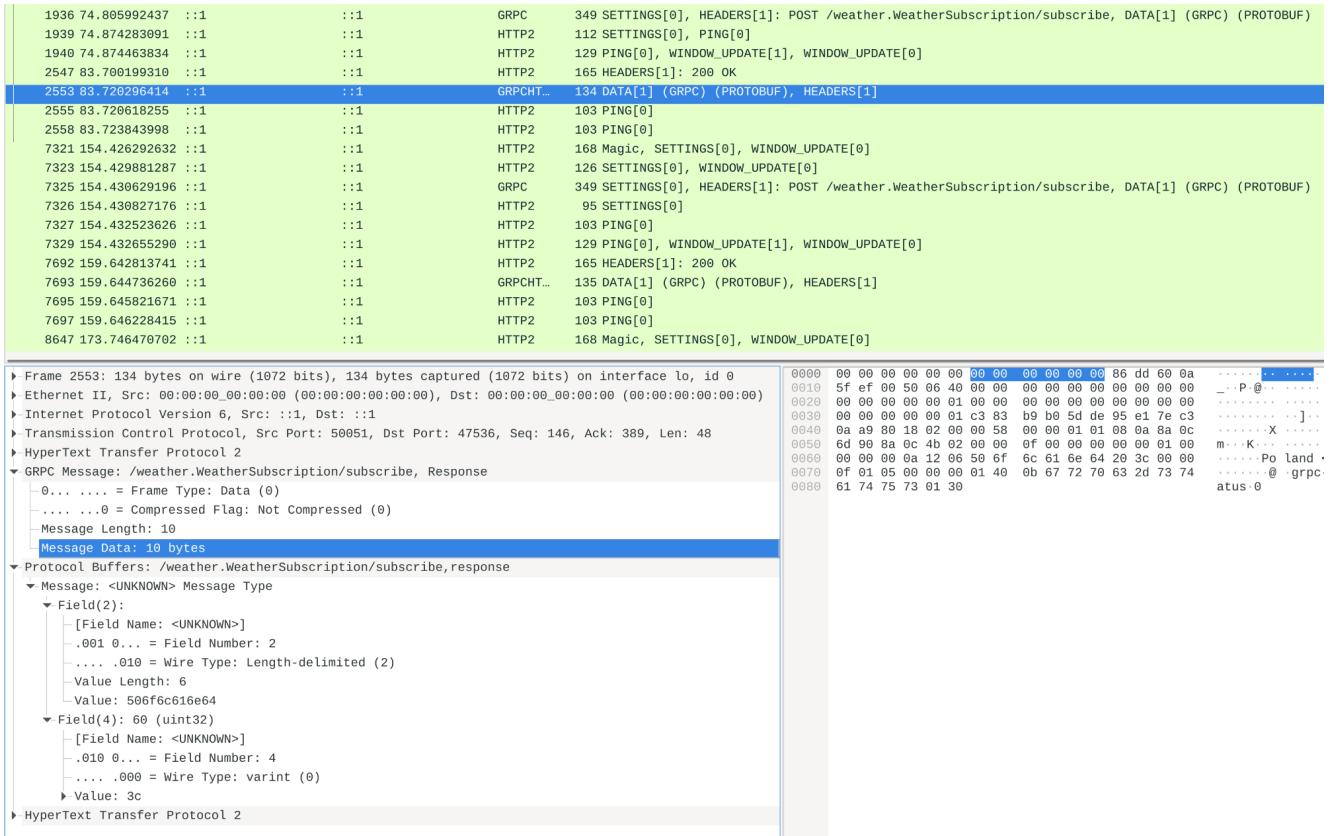
    WeatherService(Collection<SubscriptionResponse> subscriptionResponses) {
        this.subscriptionResponses = subscriptionResponses;
        SubscriptionResponse weatherInPoland = SubscriptionResponse.newBuilder().setCountry("Poland").
setHumidity(60).build();
        SubscriptionResponse weatherInGermany = SubscriptionResponse.newBuilder().setCountry("Germany").
setTemperature(10).build();
        SubscriptionResponse weatherInSpain = SubscriptionResponse.newBuilder().setTemperature(35).setHumidity
(20).build();
        subscriptionResponses.add(weatherInPoland);
        subscriptionResponses.add(weatherInGermany);
        subscriptionResponses.add(weatherInSpain);
    }

    @Override
    public void subscribe(SubscriptionRequest request, StreamObserver<SubscriptionResponse> response) {
        for (SubscriptionResponse responseWeatherInformation : subscriptionResponses) {
            int requestWeatherInformationTypes = request.getWeatherInformationCount();
            if (requestWeatherInformationTypes == 0) {
                response.onError(Status.INVALID_ARGUMENT.withDescription("You must set at least one of the
weather information types.").asException());
            }
            int satisfiedRequestWeatherInformationTypes = 0;
            for (WeatherInformation requestWeatherInformationType : request.getWeatherInformationList()) {
                if (requestWeatherInformationType == WeatherInformation.Temperature) {
                    if (request.hasMinTemperature() && request.hasMaxTemperature()) {
                        if (request.getMinTemperature() <= responseWeatherInformation.getTemperature() &&
request.getMaxTemperature() >= responseWeatherInformation.getTemperature()) {
                            ++satisfiedRequestWeatherInformationTypes;
                        } else {
                            break;
                        }
                    } else if (request.hasMinTemperature()) {
                        if (request.getMinTemperature() <= responseWeatherInformation.getTemperature()) {
                            ++satisfiedRequestWeatherInformationTypes;
                        } else {
                            break;
                        }
                    } else if (request.hasMaxTemperature()) {
                        if (request.getMaxTemperature() >= responseWeatherInformation.getTemperature()) {
                            ++satisfiedRequestWeatherInformationTypes;
                        } else {
                            break;
                        }
                    } else {
                        response.onError(Status.INVALID_ARGUMENT.withDescription("You must set at least one of
the following: 'min_temperature', 'max_temperature'.").asException());
                    }
                } else if (requestWeatherInformationType == WeatherInformation.Humidity) {
                    if (request.hasMinHumidity() && request.hasMaxHumidity()) {
                        if (request.getMinHumidity() <= responseWeatherInformation.getHumidity() &&
request.getMaxHumidity() >= responseWeatherInformation.getHumidity()) {
                            ++satisfiedRequestWeatherInformationTypes;
                        } else {
                            break;
                        }
                    } else if (request.hasMinHumidity()) {
                        if (request.getMinHumidity() <= responseWeatherInformation.getHumidity()) {
                            ++satisfiedRequestWeatherInformationTypes;
                        } else {
                            break;
                        }
                    } else if (request.hasMaxHumidity()) {
                        if (request.getMaxHumidity() >= responseWeatherInformation.getHumidity()) {
                            ++satisfiedRequestWeatherInformationTypes;
                        } else {
                            break;
                        }
                    }
                }
            }
        }
    }
}

```

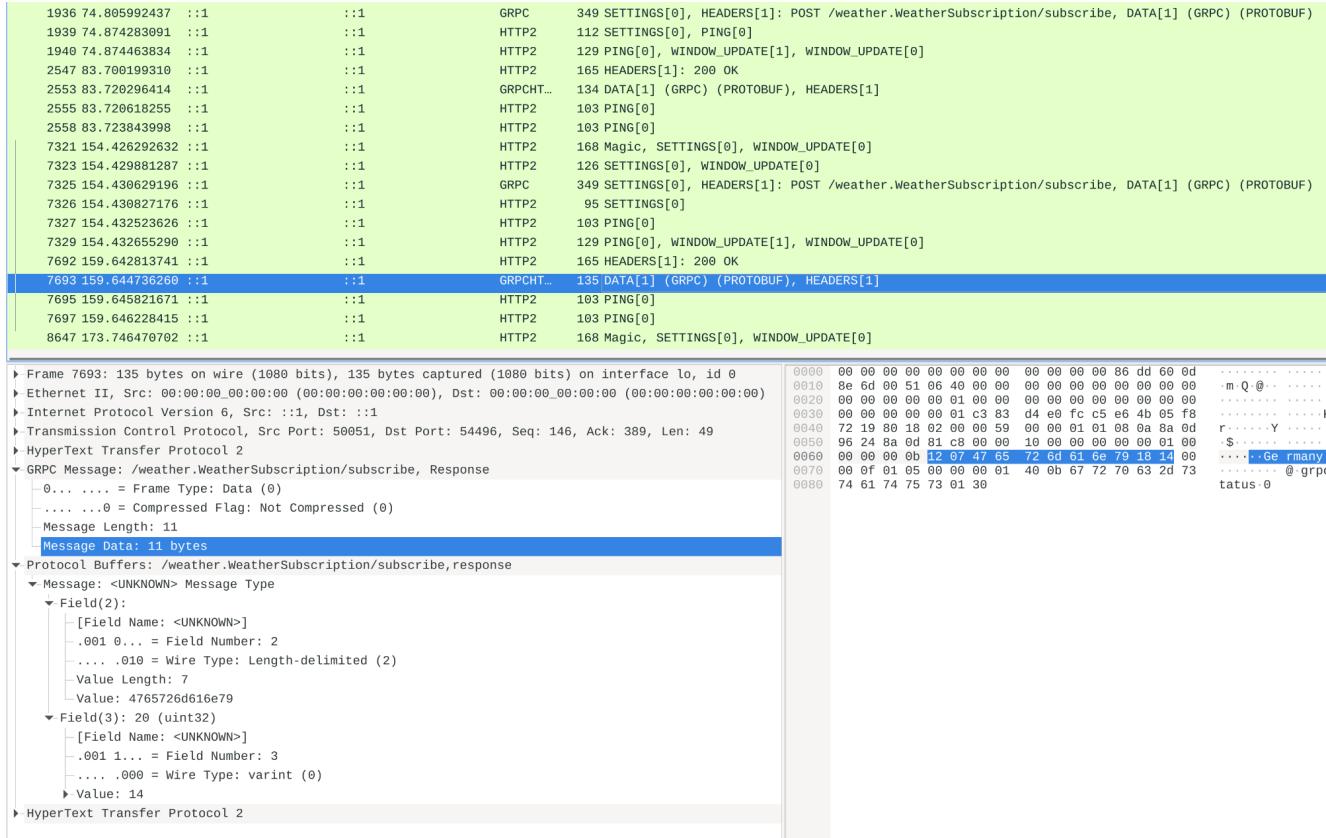
```
        }
    } else {
        response.onError(Status.INVALID_ARGUMENT.withDescription("You must set at least one of
the following: 'min_humidity', 'max_humidity'.").asException());
    }
}
if (requestWeatherInformationTypes == satisfiedRequestWeatherInformationTypes) {
    // Simulate server response
    try {
        Thread.sleep(ThreadLocalRandom.current().nextInt(5_000, 10_000 + 1));
        response.onNext(responseWeatherInformation);
    } catch (InterruptedException exception) {
        exception.printStackTrace();
    }
}
}
response.onCompleted();
}
}
```

Najpierw wyślijmy zapytanie o Polskę:



Rysunek 21: Wynik zapytania o Polskę

W przypadku temperatury typ pola to `signed int`, więc oszczędność powinna być większa niż w przypadku typów bez znaku. Zobacz, czy sprawdzi się to dla Niemiec:



Rysunek 22: Wynik zapytania o Niemcy

Typ wilgotności powietrza to liczba całkowita bez znaku, przez co otrzymujemy wartość większą o 1, czyli wszystko się zgadza.

Pozostaje przetestować największą oszczędność, czyli brak nazwy kraju w przypadku Hiszpanii:

```

7325 154.430629196 ::1      ::1      GRPC      349 SETTINGS[0], HEADERS[1]: POST /weather.WeatherSubscription/subscribe, DATA[1] (GRPC) (PROTOBUF)
7326 154.430827176 ::1      ::1      HTTP2      95 SETTINGS[0]
7327 154.432523626 ::1      ::1      HTTP2      103 PING[0]
7329 154.432655290 ::1      ::1      HTTP2      129 PING[0], WINDOW_UPDATE[1], WINDOW_UPDATE[0]
7692 159.642813741 ::1      ::1      HTTP2      165 HEADERS[1]: 200 OK
7693 159.644736260 ::1      ::1      GRPCHT... 135 DATA[1] (GRPC) (PROTOBUF), HEADERS[1]
7695 159.645821671 ::1      ::1      HTTP2      103 PING[0]
7697 159.646228415 ::1      ::1      HTTP2      103 PING[0]
8647 173.746470702 ::1      ::1      HTTP2      168 Magic, SETTINGS[0], WINDOW_UPDATE[0]
8649 173.750085295 ::1      ::1      HTTP2      126 SETTINGS[0], WINDOW_UPDATE[0]
8656 173.750780063 ::1      ::1      GRPC      347 SETTINGS[0], HEADERS[1]: POST /weather.WeatherSubscription/subscribe, DATA[1] (GRPC) (PROTOBUF)
8657 173.750966789 ::1      ::1      HTTP2      95 SETTINGS[0]
8658 173.752054299 ::1      ::1      HTTP2      103 PING[0]
8660 173.752231017 ::1      ::1      HTTP2      129 PING[0], WINDOW_UPDATE[1], WINDOW_UPDATE[0]
9048 179.572398676 ::1      ::1      GRPCHT... 207 HEADERS[1]: 200 OK, DATA[1] (GRPC) (PROTOBUF), HEADERS[1]
9049 179.572760877 ::1      ::1      HTTP2      103 PING[0]
9051 179.573102378 ::1      ::1      HTTP2      103 PING[0]

▶ Frame 9048: 207 bytes on wire (1656 bits), 207 bytes captured (1656 bits) on interface lo, id 0
▶ Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)
▶ Internet Protocol Version 6, Src: ::1, Dst: ::1
▶ Transmission Control Protocol, Src Port: 50051, Dst Port: 42512, Seq: 67, Ack: 387, Len: 121
▶ HyperText Transfer Protocol 2
▶ HyperText Transfer Protocol 2
▶ GRPC Message: /weather.WeatherSubscription/subscribe, Response
  - 0... ... = Frame Type: Data (0)
  - .... .0 = Compressed Flag: Not Compressed (0)
  - Message Length: 4
  - Message Data: 4 bytes
Protocol Buffers: /weather.WeatherSubscription/subscribe, response
  - Message: <UNKNOWN> Message Type
    - Field(3): 70 (uint32)
      [Field Name: <UNKNOWN>]
      - .001 1... = Field Number: 3
      - .... .000 = Wire Type: varint (0)
    - Value: 46
    - Field(4): 20 (uint32)
      [Field Name: <UNKNOWN>]
      - .010 0... = Field Number: 4
      - .... .000 = Wire Type: varint (0)
    - Value: 14
HyperText Transfer Protocol 2

```

Rysunek 23: Wynik zapytania o Hiszpanię

Jak widać, oszczędność jest ogromna, ale nic w tym dziwnego, gdyż jest to „najcięższy” typ.

4 Wnioski

Używanie wartości *optional* zdecydowanie się opłaca. Przy zmiennych o dużych wartościach, jak np. numer telefonu, możemy zaoszczędzić bardzo dużo miejsca zarówno przy wywoływaniu funkcji, jak i przy odbiorze wartości. W sytuacji dużych systemów umiejętne korzystanie z nich z pewnością pozytywnie wpłynie na skalowalność systemu, choć należy pamiętać o pewnych ograniczeniach, jak np. *overhead* w Zeroc ICE, który możemy jednak minimalizować, m.in. ustawiając wartość tagu na niewiększą niż 29.