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# Opcjonalne wartości struktur danych i argumenty wywołania middleware

#### 1. ICE

W przypadku niektórych technologii middleware, takich jak ICE, domyślnie wszystkie pola w strukturach i jako argumenty są wymagane. Aby oznaczyć pole jako opcjonalne, należy zdefiniować je jako "optional" wraz z tagiem. Jeśli wartość opcjonalna nie jest ustawiona (ma wartość domyślną lub jest niezainicjowana), to nie jest przekazywana wraz z przestrzenią nazw (np. w nagłówku komunikatu). W tym przypadku nie ma potrzeby przekazywania tagu do przestrzeni nazw, ponieważ wartość jest znana i stała.

Jeśli jednak wartość opcjonalna jest ustawiona, to jej tag jest przekazywany wraz z wartością do przestrzeni nazw. Dzięki temu odbiorca wiadomości wie, że wartość jest opcjonalna i może ją obsłużyć w odpowiedni sposób.

Dzięki takiemu mechanizmowi, nieustawione pola opcjonalne są pominięte podczas serializacji i nie są wysyłane przez sieć. Natomiast pola, których wartości opcjonalne są ustawione dodają dodatkowy narzut, aby oznaczyć pole jako ustawione.

W Wireshark można zaobserwować różnice w rozmiarze pakietów sieciowych, gdy pole opcjonalne jest ustawione i gdy nie jest. W przypadku braku ustawienia wartości opcjonalnej, pole to nie jest wysyłane przez sieć, co prowadzi do mniejszego rozmiaru pakietu.

Przykładowy IDL, który posłuży do testów:

```
module Bookstore
    class BookOptional
        string title;
        string author;
        optional(1) int year;
    };
    class BookNoOptional
        string title;
        string author;
        int year;
    };
    interface BookstoreService
        bool addBookOptional(string title, string author, optional(1) int year);
        bool addBookNoOptional(string title, string author, int year);
        bool addBookStructOptional(BookOptional book);
        bool addBookStructNoOptional(BookNoOptional book);
    };
```

### Uruchamiamy kod testujący:

```
// Just arguments
boolean res1 = service.addBookNoOptional( title: "Harry Potter", author: "J.K Rowling", year: 1997);
System.out.println(res1);

boolean res2 = service.addBookOptional( title: "Harry Potter", author: "J.K Rowling", java.util.OptionalInt.empty());
System.out.println(res2);

boolean res3 = service.addBookOptional( title: "Harry Potter", author: "J.K Rowling", year: 1997);
System.out.println(res3);

// Structs
boolean res4 = service.addBookStructNoOptional(new BookNoOptional ( title: "Harry Potter", author: "J.K Rowling", year: 1997));
System.out.println(res4);

boolean res5 = service.addBookStructOptional(new BookOptional( title: "Harry Potter", author: "J.K Rowling"));
System.out.println(res5);

boolean res6 = service.addBookStructOptional(new BookOptional( title: "Harry Potter", author: "J.K Rowling", year: 1997));
System.out.println(res6);
```

### W Wiresharku analizujemy pakiety:

, i	p.addr == 127.0.0.2					<b>⋈</b> → +
No.	Time	Source	Destination	Protocol	Length	Info
	688 31.776091	127.0.0.1	127.0.0.2	TCP	44	1992 → 10000 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
	741 33.820730	127.0.0.1	127.0.0.2	TCP	56	2020 → 10000 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=4 SAG
	742 33.820812	127.0.0.2	127.0.0.1	TCP	56	10000 → 2020 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=654
	743 33.820846	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=1 Ack=1 Win=131072 Len=0
	744 33.821309	127.0.0.2	127.0.0.1	ICEP	58	Validate connection
	745 33.821349	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=1 Ack=15 Win=131056 Len=0
	750 33.861341	127.0.0.1	127.0.0.2	ICEP	120	Request(1): bookstore.ice_isA()
	751 33.861402	127.0.0.2	127.0.0.1	TCP	44	10000 → 2020 [ACK] Seq=15 Ack=77 Win=130996 Len=0
	752 33.861609	127.0.0.2	127.0.0.1	ICEP	70	Reply(1): Success
	753 33.861631	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=77 Ack=41 Win=131032 Len=0
	754 33.867160	127.0.0.1	127.0.0.2	ICEP	129	Request(2): bookstore.addBookNoOptional()
	755 33.867226	127.0.0.2	127.0.0.1	TCP	44	10000 → 2020 [ACK] Seq=41 Ack=162 Win=130908 Len=0
	756 33.868010	127.0.0.2	127.0.0.1	ICEP	70	Reply(2): Success
	757 33.868079	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=162 Ack=67 Win=131004 Len=0
	758 33.871007	127.0.0.1	127.0.0.2	ICEP	123	Request(3): bookstore.addBookOptional()
	759 33.871056	127.0.0.2	127.0.0.1	TCP	44	10000 → 2020 [ACK] Seq=67 Ack=241 Win=130832 Len=0
	760 33.871633	127.0.0.2	127.0.0.1	ICEP	70	Reply(3): Success
	761 33.871685	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=241 Ack=93 Win=130980 Len=0
	762 33.874333	127.0.0.1	127.0.0.2	ICEP	128	Request(4): bookstore.addBookOptional()
	763 33.874386	127.0.0.2	127.0.0.1	TCP	44	10000 → 2020 [ACK] Seq=93 Ack=325 Win=130748 Len=0
	764 33.874873	127.0.0.2	127.0.0.1	ICEP	70	Reply(4): Success
	765 33.874905	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=325 Ack=119 Win=130952 Len=0
	766 33.885367	127.0.0.1	127.0.0.2	ICEP	165	Request(5): bookstore.addBookStructNoOptional()
	767 33.885448	127.0.0.2	127.0.0.1	TCP	44	10000 → 2020 [ACK] Seq=119 Ack=446 Win=130624 Len=0
	768 33.886286	127.0.0.2	127.0.0.1	ICEP	70	Reply(5): Success
	769 33.886326	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=446 Ack=145 Win=130928 Len=0
	770 33.889546	127.0.0.1	127.0.0.2	ICEP	157	Request(6): bookstore.addBookStructOptional()
	771 33.889584	127.0.0.2	127.0.0.1	TCP	44	10000 → 2020 [ACK] Seq=145 Ack=559 Win=130512 Len=0
	772 33.890362	127.0.0.2	127.0.0.1	ICEP	70	Reply(6): Success
	773 33.890391	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=559 Ack=171 Win=130900 Len=0
	774 33.892788	127.0.0.1	127.0.0.2	ICEP	163	Request(7): bookstore.addBookStructOptional()
	775 33.892837	127.0.0.2	127.0.0.1	TCP	44	10000 → 2020 [ACK] Seq=171 Ack=678 Win=130392 Len=0
	776 33.893828	127.0.0.2	127.0.0.1	ICEP	70	Reply(7): Success
	777 33.893867	127.0.0.1	127.0.0.2	TCP	44	2020 → 10000 [ACK] Seq=678 Ack=197 Win=130876 Len=0

### 1. Argumenty

- Podanie wszystkich argumentów do metody addBookNoOptional TCP Payload wynosi 85 bajtów.
   Input parameters size wynosi 35 bajtów.
- Nie podanie opcjonalnego argumentu do metody addBookOptional TCP Payload wynosi 79 bajtów.
   Input parameters size wynosi 31 bajtów.
- Podanie wszystkich argumentów do metody addBookOptional TCP Payload wynosi 84 bajtów.
   Input parameters size wynosi 36 bajtów.

#### 2. Struktury

- Podanie wszystkich argumentów do metody addBookStructNoOptional TCP Payload wynosi 121 bajtów.
   Input parameters size wynosi 65 bajtów.
- Nie podanie opcjonalnego argumentu do metody addBookStructOptional
   TCP Payload wynosi 113 bajtów.
   Input parameters size wynosi 59 bajtów.
- Podanie wszystkich argumentów do metody addBookStructOptional TCP Payload wynosi 119 bajtów.
   Input parameters size wynosi 65 bajtów.

Z powyższych wyników wynika, że używanie opcjonalnych pól w technologiach middleware, takich jak ICE, może pomóc zmniejszyć rozmiar pakietów sieciowych, co prowadzi do efektywniejszego przesyłania danych. W przypadku gdy wartość opcjonalna nie jest ustawiona, pole to jest pomijane podczas serializacji i nie jest wysyłane przez sieć, co prowadzi do mniejszego rozmiaru pakietu. Natomiast w przypadku gdy wartość opcjonalna jest ustawiona, jej tag jest przekazywany wraz z wartością do przestrzeni nazw, co pozwala na obsłużenie jej przez odbiorcę w odpowiedni sposób. W ten sposób narzut na oznaczenie pola jako ustawione jest minimalny.

#### 2. Thrift

W przypadku Apache Thrift, opcjonalne wartości można używać tylko w strukturach danych IDL. Można je zdefiniować przy pomocy słowa kluczowego "optional". W przypadku argumentów nie da się utworzyć pól opcjonalnych. Niezależnie od tego, czy opcjonalne parametry są ustawione, czy nie, rozmiar przesyłanych danych pozostanie taki sam. Nie są natomiast tutaj używane tagi tak jak w przypadku Ice.

Przykładowy IDL

```
namespace java genjava
namespace py genpython

struct BookOptional {
    1: string title,
    2: string author,
    3: optional i32 year,
}

struct BookNoOptional {
    1: string title,
    2: string author,
    3: i32 year,
}

service BookstoreService {
    bool addBookOptional(1:string title, 2: string author, 3: optional i32 year);
    bool addBookNoOptional(1:string title, 2: string author, 3: i32 year);
    bool addBookStructOptional(1: BookNoOptional book);
    bool addBookStructNoOptional(1: BookNoOptional book);
}
```

# Uruchamiamy kod testujący:

```
BookNoOptional bookNoOptional = new BookNoOptional();
bookNoOptional.setTitle("Harry Potter");
bookNoOptional.setAuthor("J.K. Rowling");
bookNoOptional.setYear(1997);
boolean res1 = client.addBookStructNoOptional(bookNoOptional);
System.out.println(res1);
BookOptional bookOptionalNotSet = new BookOptional();
bookNoOptional.setTitle("Harry Potter");
bookNoOptional.setAuthor("J.K. Rowling");
boolean res2 = client.addBookStructOptional(bookOptionalNotSet);
System.out.println(res2);
BookOptional bookOptionalSet = new BookOptional();
bookOptionalSet.setTitle("Harry Potter");
bookOptionalSet.setAuthor("J.K. Rowling");
bookOptionalSet.setYear(1997);
boolean res3 = client.addBookStructOptional(bookOptionalSet);
System.out.println(res3);
```

### W Wiresharku analizujemy pakiety:

No.	Т	lime	Source	Destination	Protocol	Length Info
		4.395860	127.0.0.1	127.0.0.2	TCP	56 3036 → 9090 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SACK PERM
		4.395971	127.0.0.2	127.0.0.1	TCP	56 9090 → 3036 [SYN, ACK] Seg=0 Ack=1 Win=65535 Len=0 MSS=65495 WS=256 SACK PERM
	1333 2	4.396016	127.0.0.1	127.0.0.2	TCP	44 3036 → 9090 [ACK] Seg=1 Ack=1 Win=2619648 Len=0
	1334 2	4.439604	127.0.0.1	127.0.0.2	THRIFT	129 CALL addBookStructNoOptional
	1335 2	4.439653	127.0.0.2	127.0.0.1	TCP	44 9090 → 3036 [ACK] Seg=1 Ack=86 Win=2619648 Len=0
	1336 2	4.440520	127.0.0.2	127.0.0.1	THRIFT	134 EXCEPTION addBookStructNoOptional
	1337 2	4.440564	127.0.0.1	127.0.0.2	TCP	44 3036 → 9090 [ACK] Seq=86 Ack=91 Win=2619648 Len=0
L	1351 2	4.950130	127.0.0.1	127.0.0.2	TCP	44 3036 → 9090 [RST, ACK] Seq=86 Ack=91 Win=0 Len=0
	2708 8	35.266462	127.0.0.1	127.0.0.2	TCP	56 3050 → 9090 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM
	2709 8	5.266518	127.0.0.2	127.0.0.1	TCP	56 9090 + 3050 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM
	2710 8	5.266595	127.0.0.1	127.0.0.2	TCP	44 3050 → 9090 [ACK] Seq=1 Ack=1 Win=2619648 Len=0
	2711 8	5.302066	127.0.0.1	127.0.0.2	THRIFT	129 CALL addBookStructNoOptional
	2712 8	35.302116	127.0.0.2	127.0.0.1	TCP	44 9090 → 3050 [ACK] Seq=1 Ack=86 Win=2619648 Len=0
	2713 8	5.302312	127.0.0.2	127.0.0.1	THRIFT	134 EXCEPTION addBookStructNoOptional
	2714 8	35.302351	127.0.0.1	127.0.0.2	TCP	44 3050 → 9090 [ACK] Seq=86 Ack=91 Win=2619648 Len=0
	2740 8	5.800006	127.0.0.1	127.0.0.2	TCP	44 3050 → 9090 [RST, ACK] Seq=86 Ack=91 Win=0 Len=0
	13815 5	74.994510	127.0.0.1	127.0.0.2	TCP	56 3148 → 9090 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM
	13816 5	74.994591	127.0.0.2	127.0.0.1	TCP	56 9090 → 3148 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM
	13817 5	74.994620	127.0.0.1	127.0.0.2	TCP	44 3148 → 9090 [ACK] Seq=1 Ack=1 Win=2619648 Len=0
	13818 5	75.024329	127.0.0.1	127.0.0.2	THRIFT	129 CALL addBookStructNoOptional
	13819 5	75.024364	127.0.0.2	127.0.0.1	TCP	44 9090 → 3148 [ACK] Seq=1 Ack=86 Win=2619648 Len=0
	13820 5	75.025043	127.0.0.2	127.0.0.1	THRIFT	84 REPLY addBookStructNoOptional
	13821 5	75.025079	127.0.0.1	127.0.0.2	TCP	44 3148 → 9090 [ACK] Seq=86 Ack=41 Win=2619648 Len=0
	13822 5	75.042421	127.0.0.1	127.0.0.2	THRIFT	82 CALL addBookStructOptional
	13823 5	75.042455	127.0.0.2	127.0.0.1	TCP	44 9090 → 3148 [ACK] Seq=41 Ack=124 Win=2619648 Len=0
	13824 5	75.043127	127.0.0.2	127.0.0.1	THRIFT	82 REPLY addBookStructOptional
	13825 5	75.043160	127.0.0.1	127.0.0.2	TCP	44 3148 → 9090 [ACK] Seq=124 Ack=79 Win=2619648 Len=0
		75.049680	127.0.0.1	127.0.0.2	THRIFT	127 CALL addBookStructOptional
		75.049743	127.0.0.2	127.0.0.1	TCP	44 9090 → 3148 [ACK] Seq=79 Ack=207 Win=2619648 Len=0
		75.050265	127.0.0.2	127.0.0.1	THRIFT	82 REPLY addBookStructOptional
		75.050303	127.0.0.1	127.0.0.2	TCP	44 3148 → 9090 [ACK] Seq=207 Ack=117 Win=2619648 Len=0
		75.050645	127.0.0.1	127.0.0.2	TCP	44 3148 → 9090 [FIN, ACK] Seq=207 Ack=117 Win=2619648 Len=0
		75.050681	127.0.0.2	127.0.0.1	TCP	44 9090 → 3148 [ACK] Seq=117 Ack=208 Win=2619648 Len=0
		75.050769	127.0.0.2	127.0.0.1	TCP	44 9090 → 3148 [FIN, ACK] Seq=117 Ack=208 Win=2619648 Len=0
	13833 5	75.050790	127.0.0.1	127.0.0.2	TCP	44 3148 → 9090 [ACK] Seq=208 Ack=118 Win=2619648 Len=0

#### 1. Struktury

- Podanie wszystkich argumentów do metody addBookStructNoOptional
  - TCP Payload wynosi 85 bajtów.
  - Thrift Protocol Call length wynosi 23 bajty.
- Nie podanie opcjonalnego argumentu do metody addBookStructOptional
  - TCP Payload wynosi 76 bajtów.
  - Thrift Protocol Call length wynosi 21 bajty.
- Podanie wszystkich argumentów do metody addBookStructOptional TCP Payload wynosi 83 bajtów.
  - Thrift Protocol Call length wynosi 21 bajty.

## 3. gRPC

W przypadku gRPC opcjonalne wartości w strukturach danych (messsages) definiowane są przy pomocy słowa kluczowego "optional" w proto3, który pozwala na definiowanie pól jako "opcjonalnych. Opcjonalne pola nie muszą być ustawione, co oznacza, że nie będą one serializowane i przesyłane w sieci, jeśli ich wartość nie została ustawiona.

#### Przykładowy IDL:

```
pmessage AddBookOptionalRequest {
    string title = 1;
    string author = 2;
    optional int32 year = 3;
}

pmessage AddBookNoOptionalRequest {
    string title = 1;
    string author = 2;
    int32 year = 3;
}

pmessage AddBookResponse {
    bool response = 1;
}

pservice BookstoreService {
    rpc AddBookOptional(AddBookOptionalRequest) returns (AddBookResponse);
    rpc AddBookNoOptional(AddBookNoOptionalRequest) returns (AddBookResponse);
}
```

### Uruchamiamy kod testujący:

## W Wiresharku analizujemy pakiety:

Top   15.98826   127.8.8.1   127.8.8.2   TCP   55.4924 + 9998   SWI] Send Mine 15535 Lend MSS-65495 MS-256 SACK_PERM   738 15.980737   127.8.8.1   127.8.8.2   TCP   44.4204 + 9998   ACKI   Send Arch   Mine 5535 Lend MSS-65495 MS-256 SACK_PERM   731 15.986777   127.8.0.1   127.8.0.2   TCP   44.4204 + 9998   ACKI   Send Arch   Mine 5535 Lend MSS-65495 MS-256 SACK_PERM   733 15.915861   127.8.0.1   127.8.0.2   TCP   44.4204 + 9998   ACKI   Send Arch   Mine 2619648 Lend   734 15.915861   127.8.0.1   127.8.0.2   HTTP2   14.44204 + 9998   ACKI   Send Arch   Mine 2619648 Lend   734 15.915861   127.8.0.1   127.8.0.2   HTTP2   14.44204 + 9998   ACKI   Send Arch   Mine 2619648 Lend   735 15.91561   127.8.0.2   127.8.0.1   HTTP2   53.58TTIMS[8]   MINDOW_UPDATE[8]   MINDOW_UPDATE[8]   737 15.915868   127.8.0.1   127.8.0.2   TCP   44.4204   ACKI   Send Arch   Mine 2619648 Lend   ACKI   Send Arch   ACKI   A			, , , ,		
731 15.088777 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-1 Ack-1 Min-2619648 Len-0 732 15.915801 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-1 Ack-47 Min-2619648 Len-0 733 15.915801 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-1 Ack-47 Min-2619648 Len-0 733 15.931561 127.0.0.1 127.0.0.2 HTTP2 114 Magic, SETTIMS(9), MINDOM_UPDATE(9) 735 15.931561 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 (Seq-47 Ack-17 Min-2619648 Len-0 736 15.931668 127.0.0.2 127.0.0.1 HTTP2 35 SETTIMS(9) 737 15.931668 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-71 Ack-56 Min-2619648 Len-0 738 15.083792 127.0.0.1 127.0.0.2 HTTP2 35 SETTIMS(9) 739 15.08323 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq-76 Ack-80 Min-2619648 Len-0 742 16.001269 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq-76 Ack-80 Min-2619648 Len-0 743 16.001259 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq-76 Ack-80 Min-2619648 Len-0 744 16.002884 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq-76 Ack-80 Min-261992 Len-0 745 16.002884 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq-76 Ack-80 Min-261992 Len-0 746 16.002884 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-268 Ack-258 Min-2619932 Len-0 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq-268 Ack-228 Min-2619392 Len-0 748 16.006799 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-288 Ack-230 Min-2619392 Len-0 749 16.006791 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-281 Ack-210 Min-2619392 Len-0 759 16.025251 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-213 Ack-210 Min-2619392 Len-0 750 16.070701 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-213 Ack-210 Min-2619392 Len-0 751 16.070701 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-213 Ack-210 Min-2619392 Len-0 752 16.07071 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-213 Ack-210 Min-2619392 Len-0 753 16.070701 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-213 Ack-210 Min-2619392 Len-0 754 16.070701 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-213 Ack-210 Min-2619392 Len-0 755 16.070701 127.0.0.1 127.0.0	729 15.908626	127.0.0.1	127.0.0.2	TCP	56 4204 → 9090 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM
732 15.915801 127.0.0.2 127.0.0.1 HTTP2 99 SETTIMOS[0], MINDOM_UPDATE[0] 733 15.931580 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-1 Ack-87 Win=2619648 Len-0 735 15.931591 127.0.0.1 127.0.0.2 HTTP2 114 Magic, SETTIMOS[0], MINDOM_UPDATE[0] 735 15.931561 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq-47 Ack-71 Win=2619648 Len-0 736 15.931580 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-67 Ack-71 Win=2619648 Len-0 737 15.931713 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-71 Ack-56 Win=2619648 Len-0 738 15.963823 127.0.0.1 127.0.0.2 HTTP2 35 SETTIMOS[0] 739 15.963823 127.0.0.1 127.0.0.2 HTTP2 53 SETTIMOS[0] 742 16.001260 127.0.0.1 127.0.0.2 GRPC 299 HEADERS[3]: POST /YEUTOrial.BookstoreService/AddBookNoptional, DATA[3] (GRPC) (PROTOBUF) 743 16.001259 127.0.0.1 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq-56 Ack-80 Win=26199392 Len-0 744 16.002817 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 745 16.004821 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq-85 Ack-285 Win=26199392 Len-0 746 16.004871 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq-885 Ack-73 Win=26199392 Len-0 749 16.004871 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq-885 Ack-802 Win=26199392 Len-0 749 16.004872 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-830 Ack-213 Win=2619392 Len-0 749 16.004872 127.0.0.1 127.0.0.1 TCP 44 9990 ACK] Seq-830 Ack-213 Win=2619392 Len-0 749 16.004872 127.0.0.1 127.0.0.1 TCP 44 9990 ACK] Seq-302 Ack-213 Win=2619392 Len-0 759 16.02525 127.0.0.2 127.0.0.1 TCP 44 9990 ACK] Seq-310 Ack-210 Win=2619392 Len-0 751 16.02525 127.0.0.2 127.0.0.1 TCP 44 9990 ACK] Seq-310 Ack-210 Win=2619392 Len-0 752 16.02527 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-310 Ack-210 Win=2619392 Len-0 753 16.02525 127.0.0.2 127.0.0.1 TCP 44 9990 ACK] Seq-310 Ack-210 Win=2619392 Len-0 753 16.02525 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-310 Ack-210 Win=2619392 Len-0 753 16.07070 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-310 Ack-210 Win=2619392 Len-0 753 16.070824 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq-	730 15.908730	127.0.0.2	127.0.0.1	TCP	56 9090 → 4204 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM
733 15, 915861 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 9999 [ACK] Seq-1 Ack=47 Hin=2619648 Len=0 734 15, 931561 127, 0.0.2 127, 0.0.1 TCP 44 9999 4284 [ACK] Seq-47 Ack=71 Hin=2619648 Len=0 736 15, 931568 127, 0.0.2 127, 0.0.1 HTTP2 35 SETITINS[0] 737 15, 931561 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 9999 [ACK] Seq-71 Ack=56 Win=2619648 Len=0 738 15, 931561 127, 0.0.1 127, 0.0.2 HTTP2 35 SETITINS[0] 738 15, 963392 127, 0.0.1 127, 0.0.1 TCP 44 9999 4284 [ACK] Seq-85 Ack=88 Win=2619648 Len=0 742 16, 001206 127, 0.0.1 127, 0.0.1 TCP 44 9999 4284 [ACK] Seq-85 Ack=88 Win=2619648 Len=0 742 16, 001206 127, 0.0.1 127, 0.0.1 TCP 44 9999 4284 [ACK] Seq-85 Ack=88 Win=2619648 Len=0 743 16, 001209 127, 0.0.2 127, 0.0.1 TCP 44 9999 4284 [ACK] Seq-85 Ack=88 Win=2619392 Len=0 745 16, 002844 127, 0.0.1 127, 0.0.2 TCP 44 4284 + 9999 [ACK] Seq-85 Ack=78 Win=2619392 Len=0 748 16, 0002847 127, 0.0.1 127, 0.0.2 TCP 44 4284 + 9999 [ACK] Seq-85 Ack=78 Win=2619392 Len=0 748 16, 000271 127, 0.0.2 127, 0.0.1 TCP 44 9999 4284 [ACK] Seq-85 Ack=78 Win=2619392 Len=0 749 16, 000271 127, 0.0.2 127, 0.0.1 TCP 44 4294 + 9999 [ACK] Seq-85 Ack=78 Win=2619392 Len=0 748 16, 000271 127, 0.0.2 127, 0.0.1 TCP 44 4204 + 9999 [ACK] Seq-85 Ack=78 Win=2619392 Len=0 749 16, 000271 127, 0.0.2 127, 0.0.1 TCP 44 4204 + 9999 [ACK] Seq-819 Ack=328 Win=2619392 Len=0 749 16, 000271 127, 0.0.2 127, 0.0.1 TCP 44 4204 + 9999 [ACK] Seq-819 Ack=328 Win=2619392 Len=0 749 16, 000271 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 9999 [ACK] Seq-819 Ack=328 Win=2619392 Len=0 752 16, 025251 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 9999 [ACK] Seq-819 Ack=328 Win=2619392 Len=0 753 16, 025251 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 9999 [ACK] Seq-819 Ack=328 Win=2619392 Len=0 753 16, 025251 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 9999 [ACK] Seq-819 Ack=328 Win=2619392 Len=0 753 16, 025252 127, 0.0.1 127, 0.0.1 TCP 44 9999 ACK] Seq-819 Ack=238 Win=2619392 Len=0 753 16, 025252 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 9999 [ACK] Seq-820 Ack=238 Win=2619392 Len=0 754 16, 025252 127, 0.0.1 127, 0.0.2 TCP 44 4204 + 999	731 15.908777	127.0.0.1	127.0.0.2	TCP	44 4204 → 9090 [ACK] Seq=1 Ack=1 Win=2619648 Len=0
734 15.931502 127.0.0.1 127.0.0.2 HTTP2 114 Magic, SETTINGS[0], MINDOW_UPDATE[0] 735 15.931561 127.0.0.2 127.0.0.1 TCP 44 9999 + 4204 [ACK] Seq-47 Ack-71 Min=2619648 Len=0 736 15.931513 127.0.0.1 127.0.0.2 TCP 44 4204 + 9999 [ACK] Seq-77 Ack-56 Min=2619648 Len=0 737 15.931713 127.0.0.1 127.0.0.2 TCP 44 4204 + 9999 [ACK] Seq-71 Ack-56 Min=2619648 Len=0 738 15.963792 127.0.0.1 127.0.0.2 TCP 44 9999 + 4204 [ACK] Seq-56 Ack-80 Min=2619648 Len=0 739 15.963823 127.0.0.2 127.0.0.1 TCP 44 9999 + 4204 [ACK] Seq-56 Ack-80 Min=2619648 Len=0 742 16.001260 127.0.0.1 127.0.0.2 GRPC 249 HEDBERS[3]: POST / tutorial.BookstoreService/AddBookNOOptional, DATA[3] (GRPC) (PROTOBUF) 743 16.001259 127.0.0.2 127.0.0.1 TCP 44 9999 + 4204 [ACK] Seq-56 Ack-80 Min=2619648 Len=0 744 16.002591 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 747 16.002864 127.0.0.2 127.0.0.1 TCP 44 94090 [ACK] Seq-265 Ack-80 Min=2619648 Len=0 746 16.004679 127.0.0.2 127.0.0.1 TCP 44 94090 [ACK] Seq-285 Ack-73 Min=2619648 Len=0 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9999 + 4204 [ACK] Seq-285 Ack-73 Min=2619648 Len=0 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 4204 9909 [ACK] Seq-285 Ack-73 Min=2619648 Len=0 749 16.006970 127.0.0.1 127.0.0.1 TCP 44 9999 + 4204 [ACK] Seq-285 Ack-73 Min=2619648 Len=0 749 16.006970 127.0.0.1 127.0.0.1 TCP 44 9409 + 4204 [ACK] Seq-285 Ack-280 Min=2619392 Len=0 749 16.006970 127.0.0.1 127.0.0.1 TCP 44 9409 + 4204 [ACK] Seq-213 Ack-230 Min=2619392 Len=0 750 16.005271 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-230 Ack-213 Min=2619392 Len=0 751 16.025272 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq-230 Ack-230 Min=2619392 Len=0 752 16.025327 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq-2319 Ack-230 Min=2619392 Len=0 753 16.0252517 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq-2319 Ack-230 Min=2619392 Len=0 752 16.070701 127.0.0.1 127.0.0.2 GRPC 15 HEDBERS[5]: POST / tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 753 16.070701 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq-243 Ack-2430 Min=2619392 Len=0 763	732 15.915801	127.0.0.2	127.0.0.1	HTTP2	90 SETTINGS[0], WINDOW_UPDATE[0]
735 15.931561 127.0.0.2 127.0.0.1 TCP 44 9900 + 4204 [ACK] Seq=47 Ack=71 Min=2619648 Len=0 736 15.931568 127.0.0.2 127.0.0.1 HTTP2 53 SETTIMSS[0] 737 15.931731 127.0.0.1 127.0.0.2 HTTP2 53 SETTIMSS[0] 738 15.963792 127.0.0.1 127.0.0.2 HTTP2 53 SETTIMSS[0] 739 15.963823 127.0.0.2 127.0.0.1 17.0.0.2 GRPC 249 HEADERS[3]: POST /tutorial.BookstoreService/AddBookNoOptional, DATA[3] (GRPC) (PROTOBUF) 743 16.001259 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=56 Ack=80 Min=2619548 Len=0 742 16.001259 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=56 Ack=80 Min=2619392 Len=0 743 16.002159 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=56 Ack=85 Min=2619392 Len=0 745 16.002817 127.0.0.2 127.0.0.1 TCP 44 9909 (ACK] Seq=56 Ack=85 Min=2619392 Len=0 746 16.002844 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 747 16.002847 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 748 16.006599 127.0.0.1 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=285 Ack=73 Min=2619392 Len=0 749 16.006597 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 749 16.006597 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 749 16.006597 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 4909 (ACK] Seq=302 Ack=213 Min=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 TCP 44 4204 + 9909 [ACK] Seq=302 Ack=213 Min=2619392 Len=0 753 16.02525 127.0.0.2 127.0.0.1 TCP 44 4204 + 9909 [ACK] Seq=319 Ack=220 Min=2619392 Len=0 753 16.02526 127.0.0.2 127.0.0.1 TCP 44 4204 + 9909 [ACK] Seq=319 Ack=220 Min=2619392 Len=0 753 16.02527 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=319 Ack=220 Min=2619392 Len=0 754 16.07331 127.0.0.2 127.0.0.1 TCP 44 9909 A 4204 [ACK] Seq=319 Ack=230 Min=2619392 Len=0 755 16.075311 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=319 Ack=230 Min=2619392 Len=0 756 16.075321 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=319 Ack=230 Min=2619392 Len=0 757 16.075141 127.0.0.2 127.0.0.1 GRPC1 19 HADDERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 777 16.07516 127.0.0.2 127.0.0.1 GRPC1 19 HADDERS[7]: POST /tutorial.BookstoreService/AddBookOpt	733 15.915861	127.0.0.1	127.0.0.2	TCP	44 4204 → 9090 [ACK] Seq=1 Ack=47 Win=2619648 Len=0
736 15.931688 127.0.0.2 127.0.0.1 HTTP2 53 SETTIMGS[0] 737 15.931713 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=71 Ack=56 Win=2619648 Len=0 738 15.963792 127.0.0.1 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq=56 Ack=80 Win=2619648 Len=0 742 16.001206 127.0.0.1 127.0.0.2 GRPC 249 HEADERS[3]: POST 74 Lutorial.BookstoreService/AddBookNoOptional, DATA[3] (GRPC) (PROTOBUF) 743 16.001259 127.0.0.2 127.0.0.1 TCP 44 9900 + 4204 [ACK] Seq=56 Ack=85 Win=2619392 Len=0 744 16.002817 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 745 16.002884 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 746 16.004679 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 748 16.006926 127.0.0.2 127.0.0.1 GRPCHL 184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUF), HEADERS[3], WINDOW_UPDATE[0] 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=30 Ack=30 Win=2619392 Len=0 748 16.006979 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=30 Ack=213 Min=2619392 Len=0 749 16.005979 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=30 Ack=213 Min=2619392 Len=0 759 16.025217 127.0.0.1 127.0.0.2 TCP 44 9900 + 4204 [ACK] Seq=30 Ack=213 Min=2619392 Len=0 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9900 A204 [ACK] Seq=31 Ack=319 Win=2619392 Len=0 752 16.025237 127.0.0.2 127.0.0.1 TCP 44 9900 A204 [ACK] Seq=31 Ack=319 Win=2619392 Len=0 753 16.025409 127.0.0.1 127.0.0.2 TCP 44 4204 + 9900 [ACK] Seq=310 Ack=320 Win=2619392 Len=0 754 16.070971 127.0.0.1 127.0.0.2 TCP 44 4204 + 9900 [ACK] Seq=310 Ack=320 Win=2619392 Len=0 756 16.070970 127.0.0.1 127.0.0.2 TCP 44 4204 + 9900 [ACK] Seq=310 Ack=320 Win=2619392 Len=0 756 16.070970 127.0.0.1 127.0.0.2 TCP 44 4204 + 9000 [ACK] Seq=310 Ack=320 Win=2619392 Len=0 756 16.070970 127.0.0.1 127.0.0.2 TCP 44 4204 + 9000 [ACK] Seq=320 Ack=426 Win=2619392 Len=0 757 16.070970 127.0.0.1 127.0.0.2 TCP 44 4204 + 9000 [ACK] Seq=320 Ack=426 Win=2619392 Len=0 758 16.070970 127.0.0.1 127.0.0.2 TCP 44 4204 + 9000 [ACK] Seq=320 Ack=426 Win=2619392 Len=0 757 16.070970 127.0.0.1 127.0.0.2 TCP 44 4204 + 9000 [ACK] Seq=426 Ack=230 Win=2619392 Len=0 757 16.07	734 15.931502	127.0.0.1	127.0.0.2	HTTP2	114 Magic, SETTINGS[0], WINDOW_UPDATE[0]
737 15.931713 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=71 Ack=56 Win=2619648 Len=0 738 15.963792 127.0.0.1 127.0.0.2 HTTP2 53 SETTIMS(5]0 739 15.963823 127.0.0.1 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=56 Ack=80 Win=2619648 Len=0 742 16.001260 127.0.0.1 127.0.0.2 GRPC 249 HEADERS[3]: POST /tutorial.Bookstoreservice/AddBookNloOptional, DATA[3] (GRPC) (PROTOBUF) 743 16.001259 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=56 Ack=285 Win=2619392 Len=0 744 16.002817 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 745 16.002884 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=285 Ack=73 Win=261948 Len=0 746 16.004679 127.0.0.1 127.0.0.2 TCP 44 9090 + 4204 [ACK] Seq=285 Ack=73 Win=261948 Len=0 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=73 Ack=302 Win=2619392 Len=0 749 16.006979 127.0.0.1 127.0.0.1 GRPCHT. 144 4090 + 4204 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 9090 (ACK] Seq=302 Ack=213 Win=2619392 Len=0 749 16.005171 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 752 16.025275 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 752 16.025275 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=213 Ack=310 Win=2619392 Len=0 752 16.025275 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=213 Ack=310 Win=2619392 Len=0 752 16.025275 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=213 Ack=30 Win=2619392 Len=0 752 16.070731 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=240 Win=2619392 Len=0 753 16.070731 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=240 Win=2619392 Len=0 754 16.070201 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=230 Ack=240 Win=2619392 Len=0 755 16.072072 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=230 Ack=240 Win=2619392 Len=0 756 16.072071 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=230 Ack=240 Win=2619392 Len=0 757 16.072072 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=230 Ack=240 Win=2619392 Len=0 757 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=240 Ack=240 Win=2619392 L	735 15.931561	127.0.0.2	127.0.0.1	TCP	44 9090 → 4204 [ACK] Seq=47 Ack=71 Win=2619648 Len=0
738 15.963792 127.0.0.1 127.0.0.2 HTTP2 53 SETTINGS[0] 739 15.963823 127.0.0.2 127.0.0.2 177.0.0.1 TCP 44 999 + 4204 [ACK] Seq=56 Ack=80 Win=2619648 Len=0 742 16.081266 127.0.0.2 127.0.0.2 127.0.0.1 TCP 44 999 + 4204 [ACK] Seq=56 Ack=85 Win=2619392 Len=0 743 16.081259 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 743 16.082817 127.0.0.2 127.0.0.2 TCP 44 9999 4204 [ACK] Seq=56 Ack=285 Win=2619392 Len=0 746 16.082684 127.0.0.1 127.0.0.2 TCP 44 9999 [ACK] Seq=285 Ack=73 Win=2619648 Len=0 746 16.084679 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 747 16.084721 127.0.0.2 127.0.0.1 GRPCHT. 184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUF) HEADERS[3], WINDOM_UPDATE[0] 749 16.086979 127.0.0.2 127.0.0.1 GRPCHT. 184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUF) HEADERS[3], WINDOM_UPDATE[0] 749 16.086979 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 750 16.025171 127.0.0.2 HTTP2 61 PING[0] 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=313 Ack=319 Win=2619392 Len=0 752 16.025237 127.0.0.2 127.0.0.1 TCP 44 9909 4204 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 753 16.025251 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=313 Ack=319 Win=2619392 Len=0 752 16.025251 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=313 Ack=320 Win=2619392 Len=0 753 16.025369 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=313 Ack=230 Win=2619392 Len=0 754 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.Bookstoreservice/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 753 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.Bookstoreservice/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 754 16.075201 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[7]: POST /tutorial.Bookstoreservice/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 755 16.075761 127.0.0.2 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[7]: POST /tutorial.Bookstoreservice/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 757 16.07576 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[7]: POST /tutorial.Bookstoreservice/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 777 16.07576 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909	736 15.931668	127.0.0.2	127.0.0.1	HTTP2	53 SETTINGS[0]
739 15.963823 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=56 Ack=80 Win=2619648 Len=0 742 16.001206 127.0.0.1 127.0.0.2 127.0.0.1 743 16.001259 127.0.0.2 127.0.0.1 744 16.002581 127.0.0.2 127.0.0.1 745 16.002884 127.0.0.2 127.0.0.2 TCP 44 9090 [ACK] Seq=56 Ack=285 Win=2619392 Len=0 746 16.004679 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=285 Ack=73 Win=2619392 Len=0 748 16.006926 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=73 Ack=302 Win=2619392 Len=0 749 16.006926 127.0.0.2 127.0.0.1 GRPCHT. 184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUF), HEADERS[3], WINDOM_UPDATE[0] 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=282 Ack=213 Win=2619392 Len=0 750 16.025171 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025252 127.0.0.1 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=731 Ack=302 Win=2619392 Len=0 752 16.025257 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 753 16.025252 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=313 Ack=319 Win=2619392 Len=0 752 16.025257 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025409 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 752 16.025257 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025409 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 754 16.070201 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /*tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 755 16.072071 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=2619136 Len=0 756 16.072071 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[5]: POST /*tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 757 16.075176 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=230 Ack=426 Win=2619392 Len=0 770 16.075161 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=33 Win=2619392 Len=0 771 16.075176 127.0.0.1 127.0.0.1 TCP 44 9090 [ACK] Seq=493 Ack=33 Win=2619392 Len=0 772 16.076364 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=33 Win=2619392 Len=0 7	737 15.931713	127.0.0.1	127.0.0.2	TCP	44 4204 → 9090 [ACK] Seq=71 Ack=56 Win=2619648 Len=0
742 16.001206 127.0.0.1 127.0.0.2 GRPC 249 HEADERS[3]: POST /tutorial.BookstoreService/AddBookNoOptional, DATA[3] (GRPC) (PROTOBUF) 743 16.001259 127.0.0.2 127.0.0.1 TCP 44 9909 4 2404 [ACK] Seq=266 Ack=285 Min=2619392 Len=0 745 16.002817 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 745 16.002818 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=285 Ack=38 Win=2619368 Len=0 746 16.004679 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=73 Ack=302 Win=2619392 Len=0 748 16.006996 127.0.0.2 127.0.0.1 GRPCHT. 184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUF), HEADERS[3], WINDOW_UPDATE[0] 749 16.006979 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 750 16.025171 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 752 16.025257 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 753 16.025252 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025252 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 762 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070731 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=230 Ack=426 Win=261936 Len=0 765 16.072072 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=230 Ack=426 Win=261936 Len=0 766 16.072071 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=230 Ack=426 Win=261936 Len=0 767 16.072072 127.0.0.2 127.0.0.1 TCP 44 9909 (ACK] Seq=230 Ack=426 Win=261936 Len=0 768 16.072071 127.0.0.2 127.0.0.1 TCP 44 9909 ACK] Seq=230 Ack=426 Win=261936 Len=0 769 16.072071 127.0.0.2 127.0.0.1 TCP 44 9909 ACK] Seq=230 Ack=426 Win=261936 Len=0 770 16.075141 127.0.0.2 127.0.0.1 TCP 44 9909 (ACK] Seq=230 Ack=426 Win=2619392 Len=0 770 16.075176 127.0.0.2 127.0.0.1 TCP 44 9909 ACK] Seq=230 Ack=426 Win=2619392 Len=0 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9909 ACK] Seq=230 Ack=426 Win=2619392 Len=0 772 16.075141 127.0.0.2 127.0.0.1 TCP 44 9909 ACK] Seq=240 ACK=281 Win=2619392 Len=0 773 16.076244 127.0.0.1 127.0.0.2 TCP 44 4204 + 9900	738 15.963792	127.0.0.1	127.0.0.2	HTTP2	53 SETTINGS[0]
743 16.001259 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=56 Ack=285 Win=2619392 Len=0 744 16.002817 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 745 16.002884 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 746 16.004679 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9990 [ACK] Seq=285 Ack=73 Win=2619392 Len=0 748 16.006926 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq=73 Ack=302 Win=2619392 Len=0 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 9990 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 750 16.025171 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9990 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 752 16.025225 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025225 127.0.0.2 127.0.0.1 TCP 44 9909 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 753 16.025409 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 753 16.025409 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070701 127.0.0.2 127.0.0.1 TCP 44 9090 44 [ACK] Seq=230 Ack=426 Win=2619392 Len=0 764 16.070201 127.0.0.2 127.0.0.1 GRPCHT 95 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 765 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 4204 [ACK] Seq=230 Ack=426 Win=2619392 Len=0 770 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=428 Ack=428 Win=2619392 Len=0 770 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=428 Ack=428 Win=2619392 Len=0 770 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=428 Ack=38 Win=2619392 Len=0 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=428 Ack=38 Win=2619392 Len=0 770 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=428 Ack=38 Win=2619392 Len=0 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 771 16.075176 127.0.0.1 127.0.0.2 TCP 44 4204 + 909	739 15.963823	127.0.0.2	127.0.0.1	TCP	44 9090 → 4204 [ACK] Seq=56 Ack=80 Win=2619648 Len=0
744 16.002817 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 745 16.002884 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 746 16.004679 127.0.0.1 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=285 Ack=73 Win=2619648 Len=0 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=73 Ack=302 Win=2619392 Len=0 748 16.006926 127.0.0.2 127.0.0.1 GRPCHL. 184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUP), HEADERS[3], WINDOW_UPDATE[0] 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 750 16.025171 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025252 127.0.0.2 127.0.0.1 TCP 49 909 + 4204 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025409 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 752 16.070701 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 752 16.070701 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=261936 Len=0 754 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /*tutorial.Bookstoreservice/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 753 16.070701 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=2619136 Len=0 754 16.072071 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=2619136 Len=0 755 16.072072 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=2619136 Len=0 759 16.072072 127.0.0.2 127.0.0.1 TCP 44 9090 Ack 9000 [ACK] Seq=240 Ack=281 Win=2619392 Len=0 770 16.075176 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /*tutorial.Bookstoreservice/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 4204 + 9000 [ACK] Seq=493 Ack=281 Win=2619392 Len=0 772 16.076364 127.0.0.2 127.0.0.1 TCP 44 4204 + 9000 [ACK] Seq=493 Ack=381 Win=2619392 Len=0 773 16.076424 127.0.0.2 127.0.0.1 TCP 44 4204 + 9000 [ACK] Seq=493 Ack=393 Win=2619392 Len=0 775 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9000 [ACK] Seq=493 Ack=393 Win=2619392 Len=0 776 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9000 [A	742 16.001206	127.0.0.1	127.0.0.2	GRPC	249 HEADERS[3]: POST /tutorial.BookstoreService/AddBookNoOptional, DATA[3] (GRPC) (PROTOBUF)
745 16.002884 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=285 Ack=73 Win=2619648 Len=0 746 16.004679 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=73 Ack=302 Win=2619392 Len=0 748 16.006979 127.0.0.2 127.0.0.1 127.0.0.2 TCP 44 9090 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 94090 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 750 16.025171 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9900 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 752 16.025377 127.0.0.2 127.0.0.1 TCP 44 9909 4240 [ACK] Seq=319 Ack=308 Win=2619392 Len=0 753 16.025349 127.0.0.1 127.0.0.2 TCP 44 9909 [ACK] Seq=319 Ack=2308 Win=2619392 Len=0 762 16.076701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.0769731 127.0.0.2 127.0.0.1 TCP 44 9909 4240 [ACK] Seq=230 Ack=4268 Win=2619392 Len=0 764 16.072621 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 765 16.072672 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 772 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 773 16.075176 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 773 16.075176 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=328 Win=261932 Len=0 774 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=328 Win=261932 Len=0 775 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 99090 [ACK] Seq=493 Ack=328 Win=2619392 Len=0	743 16.001259	127.0.0.2	127.0.0.1	TCP	44 9090 → 4204 [ACK] Seq=56 Ack=285 Win=2619392 Len=0
746 16.084679 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 747 16.084721 127.0.0.2 127.0.0.1 TCP 44 9999 + 4204 [ACK] Seq=73 Ack=302 Min=2619392 Len=0 748 16.086926 127.0.0.2 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=302 Ack=213 Min=2619392 Len=0 750 16.025171 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025215 127.0.0.2 127.0.0.1 TCP 44 9099 + 4204 [ACK] Seq=213 Ack=319 Min=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.02525 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=313 Ack=319 Min=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025409 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Min=2619392 Len=0 762 16.076701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.076701 127.0.0.2 127.0.0.1 TCP 44 9090 4 4204 [ACK] Seq=230 Ack=426 Min=2619392 Len=0 764 16.072021 127.0.0.2 127.0.0.1 GRPCHL 95 HEADERS[5]: 200 OK, DATA[5] (GRPC) (PROTOBUF) HEADERS[5], MINDOM_UPDATE[0] 765 16.072672 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[5]: 200 OK, DATA[5] (GRPC) (PROTOBUF), HEADERS[5], MINDOM_UPDATE[0] 767 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: 200 OK, DATA[5] (GRPC) (PROTOBUF), HEADERS[7], WINDOM_UPDATE[0] 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: 200 OK, DATA[7] (GRPC) (PROTOBUF), HEADERS[7], WINDOM_UPDATE[0] 771 16.075176 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[7]: 200 OK, DATA[7] (GRPC) (PROTOBUF), HEADERS[7], WINDOM_UPDATE[0] 772 16.076364 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=281 Ack=493 Min=2619392 Len=0 773 16.076424 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 773 16.076424 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=33 Win=2619392 Len=0 776 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=349 Win=2619392 Len=0	744 16.002817	127.0.0.2	127.0.0.1	HTTP2	61 PING[0]
747 16.004721 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=73 Ack=302 Win=2619392 Len=0 748 16.006926 127.0.0.2 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 759 16.025171 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9090   4204 [ACK] Seq=312 Ack=319 Win=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025499 127.0.0.1 127.0.0.2 TCP 44 204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 752 16.025327 127.0.0.1 127.0.0.2 TCP 44 204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 753 16.025499 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST / *tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 753 16.070731 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=261936 Len=0 754 16.070201 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 755 16.072502 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=230 Ack=426 Win=261936 Len=0 756 16.072602 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=230 Ack=426 Win=261936 Len=0 759 16.072672 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=230 Ack=426 Win=261936 Len=0 770 16.075141 127.0.0.2 GRPC 111 HEADERS[7]: POST / *tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=240 Ack=281 Win=261932 Len=0 772 16.076364 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[7]: POST / *tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 773 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=493 Ack=493 Win=261936 Len=0 774 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=493 Win=261936 Len=0 775 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=493 Win=261936 Len=0 776 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=493 Win=261936 Len=0 777 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=493 Win=261936 Len=0 777 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=493 Win=2619392 Len=0	745 16.002884	127.0.0.1	127.0.0.2	TCP	44 4204 → 9090 [ACK] Seq=285 Ack=73 Win=2619648 Len=0
748 16.006926 127.0.0.2 127.0.0.1 GRPCHT 184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUF), HEADERS[3], WINDOW_UPDATE[0] 749 16.006979 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 750 16.025225 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 752 16.025237 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025237 127.0.0.2 127.0.0.1 177.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 762 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070731 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=330 Ack=426 Win=261936 Len=0 764 16.072021 127.0.0.2 127.0.0.1 GRPCHT 95 HEADERS[5]: 200 OK, DATA[5] (GRPC) (PROTOBUF) HEADERS[5]; WINDOW_UPDATE[0] 765 16.072072 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=426 Ack=281 Win=2619392 Len=0 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 4204 + 9909 [ACK] Seq=426 Ack=281 Win=2619392 Len=0 772 16.076364 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=426 Ack=39 Win=2619392 Len=0 772 16.076364 127.0.0.2 127.0.0.1 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 773 16.076424 127.0.0.2 127.0.0.1 GRPCHT 95 HEADERS[7]: 200 OK, DATA[7] (GRPC) (PROTOBUF), HEADERS[7], WINDOW_UPDATE[0] 773 16.076424 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 774 16.112691 127.0.0.1 127.0.0.1 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 775 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=39 Win=2619392 Len=0	746 16.004679	127.0.0.1	127.0.0.2	HTTP2	61 PING[0]
749 16.006979 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=302 Ack=213 Win=2619392 Len=0 750 16.025171 127.0.0.1 127.0.0.1 177.0.0.2 HTTP2 61 PING[0] 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025409 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 762 16.087091 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.072672 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=261936 Len=0 764 16.072672 127.0.0.2 127.0.0.1 GRPCHT 95 HEADERS[5]: 200 OK, DATA[5] (GRPC) (PROTOBUF), HEADERS[5], WINDOW_UPDATE[0] 765 16.072672 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=426 Ack=281 Win=2619392 Len=0 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.1 127.0.0.1 TCP 44 9090 [ACK] Seq=4281 Ack=493 Win=2619392 Len=0 772 16.076364 127.0.0.2 127.0.0.1 TCP 44 9090 4204 [ACK] Seq=281 Ack=493 Win=2619392 Len=0 773 16.076424 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=493 Ack=332 Win=2619392 Len=0 776 16.112628 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=332 Win=2619392 Len=0 777 16.112691 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 777 16.112691 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 777 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=349 Win=2619392 Len=0	747 16.004721	127.0.0.2	127.0.0.1	TCP	44 9090 → 4204 [ACK] Seq=73 Ack=302 Win=2619392 Len=0
750 16.025171 127.0.0.1 127.0.0.2 HTTP2 61 PING[0] 751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9990 + 4204 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025329 127.0.0.1 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 762 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070731 127.0.0.2 127.0.0.1 TCP 44 9909 + 4204 [ACK] Seq=230 Ack=426 Win=261936 Len=0 764 16.072021 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[5]: 200 OK, DATA[5] (GRPC) (PROTOBUF) HEADERS[5]; WINDOW_UPDATE[0] 765 16.072072 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=240 Ack=828 Win=261936 Len=0 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9909 4 4204 [ACK] Seq=281 Ack=828 Win=261936 Len=0 772 16.075161 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 773 16.075176 127.0.0.2 127.0.0.1 TCP 44 9909 4 4204 [ACK] Seq=281 Ack=493 Win=261936 Len=0 773 16.076244 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=328 Win=2619392 Len=0 776 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=338 Win=2619392 Len=0 777 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9909 [ACK] Seq=493 Ack=349 Win=2619392 Len=0	748 16.006926	127.0.0.2	127.0.0.1	GRPCHT	184 HEADERS[3]: 200 OK, DATA[3] (GRPC) (PROTOBUF), HEADERS[3], WINDOW_UPDATE[0]
751 16.025225 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=213 Ack=319 Win=2619392 Len=0 752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025439 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 762 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070731 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=2619136 Len=0 764 16.072021 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[5]: 200 OK, DATA[5] (GRPC) (PROTOBUF) HEADERS[5]; WINDOM_UPDATE[0] 765 16.072072 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=426 Ack=281 Win=2619392 Len=0 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9090 [ACK] Seq=428 Ack=493 Win=2619392 Len=0 772 16.076364 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[7]: 200 OK, DATA[7] (GRPC) (PROTOBUF), HEADERS[7], WINDOM_UPDATE[0] 773 16.076424 127.0.0.1 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 776 16.112628 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 777 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 777 16.112691 127.0.0.2 127.0.0.1 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=39 Win=2619392 Len=0	749 16.006979	127.0.0.1	127.0.0.2	TCP	44 4204 → 9090 [ACK] Seq=302 Ack=213 Win=2619392 Len=0
752 16.025327 127.0.0.2 127.0.0.1 HTTP2 61 PING[0] 753 16.025409 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 762 16.087081 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.Bookstoreservice/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070731 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=2619136 Len=0 764 16.072021 127.0.0.2 127.0.0.1 127.0.0.2 TCP 44 204 + 9090 [ACK] Seq=230 Ack=426 Win=2619136 Len=0 770 16.075151 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075161 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 772 16.076364 127.0.0.1 127.0.0.1 TCP 44 9090 [ACK] Seq=281 Ack=493 Win=261936 Len=0 773 16.076424 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[7]: 200 OK, DATA[7] (GRPC) (PROTOBUF), HEADERS[7], WINDOW_UPDATE[0] 773 16.076424 127.0.0.1 127.0.0.1 TCP 44 9090 [ACK] Seq=493 Ack=39 Win=2619392 Len=0 776 16.112628 127.0.0.1 127.0.0.1 HTTP2 61 PING[0] 777 16.112691 127.0.0.1 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=39 Win=2619392 Len=0	750 16.025171	127.0.0.1	127.0.0.2	HTTP2	61 PING[0]
753 16.025489 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=319 Ack=230 Win=2619392 Len=0 762 16.070701 127.0.0.1 127.0.0.1 170.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070731 127.0.0.2 127.0.0.1 TCP 44 9090 + 4204 [ACK] Seq=230 Ack=426 Win=261936 Len=0 764 16.072021 127.0.0.2 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=426 Ack=281 Win=2619392 Len=0 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075176 127.0.0.2 127.0.0.1 TCP 44 9990 [ACK] Seq=426 Ack=481 Win=2619392 Len=0 772 16.075161 127.0.0.2 127.0.0.1 TCP 44 9990 [ACK] Seq=8281 Ack=493 Win=2619136 Len=0 772 16.075161 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 773 16.075176 127.0.0.2 127.0.0.1 TCP 44 9990 [ACK] Seq=8281 Ack=493 Win=2619136 Len=0 773 16.076244 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=493 Ack=332 Win=2619392 Len=0 776 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=493 Ack=349 Win=2619392 Len=0 777 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=493 Ack=349 Win=2619392 Len=0	751 16.025225	127.0.0.2	127.0.0.1	TCP	44 9090 → 4204 [ACK] Seq=213 Ack=319 Win=2619392 Len=0
762 16.070701 127.0.0.1 127.0.0.2 GRPC 151 HEADERS[5]: POST /tutorial.BookstoreService/AddBookOptional, DATA[5] (GRPC) (PROTOBUF) 763 16.070731 127.0.0.2 127.0.0.1 TCP 44 9999 + 4204 [ACK] Seq=230 Ack=426 Min=2619136 Len=0 764 16.072021 127.0.0.2 127.0.0.1 127.0.0.2 TCP 44 4204 + 9990 [ACK] Seq=426 Ack=281 Win=2619392 Len=0 770 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: 200 OK, DATA[5] (GRPC) (PROTOBUF), HEADERS[5], WINDOM_UPDATE[0] 771 16.075141 127.0.0.1 127.0.0.2 GRPC 111 HEADERS[7]: POST /tutorial.BookstoreService/AddBookOptional, DATA[7] (GRPC) (PROTOBUF) 771 16.075161 127.0.0.2 127.0.0.1 GRPCHT. 95 HEADERS[7]: 200 OK, DATA[7] (GRPC) (PROTOBUF), HEADERS[7], WINDOM_UPDATE[0] 773 16.076244 127.0.0.1 127.0.0.1 GRPCHT. 95 HEADERS[7]: 200 OK, DATA[7] (GRPC) (PROTOBUF), HEADERS[7], WINDOM_UPDATE[0] 773 16.076424 127.0.0.1 127.0.0.1 HTTP2 61 PING[0] 776 16.112691 127.0.0.1 127.0.0.1 TCP 44 4204 + 9990 [ACK] Seq=493 Ack=349 Win=2619392 Len=0	752 16.025327	127.0.0.2	127.0.0.1	HTTP2	61 PING[0]
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777 16.112691 127.0.0.1 127.0.0.2 TCP 44 4204 + 9090 [ACK] Seq=493 Ack=349 Win=2619392 Len=0	773 16.076424	127.0.0.1	127.0.0.2	TCP	44 4204 → 9090 [ACK] Seq=493 Ack=332 Win=2619392 Len=0
	776 16.112628	127.0.0.2	127.0.0.1	HTTP2	61 PING[0]
L 823 16.677492 127.0.0.1 127.0.0.2 TCP 44 4204 → 9090 [RST, ACK] Seq=493 Ack=349 Win=0 Len=0				TCP	
	L 823 16.677492	127.0.0.1	127.0.0.2	TCP	44 4204 → 9090 [RST, ACK] Seq=493 Ack=349 Win=0 Len=0

### 1. Wiadomości

- Podanie wszystkich argumentów do metody addBookStructNoOptional
   TCP Payload wynosi 205 bajtów.
   GRPC Message Data wynosi 31 bajtów.
- Nie podanie opcjonalnego argumentu do metody addBookStructOptional
  - TCP Payload wynosi 105 bajtów. GRPC Message Data wynosi 28 bajtów.
- Podanie wszystkich argumentów do metody addBookStructOptional TCP Payload wynosi 67 bajtów.
   GRPC Message Data wynosi 31 bajtów.

# 4. Wnioski

Opcjonalne wartości w strukturach danych i argumentach wywołania middleware pozwalają na bardziej elastyczną komunikację między aplikacjami. Dzięki nim, można uniknąć przesyłania zbędnych informacji, co w przypadku Ice, jak i gRPC prowadzi do mniejszych rozmiarów pakietów sieciowych. W przypadku Thrift rozmiar pakietów sieciowych pozostaje taki sam niezależnie, czy parametry opcjonalne są ustawione, czy też nie.