Client-Server communication in C#

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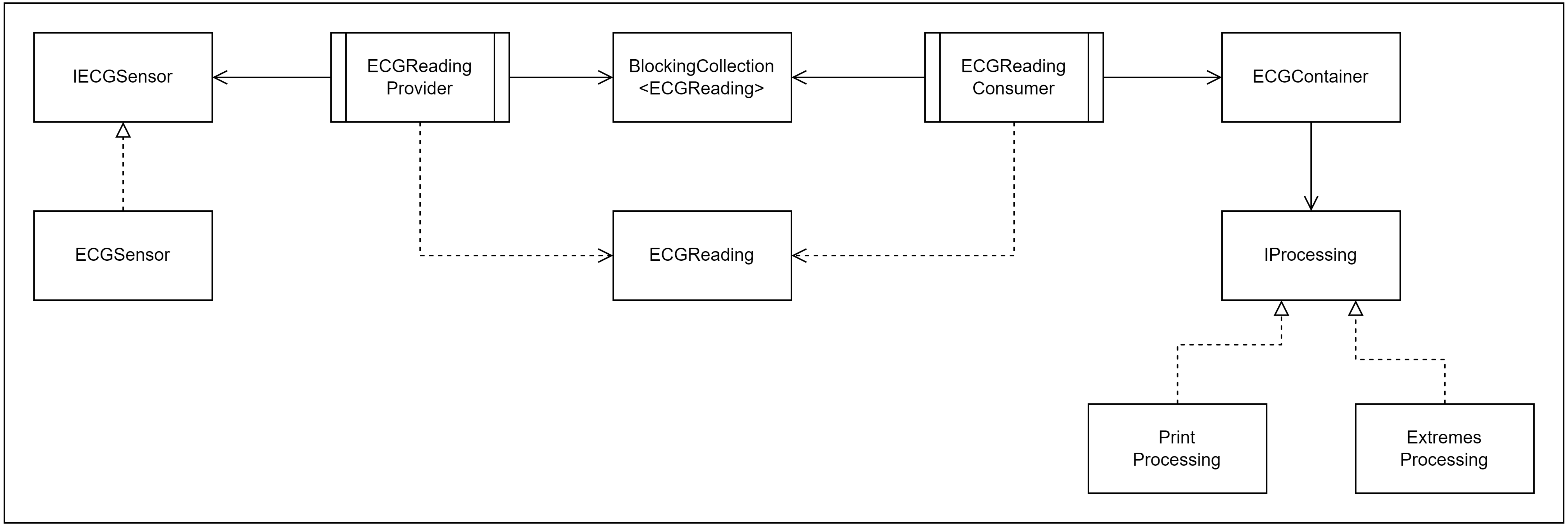
Agenda

The end goal

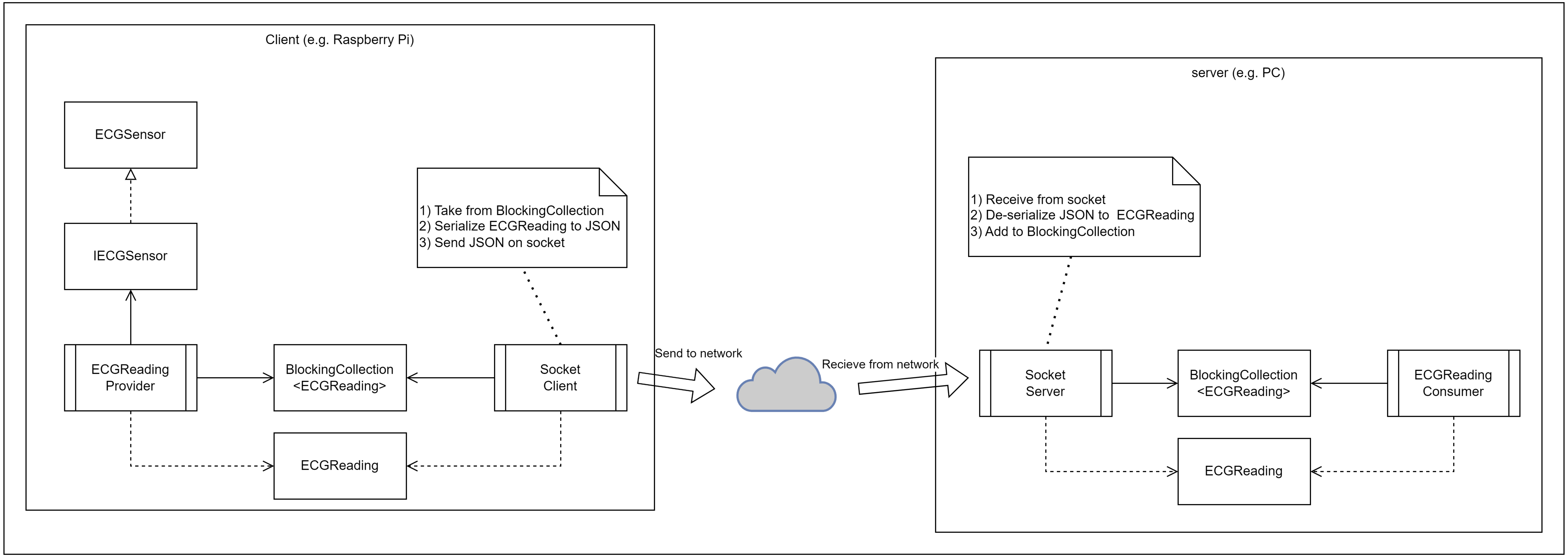
Client <-> Server socket communication

Where we want to end up

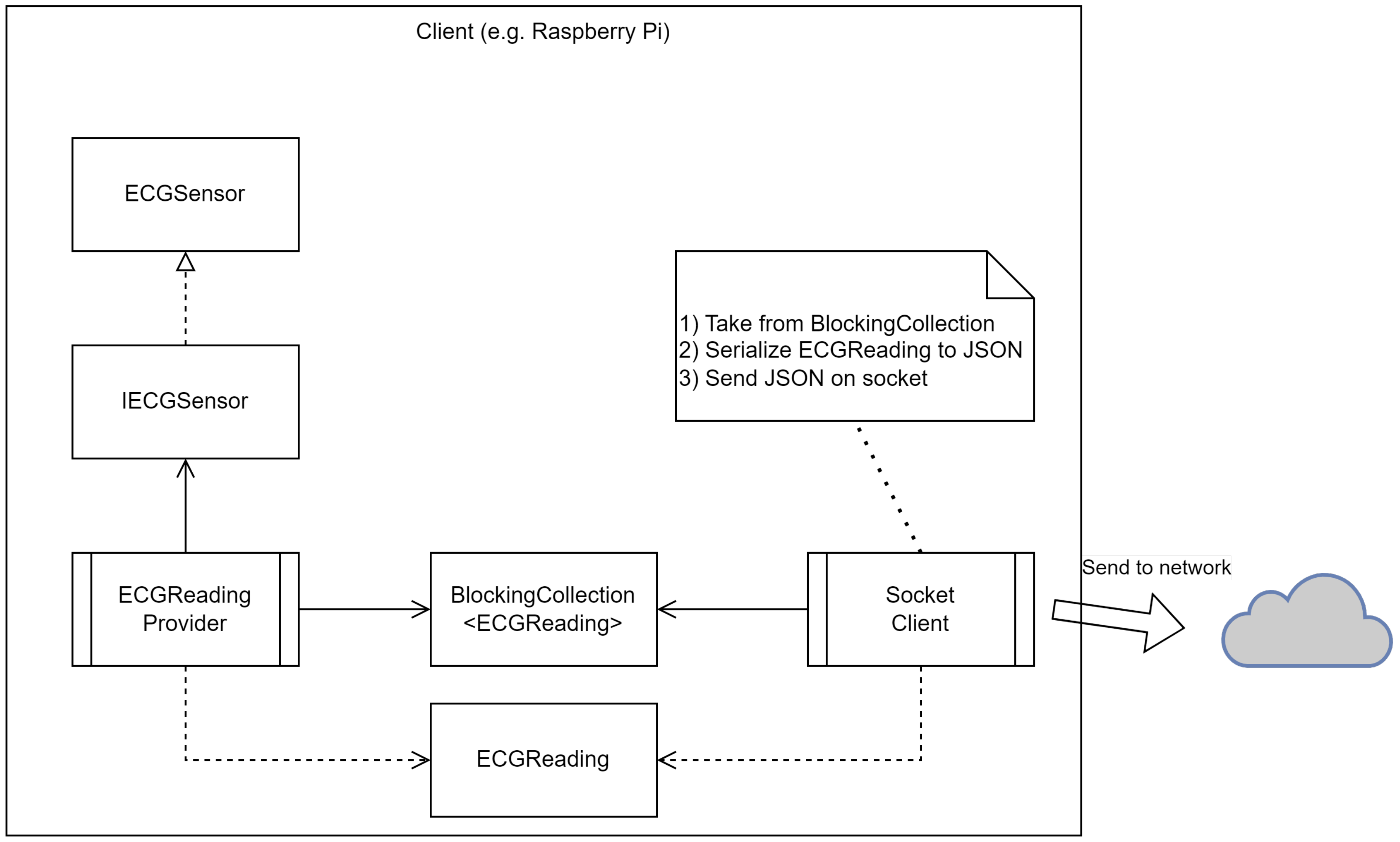
We want to go from this



To this


Client (e.g. Raspberry Pi)
ECGSensor
IECGSensor
ECGReading Provider
BlockingCollection <ECGReading>
Socket Client
ECGReading
1) Take from BlockingCollection
2) Serialize ECGReading to JSON
3) Send JSON on socket
Send to network
Recieve from network
server (e.g. PC)
1) Receive from socket
2) De-serialize JSON to ECGReading
3) Add to BlockingCollection
Socket Server
BlockingCollection <ECGReading>
ECGReading Consumer
ECGReading

Client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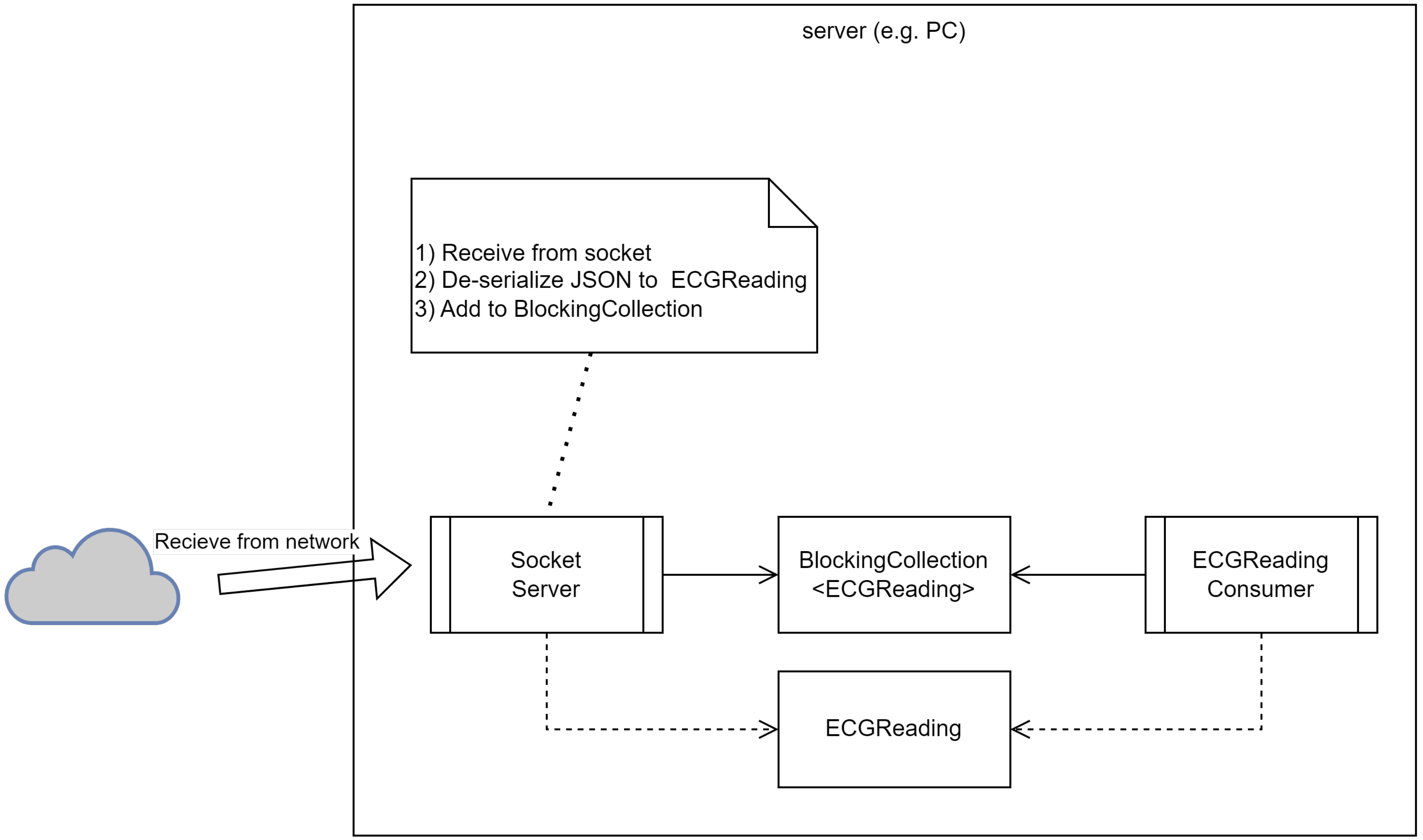
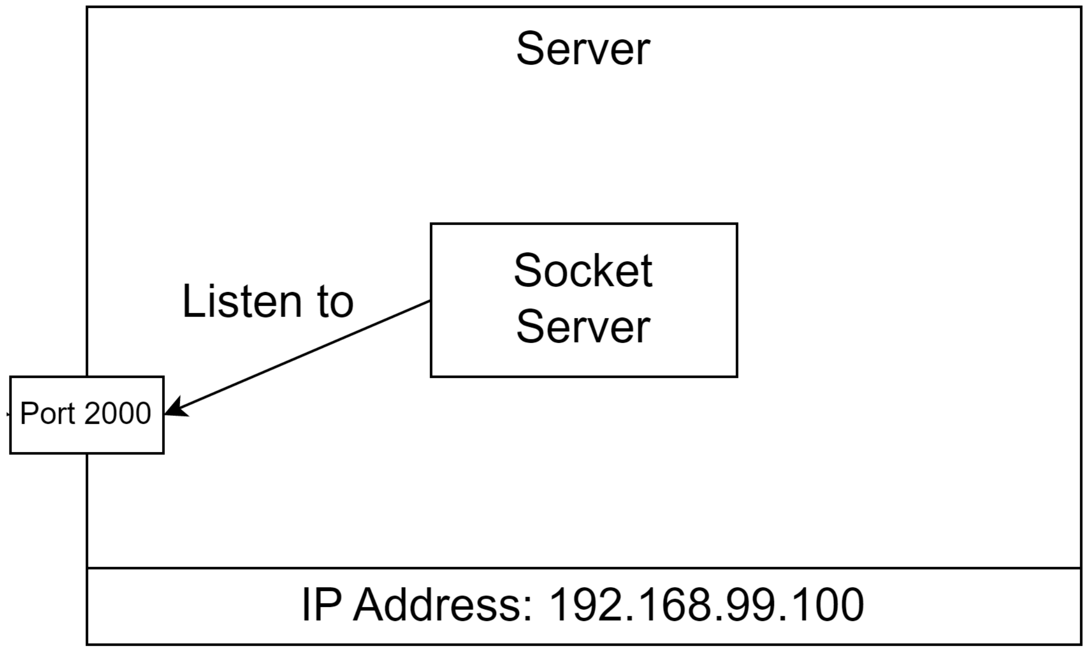
Send to network

Server


server (e.g. PC)
1) Receive from socket
2) De-serialize JSON to ECGReading
3) Add to BlockingCollection
Recieve from network
Socket Server
BlockingCollection <ECGReading>
ECGReading Consumer
ECGReading

Socket communication

The server listens



The Server specifies where to listen:

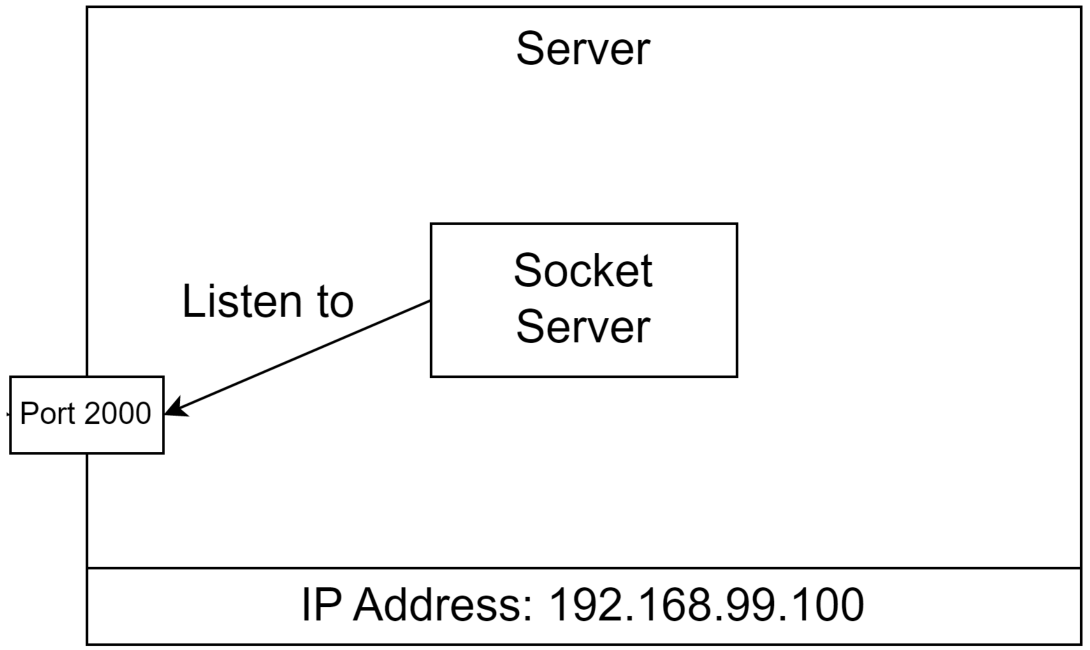
- IP Address
- Port number

The server listens

The server can have multiple network cards and more than one address.

IP Address to listen to can be:

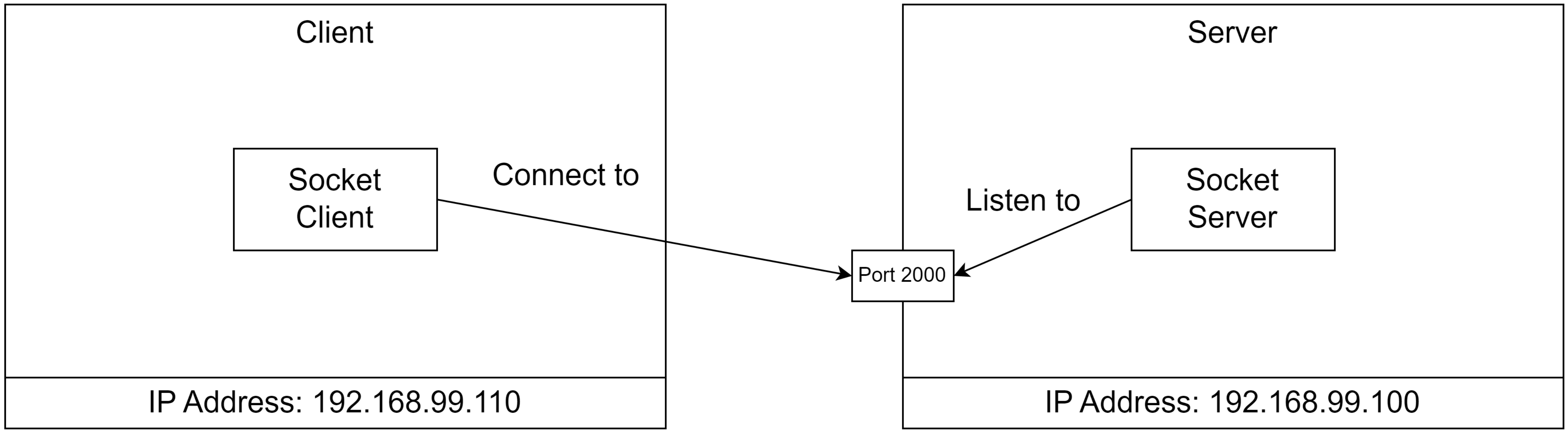
- **Any** <= all network interfaces
- **Loopback** <= 127.0.0.1
- A specific IP address



The Server specifies where to listen:

- IP Address
- Port number

The client connects to the server



The client connects to a server socket:

- IP Address
- Port number

SocketServer

```csharp
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network addresses for this machine
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket listener = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

SocketServer

Create and IPEndPoint with Address = Any and Port = 2000.

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network ad[illegible]sses for this m
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket listener = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

SocketServer

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network ad      sses for this m
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoi      ddress, 2000);

        using Socket listener = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

Create a new socket.

- ‘AddressFamily’ is the one for IP addresses – ”InterNetwork”.
- Socket type is Stream, which means a two-way data stream.
- The protocol type is Transmission Control Protocol - TCP.

SocketServer

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network addres     for this n
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint(ipA    ss, 2000);

        using Socket listener = new Socket(ip    Point.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Co    ole.WriteLine($"Listening on: {ipAddress}");

                                                        ffer, SocketFlags.None);
                                                        uffer, 0, numberOfBytesReceived);
                                                        ta}");

            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

Create a new socket.

- ‘AddressFamily’ is the one for IP addresses – ”InterNetwork”.
- Socket type is Stream, which means a two-way data stream.
- The protocol type is Transmission Control Protocol - TCP.

The Socket implements the ‘IDisposable’ interface.

The ‘using’ keywork means, that the ‘listener’ object will be disposed correctly, even if any exceptions occur in the code.

SocketServer

Associate socket with local endpoint on the machine.

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network ad[illegible]sses for this m
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint[illegible]ddress, 2000);

        using Socket listener = new Soc[illegible](ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

SocketServer

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network ad    sses for this n
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoin    ddress, 2000);

        using Socket listener = new Soc    (ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"L    ning on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

Start listening on the socket.

SocketServer

Wait for a connection from a client.

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network addresses f[illegible] this m
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress[illegible]00);

        using Socket listener = new Socket(ipEndPoi[illegible]ddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {i[illegible]ress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

SocketServer

Read bytes from the socket in to a buffer

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network addresses for this m
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket listener = new Socket(ipEndPoint.AddressFamily, S   ketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
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SocketServer

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        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(b   er, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

Convert to text (UTF-8)

SocketServer

Read bytes from the socket in to a buffer

```
class SocketServer
{
    public void RunServer()
    {
        // listen to 'Any' which means all network addresses for this m
        IPAddress ipAddress = IPAddress.Any;
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        using Socket listener = new Socket(ipEndPoint.AddressFamily, S   etType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
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            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```

SocketServer

```
class SocketServer
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        // listen to 'Any' which means all network addresses for this m
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        using Socket listener = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (true)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
            Console.WriteLine($"Server received:{receivedData}");

            string reply = "ACK";
            byte[] replyBytes = Encoding.UTF8.GetBytes(reply);
            handler.Send(replyBytes, SocketFlags.None);
        }
    }
}
```
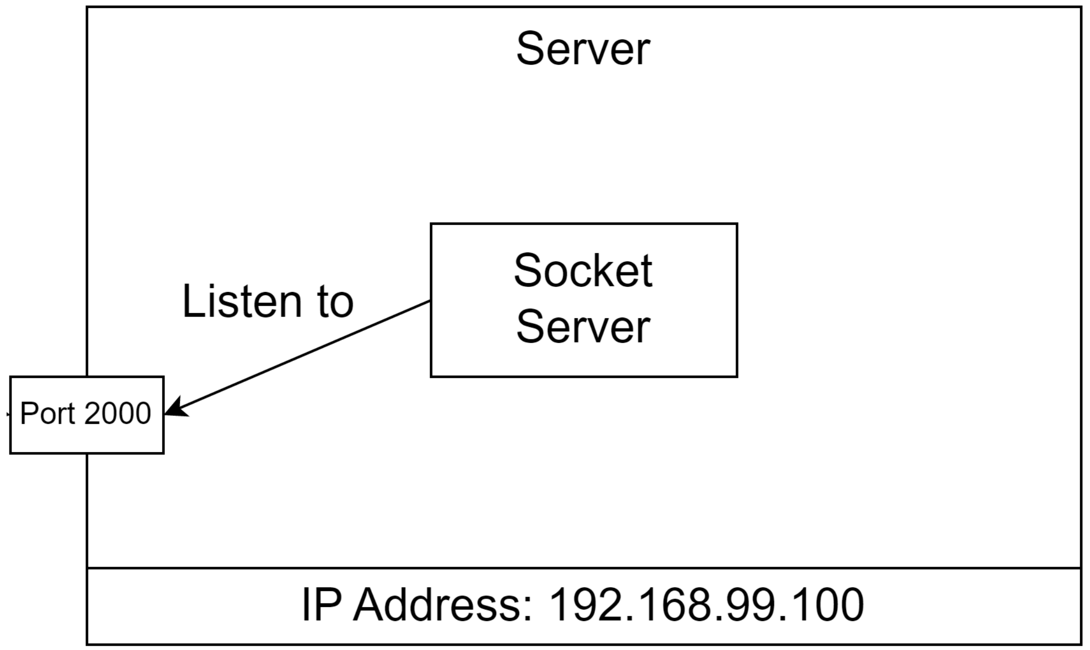

Send ”ACK” message back to the client.

NOTE:
There is no requirement to send anything back to the client. It is only included here to show two-way communication.

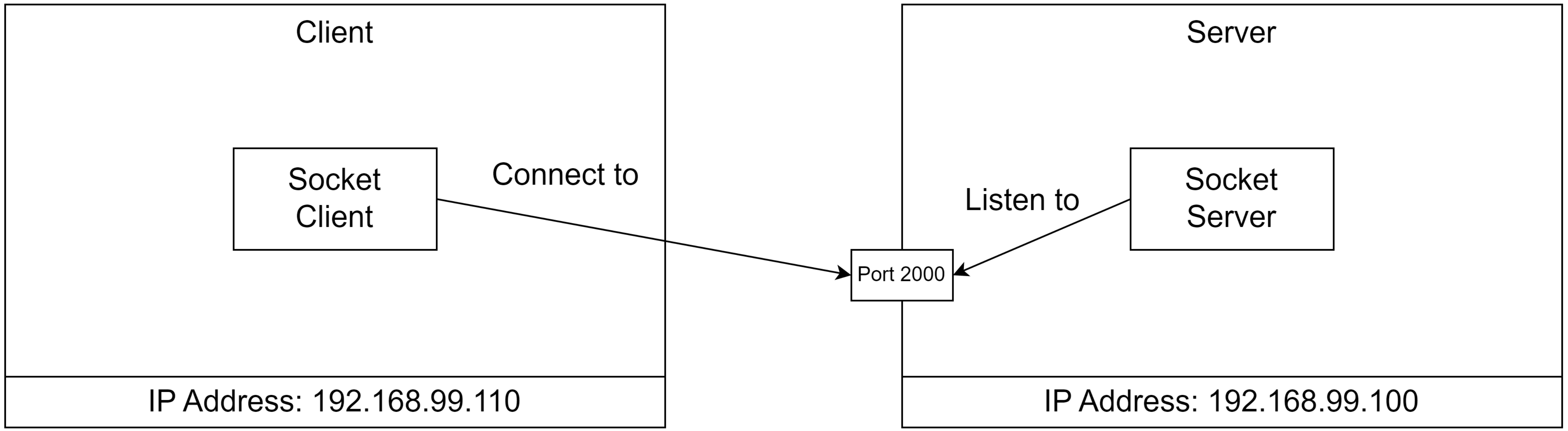
The server listens



The Server specifies where to listen:

- IP Address = Any
- Port number = 2000

The client connects to the server



The client connects to a server socket:

- IP Address
- Port number

SocketClient

```csharp
class SocketClient
{
    public void RunClient()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket client = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);

        for (int i = 0; i < 10; i++)
        {
            // Send message.
            var message = "Hello " + i;
            var messageBytes = Encoding.UTF8.GetBytes(message);
            client.Send(messageBytes, SocketFlags.None);
            Console.WriteLine($"Socket client sent message: {message}");

            // Receive ack.
            var buffer = new byte[1024];
            var received = client.Receive(buffer, SocketFlags.None);
            var response = Encoding.UTF8.GetString(buffer, 0, received);

            Console.WriteLine($"Client received: {response}");
            Thread.Sleep(1000);
        }

        client.Shutdown(SocketShutdown.Both);
    }
```

SocketClient

```
class SocketClient
{
    public void RunClient()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket client = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);

        for (int i = 0; i < 10; i++)
        {
            // Send message.
            var message = "Hello " + i;
            var messageBytes = Encoding.UTF8.GetBytes(message);
            client.Send(messageBytes, SocketFlags.None);
            Console.WriteLine($"Socket client sent message: {message}");

            // Receive ack.
            var buffer = new byte[1024];
            var received = client.Receive(buffer, SocketFlags.None);
            var response = Encoding.UTF8.GetString(buffer, 0, received);

            Console.WriteLine($"Client received: {response}");
            Thread.Sleep(1000);
        }

        client.Shutdown(SocketShutdown.Both);
    }
```

Create and IPEndPoint with
Address = 127.0.0.1 (localhost)
and
Port = 2000.

If the server is on a different machine, the Address shall be the IP address of that machine.

SocketClient

```
class SocketClient
{
    public void RunClient()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket client = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);

        for (int i = 0; i < 10; i++)
        {
            // Send message.
            var message = "Hello " + i;
            var messageBytes = Encoding.UTF8.GetBytes(message);
            client.Send(messageBytes, SocketFlags.None);
            Console.WriteLine($"Socket client sent message: {message}");

            // Receive ack.
            var buffer = new byte[1024];
            var received = client.Receive(buffer, SocketFlags.None);
            var response = Encoding.UTF8.GetString(buffer, 0, received);

            Console.WriteLine($"Client received: {response}");
            Thread.Sleep(1000);
        }

        client.Shutdown(SocketShutdown.Both);
    }
```

Create the socket and connect to the IP Endpoint.

The connection attempt may time out if the endpoint does not exist, which will throw an exception.

SocketClient

Create the message to send.
Convert to bytes.
Send the bytes.

```
class SocketClient
{
    public void RunClient()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 20[illegible];

        using Socket client = new Socket(ipEndPoint.Addr[illegible]sFamily, SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);

        for (int i = 0; i < 10; i++)
        {
            // Send message.
            var message = "Hello " + i;
            var messageBytes = Encoding.UTF8.GetBytes(message);
            client.Send(messageBytes, SocketFlags.None);
            Console.WriteLine($"Socket client sent message: {message}");

            // Receive ack.
            var buffer = new byte[1024];
            var received = client.Receive(buffer, SocketFlags.None);
            var response = Encoding.UTF8.GetString(buffer, 0, received);

            Console.WriteLine($"Client received: {response}");
            Thread.Sleep(1000);
        }

        client.Shutdown(SocketShutdown.Both);
    }
```

SocketClient

```
class SocketClient
{
    public void RunClient()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket client = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);

        for (int i = 0; i < 10; i++)
        {
            // Send message.
            var message = "Hello " + i;
            var messageBytes = Encoding.UTF8.GetBytes(message);
            client.Send(messageBytes, SocketFlags.None);
            Console.WriteLine($"Socket client sent message: {message}");

            // Receive ack.
            var buffer = new byte[1024];
            var received = client.Receive(buffer, SocketFlags.None);
            var response = Encoding.UTF8.GetString(buffer, 0, received);

            Console.WriteLine($"Client received: {response}");
            Thread.Sleep(1000);
        }

        client.Shutdown(SocketShutdown.Both);
    }
```

Receive ”ACK” message from the server.

NOTE:
There is no requirement to send anything back to the client. It is only included here to show two-way communication.

SocketClient

```
class SocketClient
{
    public void RunClient()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket client = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);

        for (int i = 0; i < 10; i++)
        {
            // Send message.
            var message = "Hello " + i;
            var messageBytes = Encoding.UTF8.GetBytes(message);
            client.Send(messageBytes, SocketFlags.None);
            Console.WriteLine($"Socket client sent message: {message}");

            // Receive ack.
            var buffer = new byte[1024];
            var received = client.Receive(buffer, SocketFlags.None);
            var response = Encoding.UTF8.GetString(buffer, 0, received);

            Console.WriteLine($"Client received: {response}");
            Thread.Sleep(1000);
        }

        client.Shutdown(SocketShutdown.Both);
    }
```

Shutdown both sending and receiving socket when done.

Your turn

Solve
Exercise 1
in
”Client-Servercommunication.pdf”

Sending objects from the client

```csharp
internal class SocketClient
{
    private readonly BlockingCollection<ECGReading> _ecgReadings;

    public SocketClient(BlockingCollection<ECGReading> ecgReadings)
    {
        _ecgReadings = ecgReadings;
    }

    public void Run()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket client = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);

        while (!_ecgReadings.IsCompleted)
        {
            try
            {
                ECGReading ecgReading = _ecgReadings.Take();

                string objectAsJson = JsonSerializer.Serialize(ecgReading);
                var messageBytes = Encoding.UTF8.GetBytes(objectAsJson);
                client.Send(messageBytes, SocketFlags.None);
                Console.WriteLine($"Socket client sent message: {objectAsJson}");
            }
            catch (InvalidOperationException)
            {
                // IOE means that Take() was called on a completed collection.
            }
        }
        client.Shutdown(SocketShutdown.Both);
    }
}
```

Sending objects from the client

```
internal class SocketClient
{
    private readonly BlockingCollection<ECGReading> _ecgReadings;

    public SocketClient(BlockingCollection<ECGReading> ecgReadings)
    {
        _ecgReadings = ecgReadings;
    }

    public void Run()
    {
        IPAddress ipAddress = IPAddress.Parse("127.0.0.1");
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket client = new Socket(ipEndPoint.AddressFamily,
SocketType.Stream, ProtocolType.Tcp);
        client.Connect(ipEndPoint);
        client.Connect(ipEndPoint);

        while (!_ecgReadings.IsCompleted)
        {
            try
            {
                ECGReading ecgReading = _ecgReadings.Take();

                string objectAsJson = JsonSerializer.Serialize(ecgReading);
                var messageBytes = Encoding.UTF8.GetBytes(objectAsJson);
                client.Send(messageBytes, SocketFlags.None);
                Console.WriteLine($"Socket client sent message: {objectAsJson}");
            }
            catch (InvalidOperationException)
            {
                // IOE means that Take() was called on a completed collection.
            }
        }
        client.Shutdown(SocketShutdown.Both);
    }
}
```

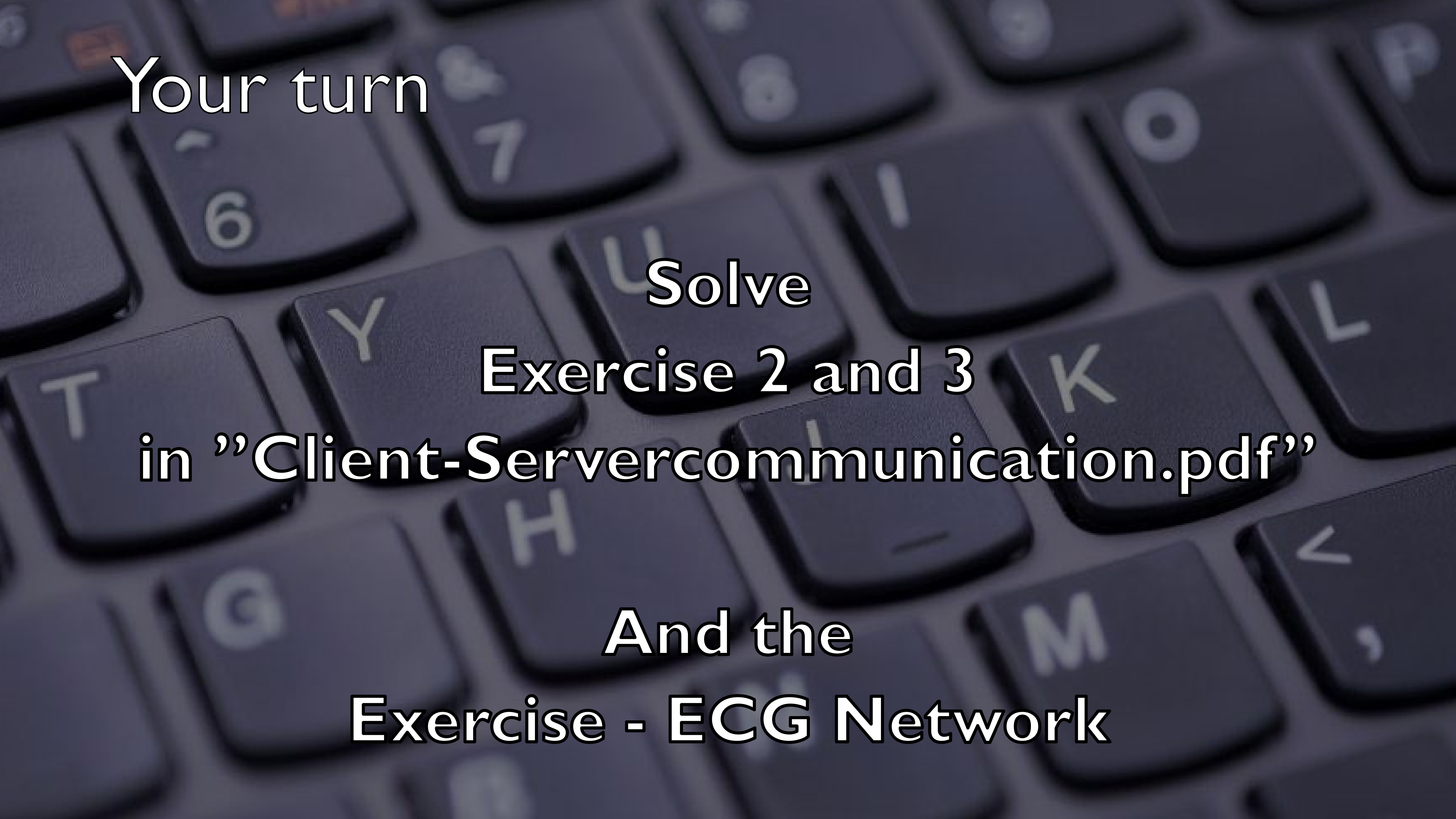
Receiving objects on the server

```
internal class SocketServer
{
    private readonly BlockingCollection<ECGReading> _ecgReadings;

    public SocketServer(BlockingCollection<ECGReading> ecgReadings)
    {
        _ecgReadings = ecgReadings;
    }
    public void Run()
    {
        RunServer();
    }

    public void RunServer()
    {
        // listen to 'Any' which means all network addresses for this machine
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket listener = new Socket(ipEndPoint.AddressFamily, SocketType.Stream, ProtocolType.Tcp);

        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (!ShallStop)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            if (numberOfBytesReceived > 0)
            {
                string receivedData = Encoding.UTF8.GetString(buffer, 0, numberOfBytesReceived);
                Console.WriteLine($"Server received:{receivedData}");

                try
                {
                    ECGReading? ecgReading = JsonSerializer.Deserialize<ECGReading>(receivedData);
                    if (ecgReading != null) _ecgReadings.Add(ecgReading);
                }
                catch (System.Text.Json.JsonException e)
                {
                    // log any parsing exceptions
                    Console.WriteLine(e);
                }
            }
        }
        listener.Close();
        _ecgReadings.CompleteAdding();
    }

    public bool ShallStop { get; set; } = false;
}
```

Receiving objects on the server

```
internal class SocketServer
{
    private readonly BlockingCollection<ECGReading> _ecgReadings;

    public SocketServer(BlockingCollection<ECGReading> ecgReadings)
    {
        _ecgReadings = ecgReadings;
    }
    public void Run()
    {
        RunServer();
    }

    public void RunServer()
    {
        // listen to 'Any' which means all network addresses for this machine
        IPAddress ipAddress = IPAddress.Any;
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 2000);

        using Socket listener = new Socket(ipEndPoint.AddressFamily,
        IPEndPoint ipEndPoint = new IPEndPoint(ipAddress, 1000);

        using Socket listener = new Socket(ipEndPoint.AddressFamily,
SocketType.Stream, ProtocolType.Tcp);

        listener.Bind(ipEndPoint);

        Console.WriteLine($"Listening on: {ipAddress}");
        listener.Listen();

        var handler = listener.Accept();

        while (!ShallStop)
        {
            byte[] buffer = new byte[1024];
            int numberOfBytesReceived = handler.Receive(buffer, SocketFlags.None);
            if (numberOfBytesReceived > 0)
            {
                string receivedData = Encoding.UTF8.GetString(buffer, 0,
numberOfBytesReceived);
                Console.WriteLine($"Server received:{receivedData}");

                try
                {
                    ECGReading? ecgReading =
JsonSerializer.Deserialize<ECGReading>(receivedData);
```

```
            {
                string receivedData = Encoding.UTF8.GetString(buffer, 0,
numberOfBytesReceived);
                Console.WriteLine($"Server received:{receivedData}");

                try
                {
                    ECGReading? ecgReading =
JsonSerializer.Deserialize<ECGReading>(receivedData);
                    if (ecgReading != null) _ecgReadings.Add(ecgReading);
                }
                catch (System.Text.Json.JsonException e)
                {
                    // log any parsing exceptions
                    Console.WriteLine(e);
                }
            }
        }
        listener.Close();
        _ecgReadings.CompleteAdding();
    }

    public bool ShallStop { get; set; } = false;
}
```



Your turn

Solve

Exercise 2 and 3

in ”Client-Servercommunication.pdf”

And the

Exercise - ECG Network

References and image sources

Computer keyboard:
http://stockmedia.cc/computing_technology/slides/DSD_8790.jpg

Warning tape: https://www.pngall.com/warning-sign-png/download/69428

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