

## GO BACK N-ARQ

I am solving Go-Back N-Arq I only have confusion in the window size concept I know that in the question in my exam They'll either give sequence number Or bits in sequence number Or directly window size

Can u give me an example of all three?

Ah, I see! You want to get a handle on **how to interpret window size, sequence number bits, and sequence numbers** in Go-Back-N ARQ, and how they relate to each other in practice.

Let's go through **three different types of problems** you might encounter:

1. **Given the sequence number bits, find the window size.**
2. **Given the window size, find the sequence number bits.**
3. **Given the sequence number range (e.g., number of sequence numbers), find the window size.**

I'll break down all three scenarios clearly with examples.

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### **Example 1: Given sequence number bits (m), find the window size (W)**

#### **Problem:**

You are told that the **sequence number field** is 3 bits long (i.e., **m = 3**). Find the **maximum window size** for **Go-Back-N ARQ**.

#### **Solution:**

For **Go-Back-N ARQ**, the maximum window size W is given by:

$$W = 2^m - 1$$

Here, **m = 3**:

$$\begin{aligned} W &= 2^3 - 1 \\ &= 8 - 1 \\ &= 7 \end{aligned}$$

So, the **maximum window size** is 7.

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### **Example 2: Given the window size (W), find the sequence number bits (m)**

#### **Problem:**

You are told that the **window size** for Go-Back-N ARQ is **5**. Find the **sequence number bits (m)** required.

**Solution:**

We know the formula for window size is:

$$W=2^m-1$$

So, if the window size is **5**, we solve for m:

$$5=2^m-1$$

Add **1** to both sides:

$$6=2^m$$

Now we find that **6** is **not** a power of 2. So, a **window size of 5** isn't possible for Go-Back-N ARQ because the window size must be in the form of  **$2^m - 1$** .

To clarify:

- **Valid window sizes** for Go-Back-N would be **3 ( $2^2 - 1$ )**, **7 ( $2^3 - 1$ )**, **15 ( $2^4 - 1$ )**, and so on.
- **5 is not a valid window size** in this case.

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**Example 3: Given the sequence number range (e.g., number of sequence numbers), find the window size (W)**

**Problem:**

You are given that the sequence numbers range from **0 to 15**. Find the **window size** for Go-Back-N ARQ.

**Solution:**

The **total number of sequence numbers** is 16, which is from 0 to 15. This means the total number of sequence numbers  $2^m$  is **16**.

$$2^m=16 \Rightarrow m=4$$

Now, we use the formula for the window size:

$$W=2^m-1$$

Substitute **m = 4**:

$$W=2^4-1$$

$$=16-1$$

$$=15$$

So, the **window size** is **15**.

## Sender Window Size is $2^m-1$ y not $2^m$ or greater than $2^m$ ?

### Example and Explanation:

#### Scenario 1: $m = 3$ (3-bit sequence number)

- If the sequence number field uses **3 bits**, then the total number of sequence numbers is  $2^3=8$ , which means the sequence numbers will range from **0 to 7**.
- So, the sender can potentially use **8 sequence numbers**.

Now, if we apply the **Go-Back-N ARQ rule** for the sender's window size:

$$\begin{aligned}W_{\text{sender}} &= 2^m - 1 \\ &= 2^3 - 1 \\ &= 8 - 1 \\ &= 7\end{aligned}$$

### Explanation:

- The sender can have a window size of **7**, which means it can send up to **7 frames** before needing an acknowledgment.
- **Why not 8?**
  - If the sender's window size were **8**, the sequence numbers would wrap around. For example, the sender could send frame 0, 1, 2, ..., 7. If the receiver has not acknowledged any of them and the sender starts sending frame 8, there would be a conflict. Frame **8** would **overwrite** sequence number **0**, and the receiver wouldn't know whether frame 0 was new or just a retransmission, leading to errors and confusion.

#### Scenario 2: $m = 4$ (4-bit sequence number)

- If the sequence number field uses **4 bits**, then the total number of sequence numbers is  $2^4=16$ , which means the sequence numbers will range from **0 to 15**.
- So, the sequence numbers will range from **0 to 15**.
- Applying the formula for the sender's window size:

$$\begin{aligned}W_{\text{sender}} &= 2^m - 1 \\ &= 2^4 - 1 \\ &= 16 - 1 \\ &= 15\end{aligned}$$

### Explanation:

- The sender's window size is **15**, meaning it can send **15 frames** before it needs an acknowledgment.
- **Why not 16?**
  - If the sender were allowed to send 16 frames, the sequence numbers would overlap once the window size exceeds  $2^m$ . For instance, the sender could send frames 0 through 15, and if no acknowledgments are received, it would eventually

need to send a new frame with sequence number **0**, which would overlap with frame 0 that hasn't been acknowledged yet. This would confuse the receiver and lead to errors.

## Selective Repeat ARQ

Window Size

$$W = \frac{N}{2}$$

$$N = 2^m$$

In Selective Repeat ARQ, the window size of the sender and the receiver are the Same.

### 1. Given the Sequence Number Bits ( $m$ ), Find the Window Size ( $W$ )

#### Problem:

The sequence number field is 4 bits long. Find the window size  $W$  for Selective Repeat ARQ.

#### Solution:

- Step 1: Calculate the total number of sequence numbers  $N$  from the sequence number bits  $m$ .

$$N = 2^m$$

Since  $m = 4$ , we have:

$$N = 2^4 = 16$$

- Step 2: The window size  $W$  is half of the total number of sequence numbers:

$$W = \frac{N}{2} = \frac{16}{2} = 8$$

- Answer: The window size  $W$  is 8.

## 2. Given the Window Size (W), Find the Sequence Number Bits (m)

### Problem:

The window size  $W$  for Selective Repeat ARQ is 8. Find the number of sequence number bits  $m$ .

### Solution:

- **Step 1:** Use the relationship  $W = \frac{N}{2}$  to find  $N$  (the total number of sequence numbers).

$$W = \frac{N}{2} \Rightarrow N = 2 \times W = 2 \times 8 = 16$$

- **Step 2:** The total number of sequence numbers  $N = 16$ , and  $N = 2^m$ . Now, solve for  $m$ :

$$2^m = 16 \Rightarrow m = 4$$

- **Answer:** The number of sequence number bits  $m$  is 4.

## 3. Given the Total Sequence Number Range (N), Find the Window Size (W)

### Problem:

The sequence number range is from 0 to 31 (so the total sequence numbers  $N = 32$ ). Find the window size  $W$ .

### Solution:

- **Step 1:** The total sequence numbers  $N = 32$ .
- **Step 2:** Use the relationship  $W = \frac{N}{2}$ :

$$W = \frac{32}{2} = 16$$

- **Answer:** The window size  $W$  is 16.