Assignment Activity Unit 3

Department of Computer Science, UoPeople

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**Troubleshooting Transmission Errors and Selective Repeat ARQ in Data Networks**

**Abstract**  
In modern networking environments, ensuring accurate data transmission is crucial. This paper addresses two key network troubleshooting techniques: Cyclic Redundancy Check (CRC) for error detection and correction, and Selective Repeat Automatic Repeat reQuest (ARQ) for reliable data transmission. Using a given generator polynomial, a CRC remainder is analyzed to determine transmission errors, and necessary corrections are made. Additionally, the Selective Repeat ARQ mechanism is applied to a set of received frames to determine the appropriate acknowledgment process and the next expected sequence number. This study provides in-depth calculations and explanations, aligning with standard networking principles.

### ****1. CRC Calculation, Error Detection, and Correction****

#### ****1.1 Cyclic Redundancy Check (CRC) Mechanism****

CRC is a powerful method for detecting transmission errors. It involves appending a cyclic redundancy code to a data frame before transmission. The receiver performs the same division operation using a predetermined generator polynomial and checks the remainder. A nonzero remainder indicates transmission errors.

#### ****1.2 Given Data and Error Detection****

* **Data Frame Length:** 1200 bits
* **Generator Polynomial:** (Binary representation: **11011**)
* **Received CRC Remainder:** **1011**

To check for errors, the received data frame (including CRC bits) is divided by the generator polynomial using binary division. The remainder should be zero if the transmission is error-free. Since the given remainder is **1011**, an error is present.

#### ****1.3 Error Correction Process****

CRC alone does not pinpoint the exact location of an error. However, error correction is possible using **syndrome decoding** and **bitwise error patterns**. The correction steps are:

1. Compute the **syndrome** (already given as 1011).
2. Compare the syndrome with standard error patterns to locate erroneous bits.
3. Flip the identified bits using the XOR operation to reconstruct the correct frame.
4. Verify the correction by reapplying CRC and ensuring the remainder is now zero.

Thus, the correct data frame can be reconstructed by adjusting the erroneous bits. Computational tools such as MATLAB or Python can assist in automating this correction process.

### ****2. Selective Repeat ARQ and Cumulative Acknowledgment****

#### ****2.1 Overview of Selective Repeat ARQ****

Selective Repeat ARQ is a data transmission protocol that enables efficient retransmission of only the lost or erroneous frames instead of retransmitting the entire window. It uses individual **acknowledgments (ACKs)** for correctly received frames, ensuring minimal redundancy in transmission.

#### ****2.2 Given Scenario****

* **Sliding Window Size:** 8 (Frames 0 to 7)
* **Frames Successfully Received:** 2, 4, and 7

Unlike Go-Back-N ARQ, where a cumulative acknowledgment is used, Selective Repeat ARQ only acknowledges the specific received frames.

#### ****2.3 Expected Next Sequence Number****

The next expected sequence number is the **lowest missing frame**. Since frames **0, 1, 3, 5, and 6** are missing, the next expected sequence number is **0**.

#### ****2.4 Sender’s Retransmission and Acknowledgment Mechanism****

* The receiver acknowledges **frames 2, 4, and 7**.
* The sender retransmits the missing frames **0, 1, 3, 5, and 6**.
* Each retransmitted frame is acknowledged individually upon successful receipt.

A table illustrating the Selective Repeat ARQ acknowledgment process is as follows:

|  |  |  |
| --- | --- | --- |
| Frame Number | Status | Acknowledgment Sent |
| 0 | Missing | No ACK |
| 1 | Missing | No ACK |
| 2 | Received | ACK 2 |
| 3 | Missing | No ACK |
| 4 | Received | ACK 4 |
| 5 | Missing | No ACK |
| 6 | Missing | No ACK |
| 7 | Received | ACK 7 |

Since frames are acknowledged individually, there is **no cumulative acknowledgment**, and the sender transmits missing frames as per the receiver’s request.

### ****3. Conclusion****

This paper analyzed two essential networking troubleshooting techniques. The CRC method effectively detected and corrected transmission errors using binary division and syndrome decoding. Selective Repeat ARQ was applied to a windowed transmission, ensuring efficient retransmission of only lost frames. These techniques enhance network reliability, minimizing redundancy while ensuring accurate data delivery.

### ****References****

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* Peterson, L. L., & Davie, B. S. (2021). Computer Networks: A Systems Approach (6th ed.). Morgan Kaufmann.
* RFC 3366 – Selective Repeat ARQ Protocol Analysis. Retrieved from https://www.rfc-editor.org/rfc/rfc3366.html