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Institute of automation and information technologies

Department Electronics, telecommunications and space technologies

Lecture 15
Information Transmission Systems with Feedback

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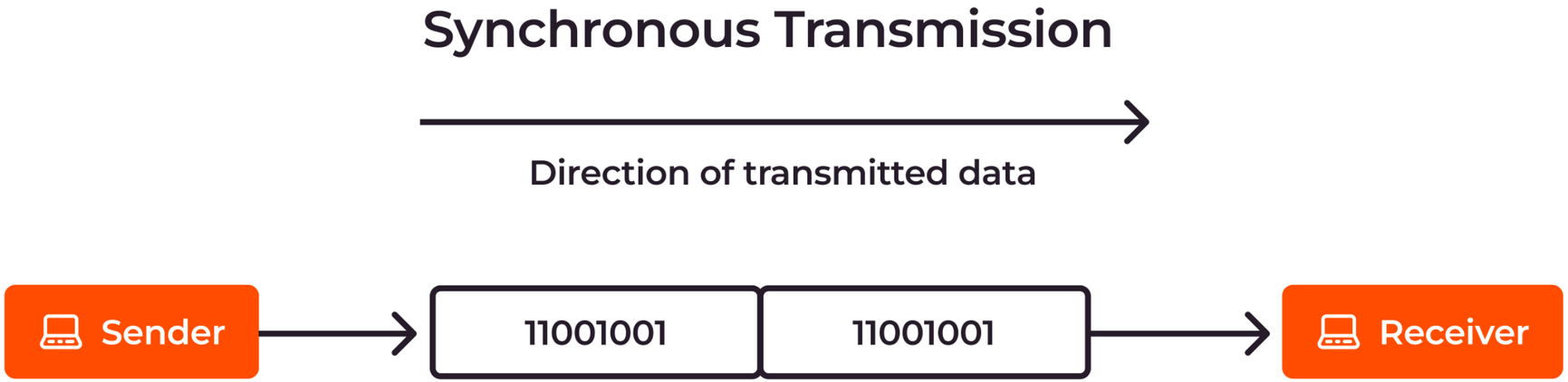
Content

- Introduction to Information Transmission Systems
- What is Feedback in Transmission Systems?
- Basic Feedback Mechanisms
- Types of Feedback in Communication Systems
- Examples of Feedback in Practice
- Conclusion

Introduction

Information transmission systems refer to the methods and technologies used to transfer data from one point to another over a communication channel. These systems convert data into signals, which are then transmitted, received, and converted back into usable information.



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Key Components of Information Transmission Systems

Source:

The origin of the information (e.g., a computer, sensor, or microphone) that generates the data to be transmitted.Transmitter:Converts the data into a signal suitable for transmission. This can involve modulation processes that prepare the signal for the chosen medium (e.g., a modem for digital signals or an analog transmitter for radio waves).

Channel:

The medium through which the signal travels. Channels can be physical (like cables and fiber optics) or wireless (like air for radio signals). Characteristics of the channel, such as bandwidth and noise levels, can significantly affect transmission quality.

Receiver:

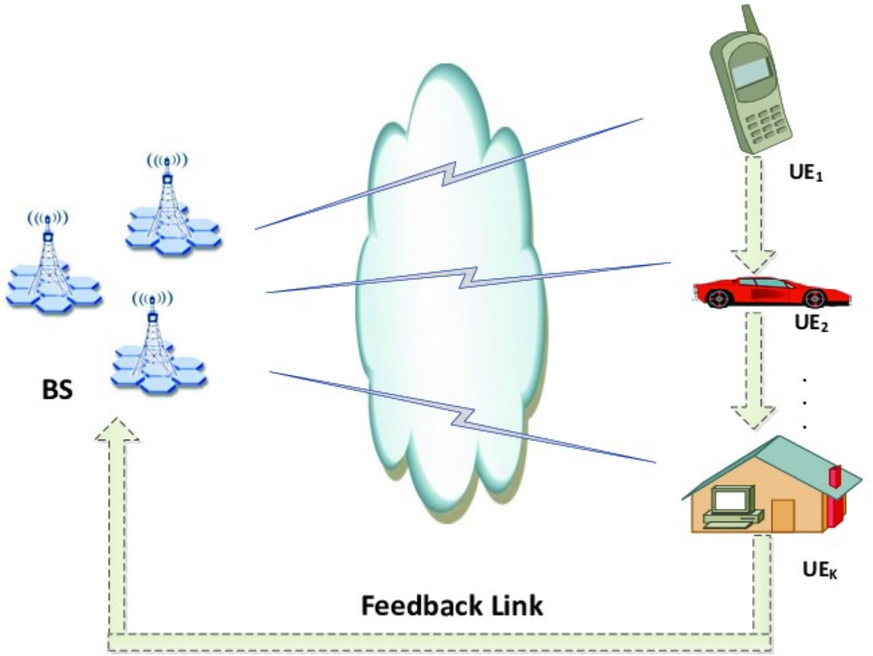
Captures the transmitted signal and converts it back into a form that can be understood by the destination. This may involve demodulation and filtering processes to extract the original data from the received signal.

Destination:

The endpoint of the communication, where the information is utilized (e.g., a computer screen, speaker, or storage device).

Feedback in Transmission Systems

Feedback in Transmission Systems is a crucial concept that involves the use of information about the output of a system to adjust and optimize its performance. In the context of communication and information transmission, feedback mechanisms play an essential role in enhancing reliability, accuracy, and efficiency.



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Types of Feedback

Positive Feedback:

Reinforces or amplifies the output. While this can lead to increased performance in certain scenarios, it may also cause instability in the system if not properly managed.

Example: In amplifiers, positive feedback can enhance signal strength but might lead to distortion if uncontrolled.

Negative Feedback:

Damps or reduces the output, promoting stability and accuracy. This is the most common form of feedback used in communication systems to ensure reliable performance.

Example: A system adjusts its transmission power based on feedback about signal quality, reducing power when the signal is strong and increasing it when the signal is weak.

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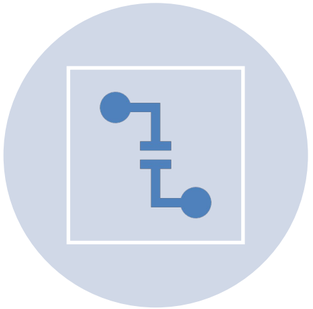
Basic Feedback Mechanisms



CLOSED-LOOP SYSTEMS:

DESCRIBE THE STRUCTURE OF CLOSED-LOOP SYSTEMS WHERE THE OUTPUT INFLUENCES THE INPUT.

CONTROL SIGNALS:

EXPLAIN HOW CONTROL SIGNALS ARE GENERATED BASED ON FEEDBACK TO ADJUST THE TRANSMISSION PROCESS.

EXAMPLE:

ILLUSTRATE WITH A SIMPLE BLOCK DIAGRAM SHOWING A FEEDBACK LOOP IN A TRANSMISSION SYSTEM.

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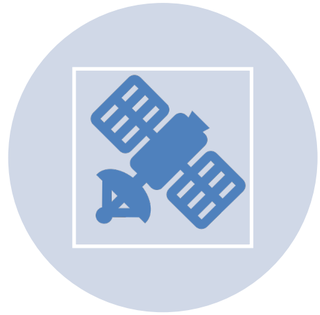
Types of Feedback in Communication Systems

EXPLICIT FEEDBACK: DIRECTLY RECEIVED INFORMATION ABOUT THE TRANSMISSION QUALITY (E.G., ACK/NACK SIGNALS IN PROTOCOLS).

IMPLICIT FEEDBACK: INFERRED FEEDBACK BASED ON PERFORMANCE METRICS, SUCH AS ERROR RATES OR THROUGHPUT.



CHANNEL ESTIMATION:

USE OF FEEDBACK TO ESTIMATE THE STATE OF THE COMMUNICATION CHANNEL, ADAPTING TRANSMISSION STRATEGIES ACCORDINGLY.

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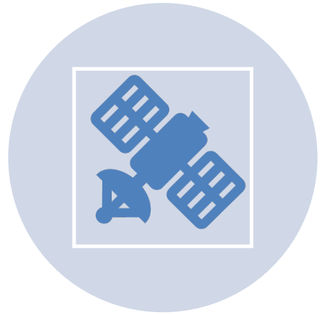

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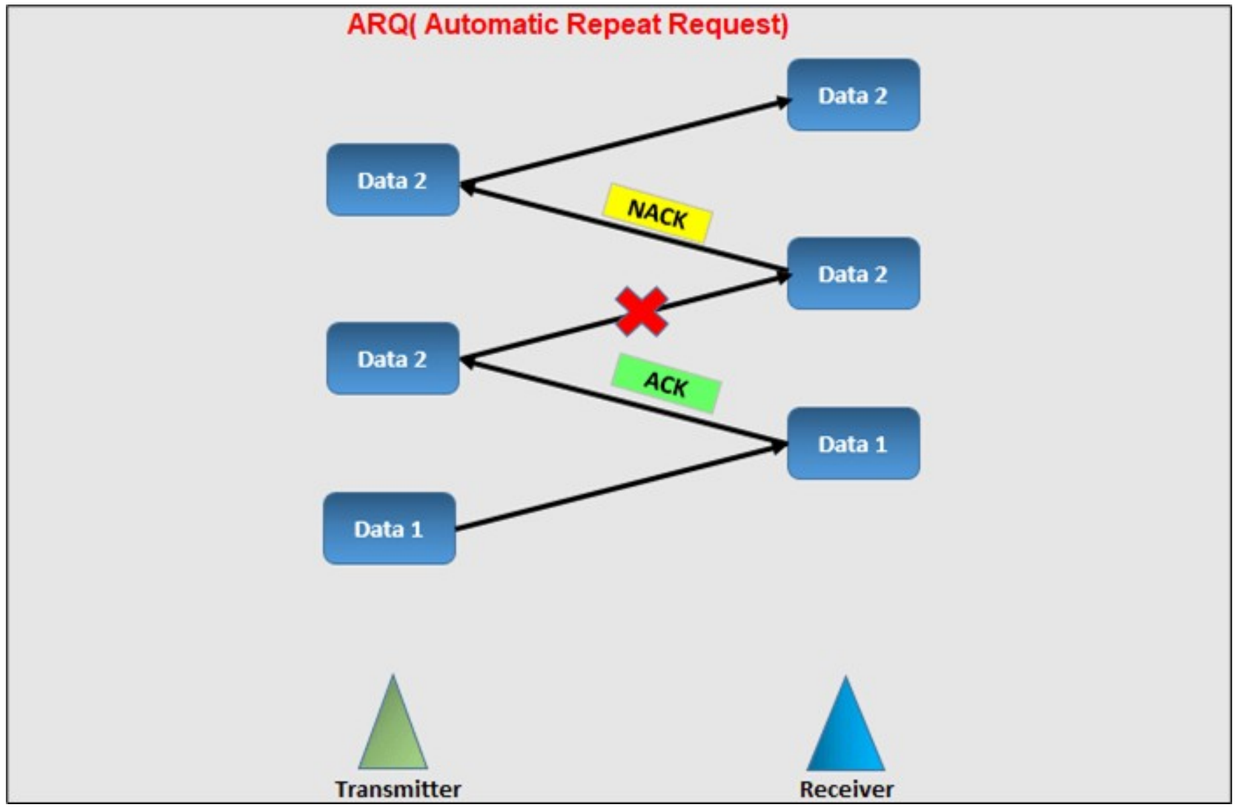
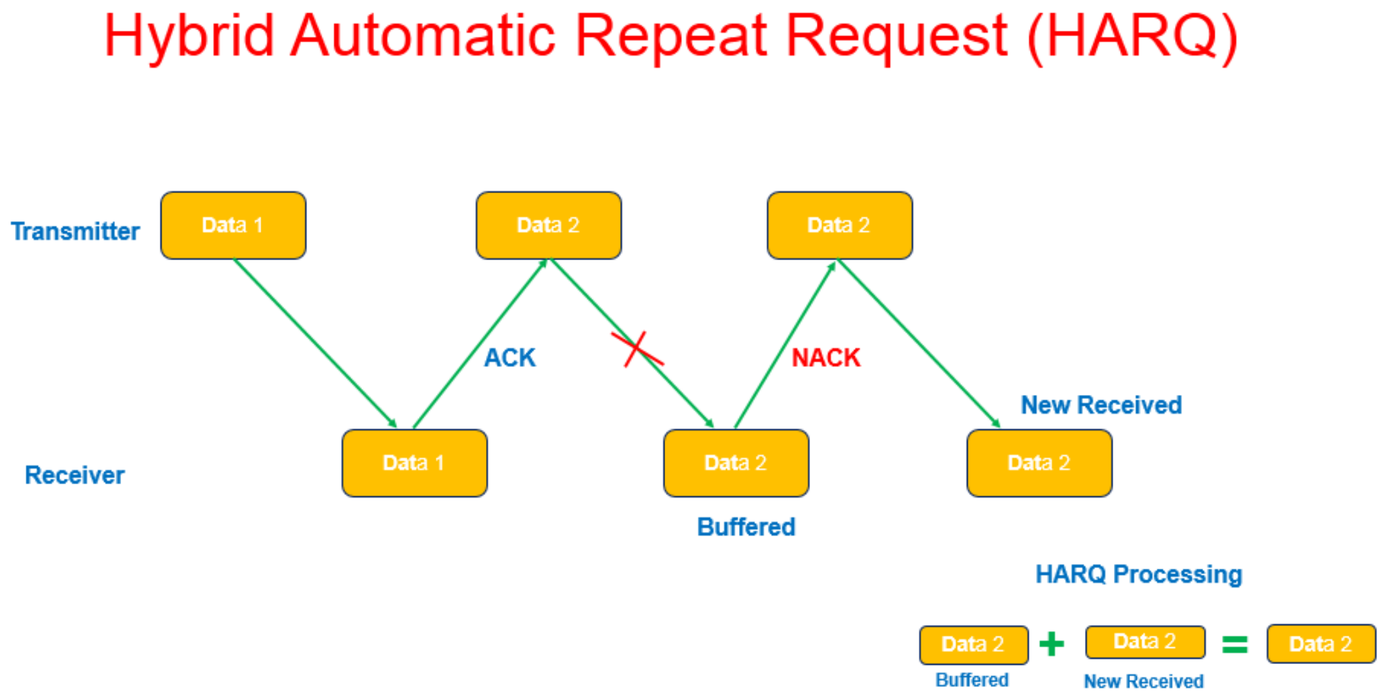
Examples of Feedback in Practice

Automatic Repeat Request (ARQ): Explain how systems request retransmission of data packets based on received acknowledgments.



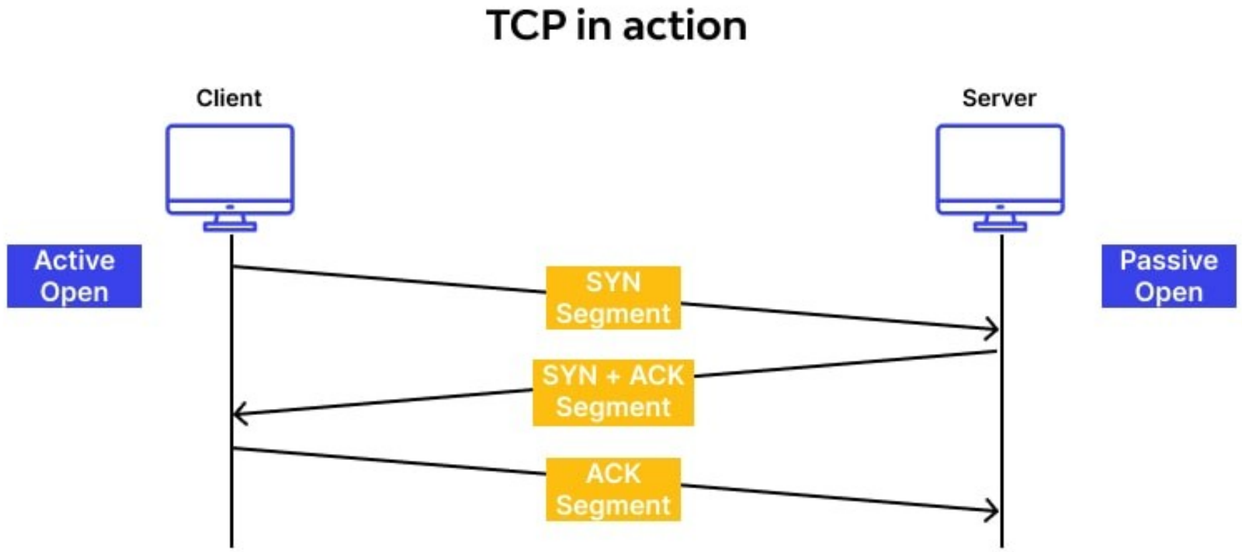
Examples of Feedback in Practice

Hybrid Automatic Repeat Request (HARQ): Combines ARQ with forward error correction to enhance reliability.



Examples of Feedback in Practice

TCP Protocol: Discuss how TCP uses feedback to manage data flow and control congestion in networks.



Conclusion

Summary of Key Points: Recap the importance of feedback in enhancing the performance and reliability of information transmission systems.

Final Thoughts: Emphasize the continuous evolution of feedback technologies in telecommunications and their significance in future innovations.