

# What Protection Engineers Need to Know About Networking

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GE Digital Energy

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# Topics

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- Trends in P&C Communications
- Protective Relays and Routing
- Reliability through Redundancy
- Security Considerations
- Conclusions

# Trends in P&C Communications

- Continuous addition of protective features
  - For faster, more selective and reliable protection
- Interoperability
  - Led to standardization of data
  - IEC 61850
- High Availability Requirement

## Evolution of the communications media

- -> Point to point
- -> System wide networks with fixed architectures
  - -> Ethernet

# Trends in P&C Communications

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## Ethernet Benefits:

- Flexible
- Easy to deploy
- Low cost
- Mature
- Well standardized

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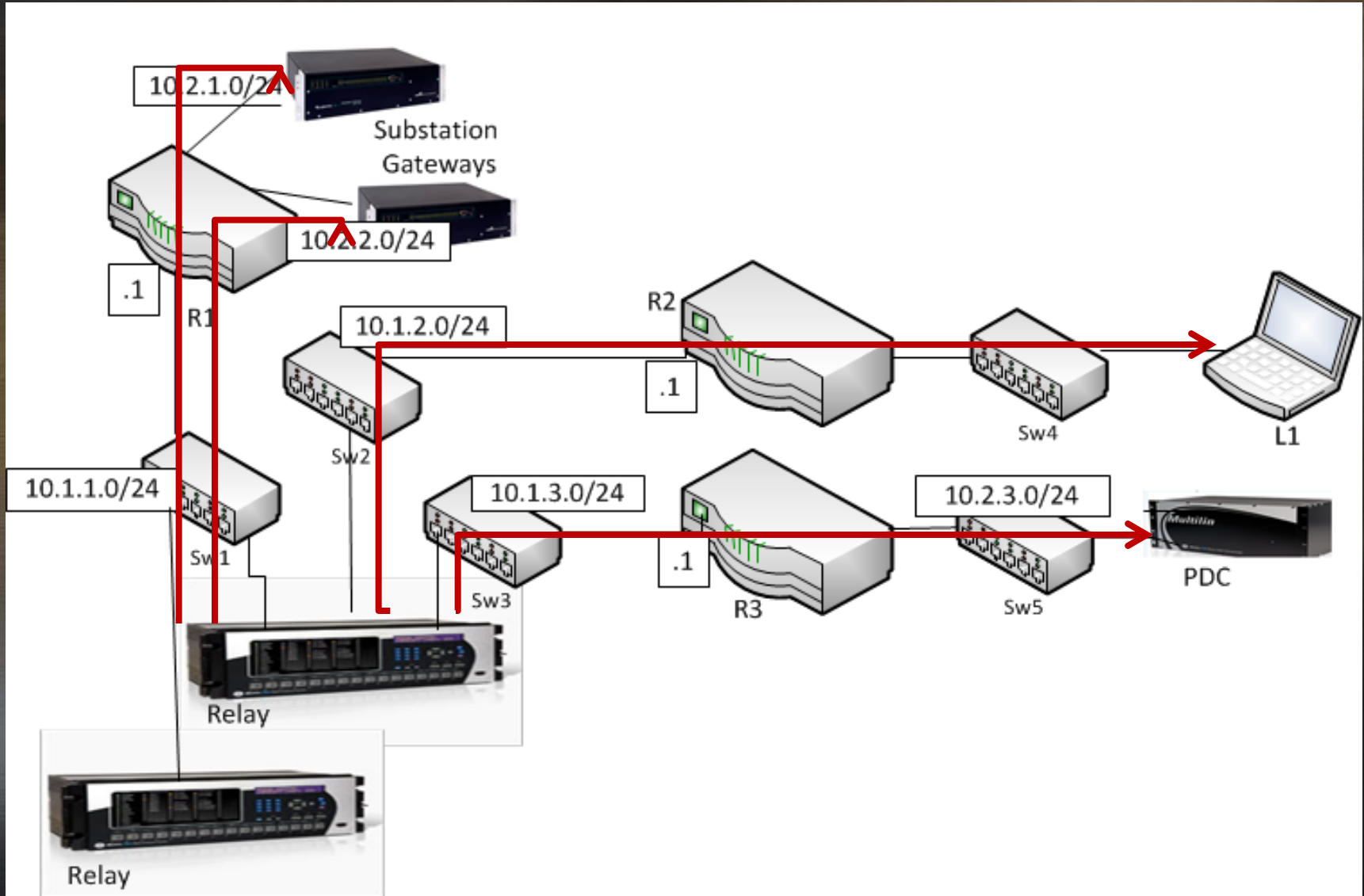
# Protective Relays and Routing

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- **Routing** – the process of selecting best paths in a network.
- **Routers** – devices that forward data packets between networks
- **Routing table** – a data table that lists the paths to network destinations
- **Routing protocols** – protocols designed to assist routers with dynamically adjusting their routing tables
- **Static routes** – routes statically configured

# Protective Relays and Routing

## Example of Deployment



# Protective Relays and Routing

## The Routing Table for the Presented Deployment

Route Name	Route Destination		Route Gateway (Next hop)
	IP Address	IP Mask	
Route 1	10.2.1.0	255.255.255.0 (/24)	10.1.1.1
Route 2	10.2.2.0	255.255.255.0	10.1.1.1
Route 3	10.2.3.0	255.255.255.0	10.1.3.1
Default route			10.1.2.1



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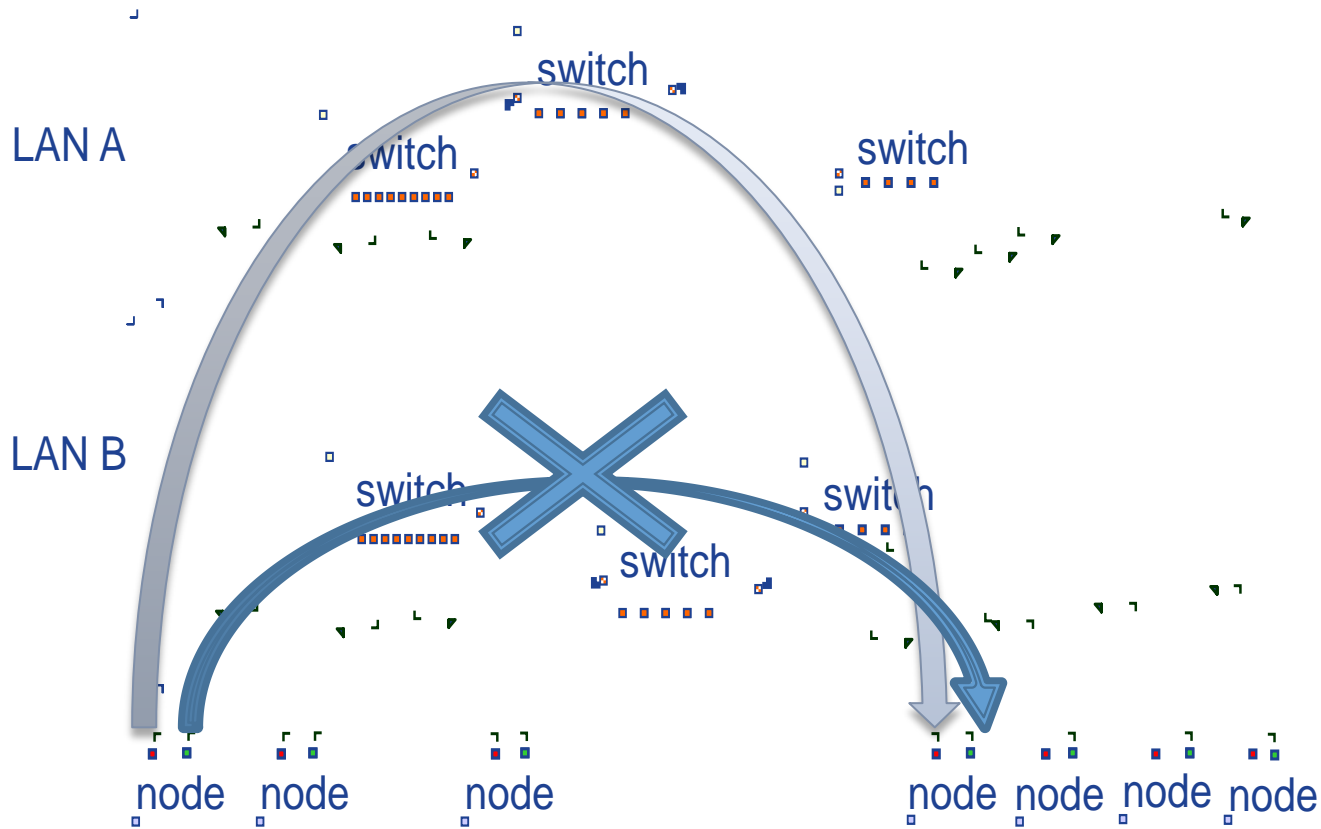
# Reliability through Redundancy

## Measures for achieving High Availability

- High quality materials and good maintenance
- Redundancy in the network – RSTP (IEEE 802.1D)
  - Used in general automation systems
  - Response time: less than 500ms
- Redundancy in the device – IEC 62439
  - Parallel Redundancy (IEC 62439-3)
    - Parallel Redundancy Protocol (PRP)
    - High-availability Seamless Redundancy (HSR)
  - Used with critical real time systems
  - Response time: 0 ms

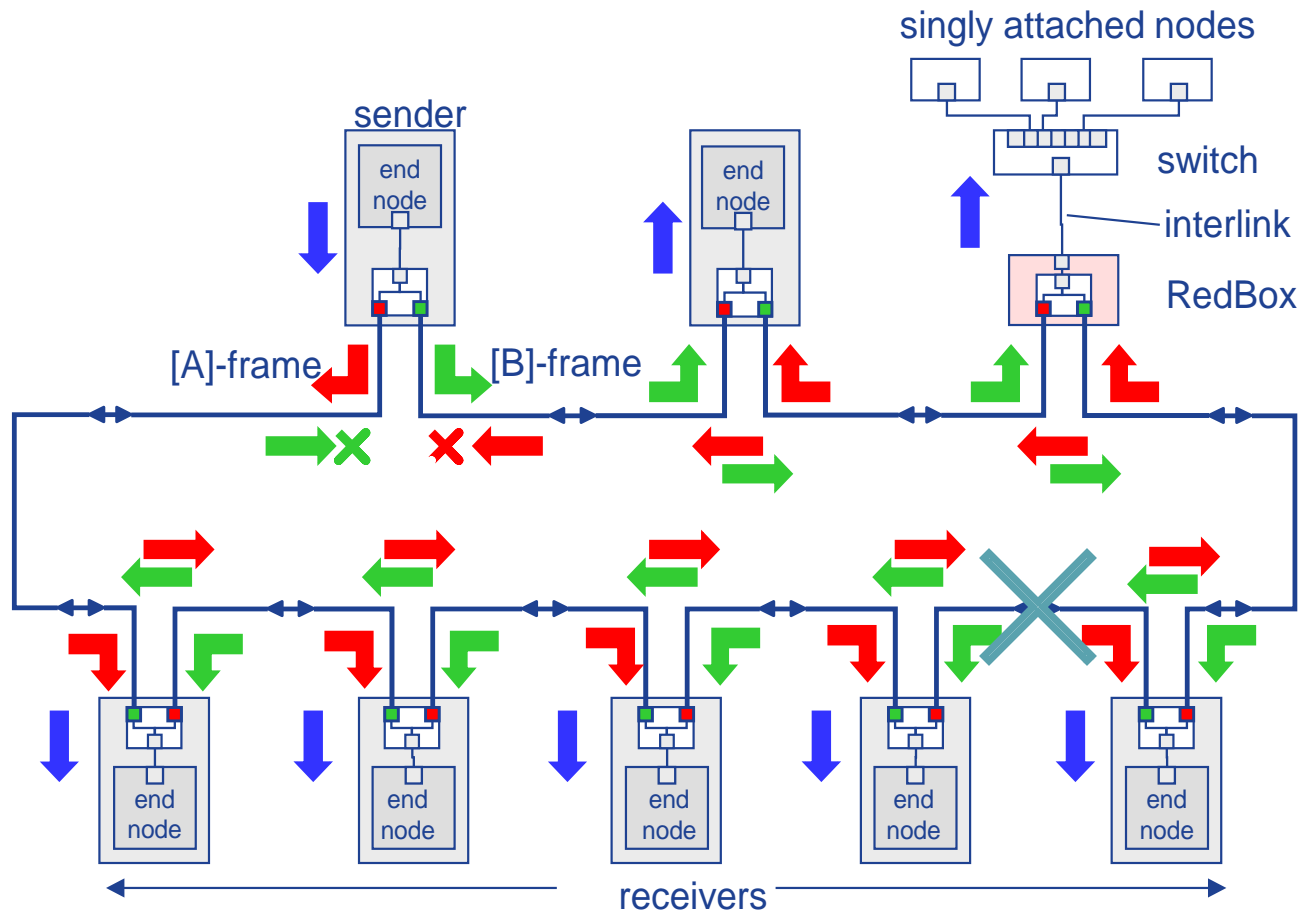
# Reliability through Redundancy

## Example of PRP Network



# Reliability through Redundancy

## Example of HSR Network



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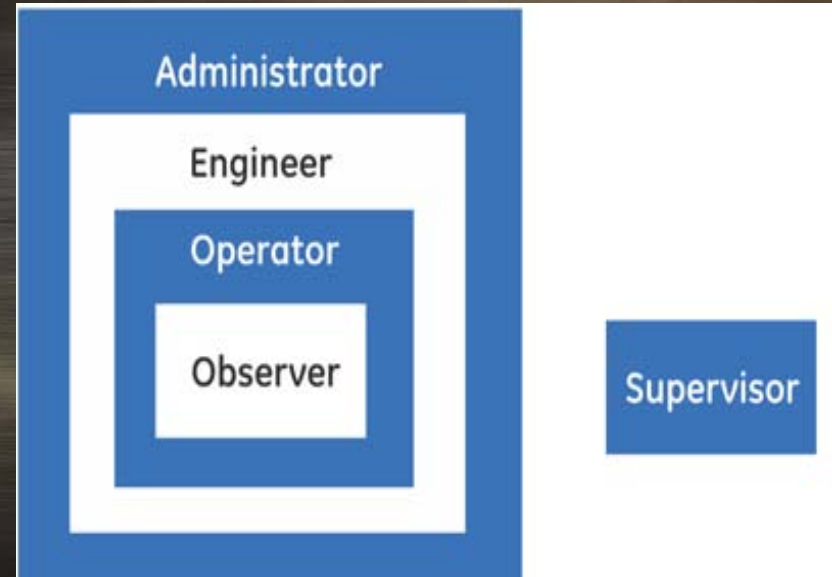
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# Security Considerations

## Security Principles Applied to P&C:

- Secure Defaults
- Restricted system access - RBAC
- Separation of duty
- Principle of least privilege
- Fail secure principle



# Security Considerations

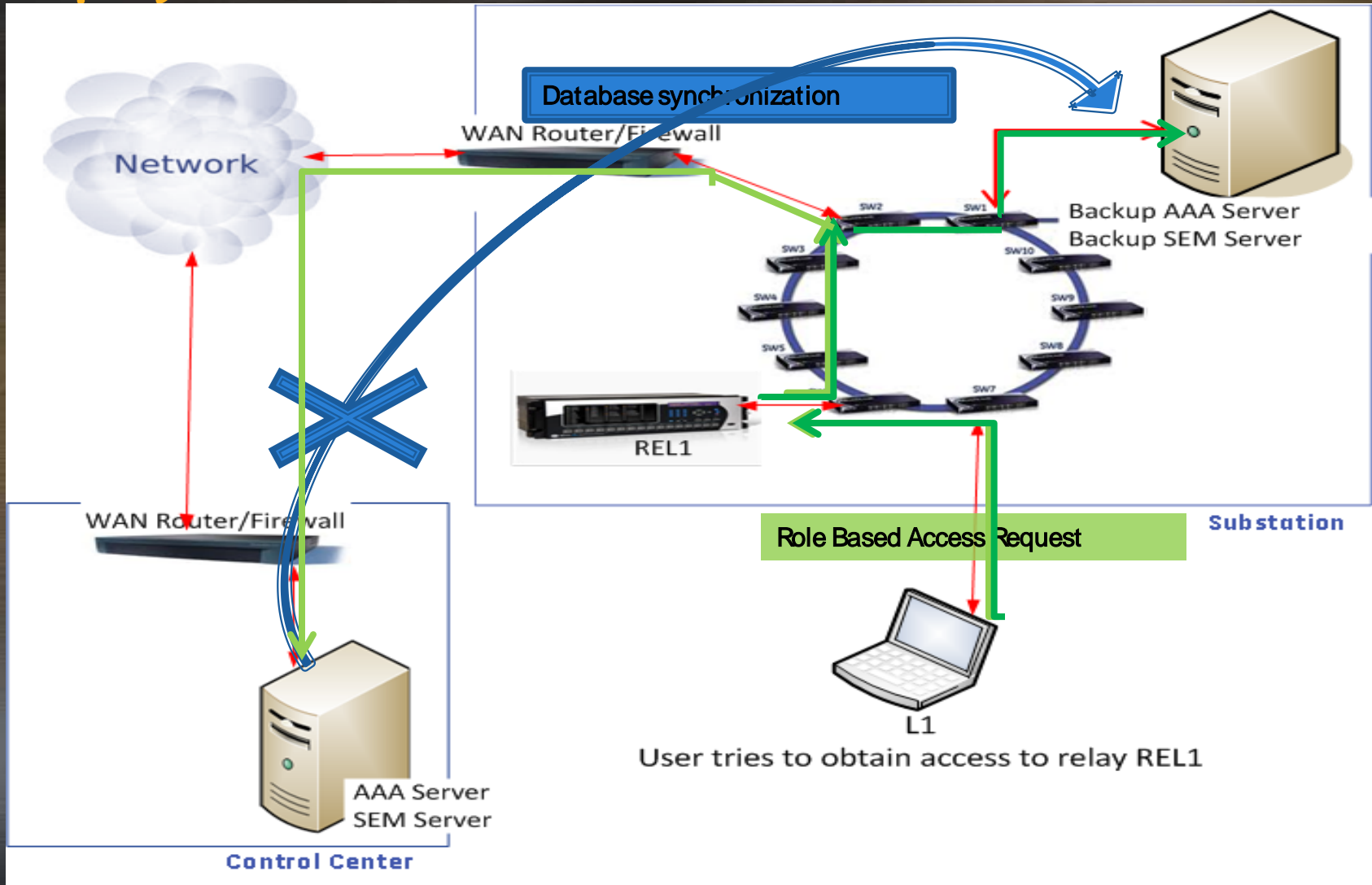
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## Multidimensional Approach:

- Secure Design and Implementation
  - Apply security principles
  - Software development processes to enforce consistency and quality
- Security through Prevention
  - Controlled user access to device (RBAC, strong password)
  - Centralized Authentication and Authorization
  - Data authentication / encryption
- Security through Detection
  - Security events logging (login, logout, setting changes)
  - Security Event Management servers

# Security Considerations

## Deployment with Redundant AAA and SEM servers



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# Conclusions

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- Protective relays are required to participate in complex deployments and rely on Ethernet.
- Baseline networking knowledge becomes very valuable to P&C engineers.
- This paper aimed to give ideas and solutions to some typical problems faced when integrating protective relays in an Ethernet based network.



Thank You

Questions?

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