HSR* Hands-On

- Part of workshop** on “HSR/PRP and PTP: Network Redundancy and Time Clock Synchronization” -

기안도
adki@future-ds.com

주최/주관: 한국통신학회 군통신연구회 / 명지대학교
장소: 숭실대학교 조만식기념관 427호
일자: 2019년6월7일

* HSR: High-availability Seamless Redundancy
** 이중화네트워크와 시각동기화 워크샵

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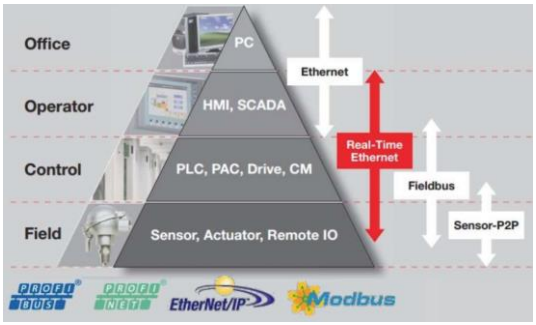
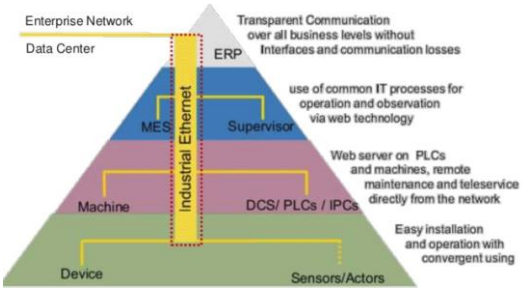
Ethernet is dominating in industrial network



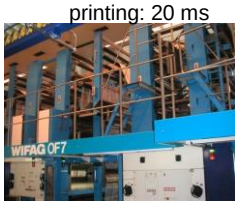


Time critical cases

- **Grace time**: the time that the plant allows for recovery before taking emergency actions (e.g. emergency shut-down, fall-back mode).
  - ► 유예시간(그레이스타임): 플랜트가 위급조치를 하기 전에 복원이 가능한 시간

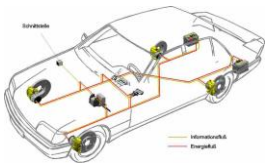
chemical: 1s

printing: 20 ms



cement: 10s

tilting train: 100ms



X-by wire: 10ms

substations: 5 ms

(Hard) real-time system with fault-tolerance

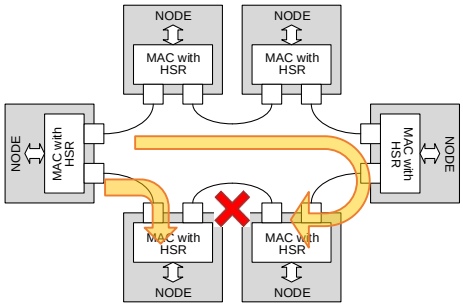
Failover time of redundancy protocol

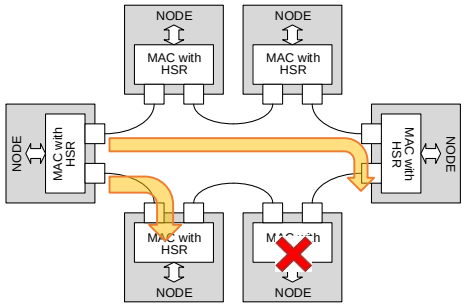
Protocol		standard	Typical reconfigure time	Remarks
STP	Spanning tree	IEEE 802.1	30s	any topology
RSTP	Rapid spanning tree	IEEE 802.1	2s	any topology
MRP	Media redundancy protocol	IEC 62439	200-500ms	ring
CRP	Cross network protocol	IEC 62439	1s	any topology
PRP	Parallel redundancy protocol	IEC 62439	0ms	any topology
BRP	Beacon redundancy protocol	IEC 62439	4.8ms	
Optimized RSTP	Rapid spanning tree	IEC 62439	5-20ms/hop	
Fast MRP	Media redundancy protocol		5-20ms	ring
HSR	High availability seamless redundancy	IEC 62439	0ms	ring
DRP	Distributed redundancy protocol	IEC 62439	100ms	ring

failover: 장애처리, 장애극복, 장애조치

What is HSR

- HSR: High-availability Seamless Redundancy protocol specified by IEC 62439-3 standard
  - HSR is a network protocol for Ethernet of ring topology that provides seamless failover against failure of any network component. (Zero reconfiguration time)
    - HSR은 네트웍 소자의 고장을 즉시 복구하는 링 토폴로지 이더넷용 네트웍 프로토콜이다

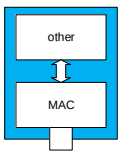




IEC - International Electrotechnical Commission

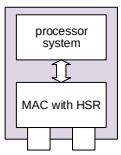
HSR components

- SAN (Single Attached Node)
  - Normal network component without HSR



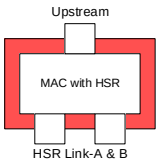
Single Link

- DANH (Double Attached Node with HSR)



HSR Link-A & B

- RedBox (Redundancy Box)

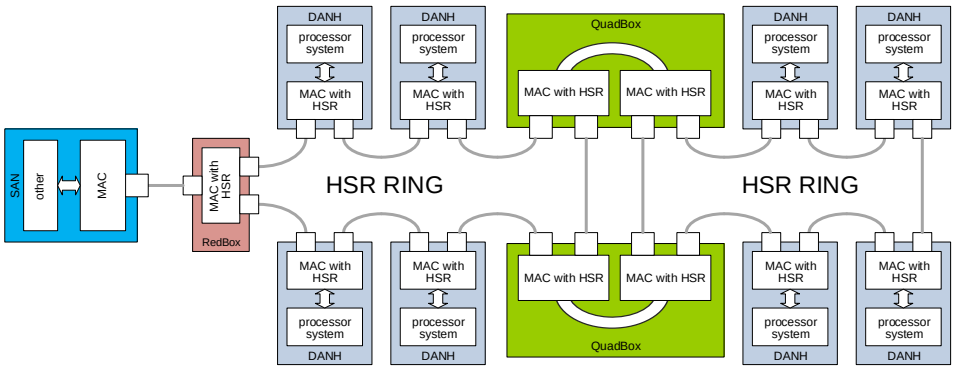


HSR Link-A & B

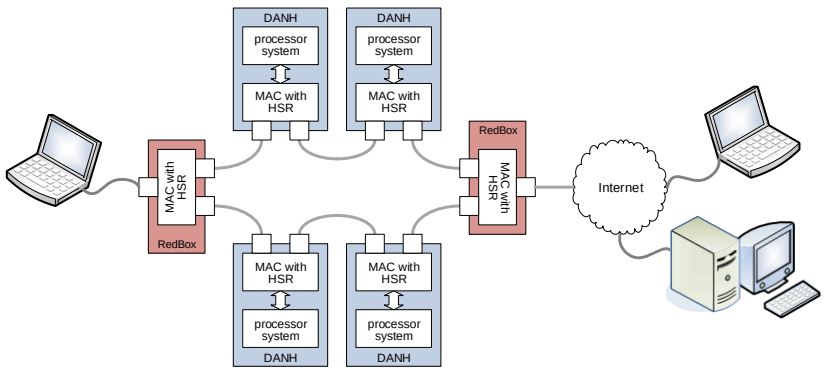
- QuadBox

HSR Link-A & B HSR Link-A & B

HSR network



An implementation of HSR system



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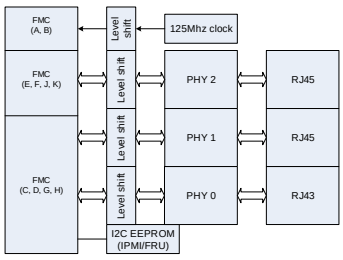
- Background
- An implementation of HSR system
- Hands-on practice

- An implementation of HSR system
  - Three-port board: FMC-GbE-RJ45
  - HSR MAC
  - HSR node: RedBox, DANH
  - Other components: MAC, PKT GEN, Bypass, Snoop, Optic
  - HSR system in action

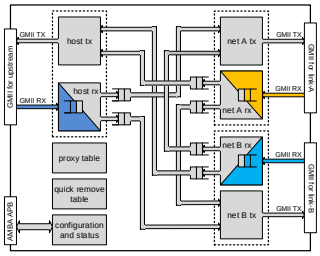
Three-port board: FMC-GbE-RJ45

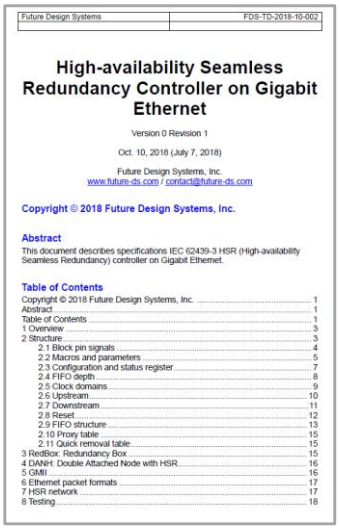


- An FMC board
- Compliant with VITA 57.1
- Gigabit Ethernet
  - GMII interface
  - RGMII interface

HSR controller

- HSR
  - Gigabit Ethernet
  - RedBox or DANH
  - Proxy table
  - Quick remove





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High-availability Seamless Redundancy Controller on Gigabit Ethernet

Version 0 Revision 1

Oct. 10, 2018 (July 7, 2018)

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Abstract

This document describes specifications IEC 62439-3 HSR (High-availability Seamless Redundancy) controller on Gigabit Ethernet.

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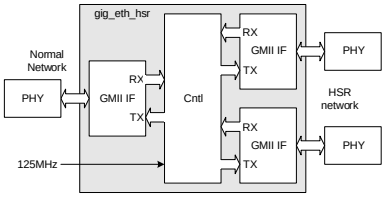
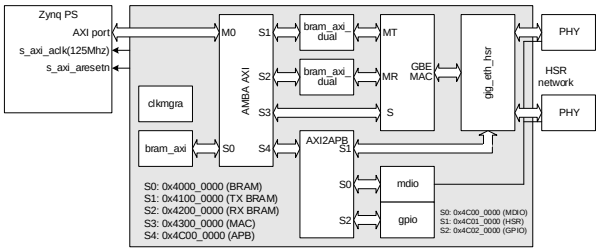
HSR node: RedBox



- One host (upstream) port
- Two HSR links
- Proxy table
- QR table

SAN (Single Attached Node).
➔ Any network node with Gigabit Ethernet port.

HSR node: DANH

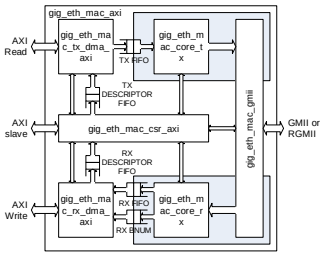


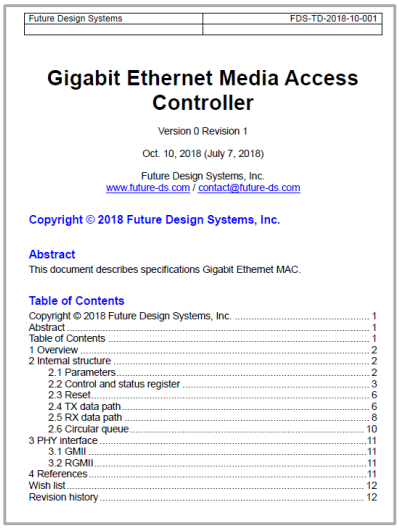
- AMBA AXI interface for processor system
  - Dual-core ARM Cortex A9 for Zynq board @ 667Mhz
- Two HSR links
- Proxy table
- QR table

HSR network link

MAC

- MAC (Media Access Controller)
  - AMBA AXI interface





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Gigabit Ethernet Media Access Controller

Version 0 Revision 1

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Abstract

This document describes specifications Gigabit Ethernet MAC.

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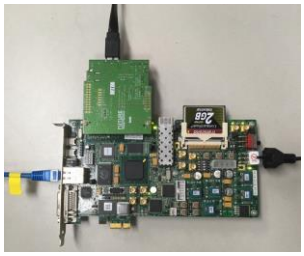
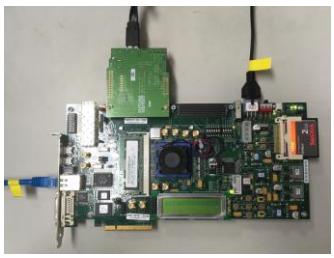
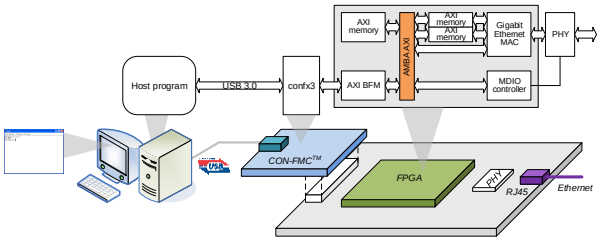
Other components



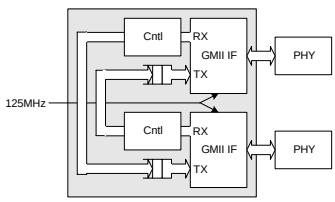


- Host program driven through CON-FMC with USB 3.0
- Generates and receive Ethernet packets

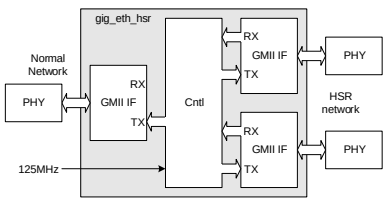


Other components

- Bypass
  - Simply forwarding packets



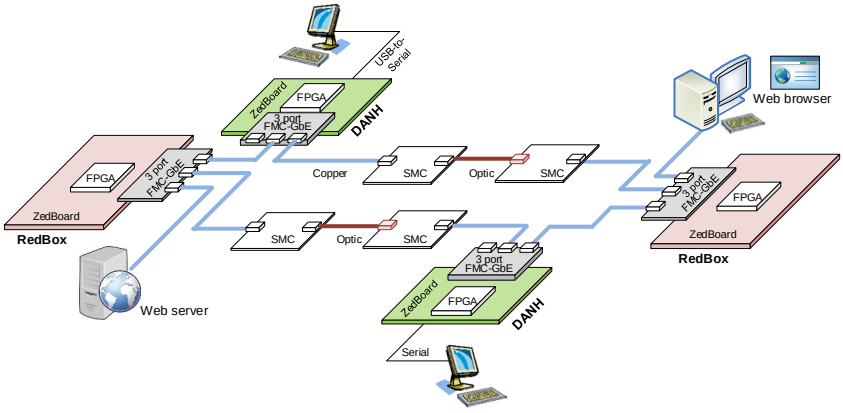
- Snoop
  - Listen network activity without any interventions



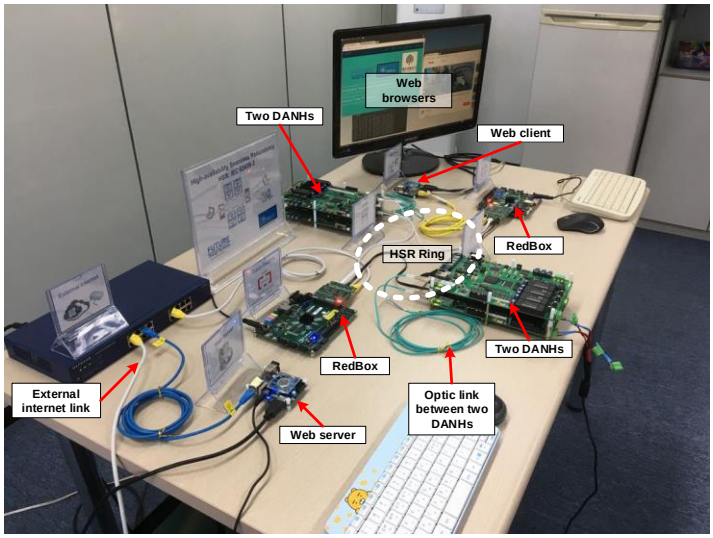
Other components

- Optic Ethernet & copper

An implementation of HSR system in action



An implementation of HSR system: in action



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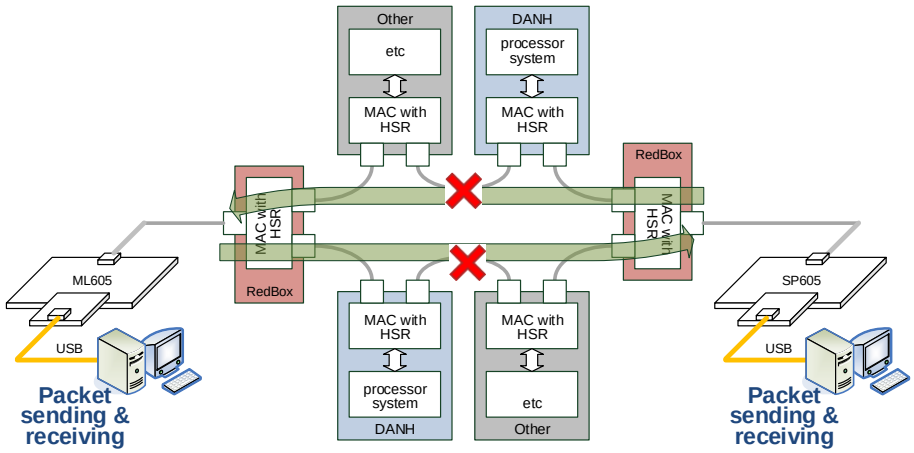
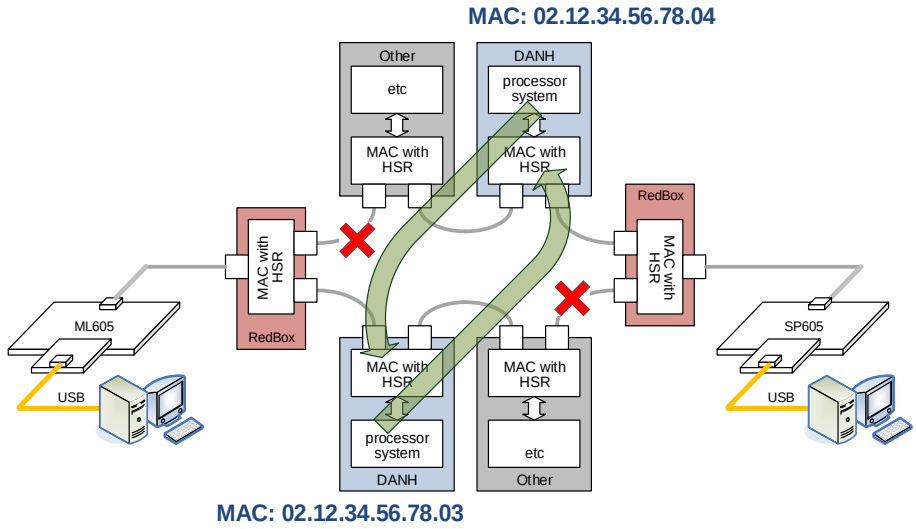
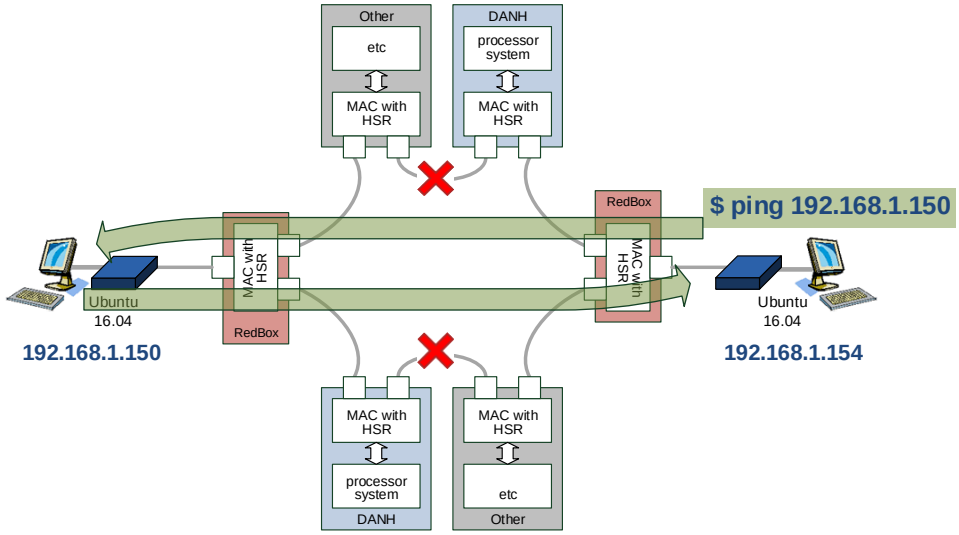
Using packet generator



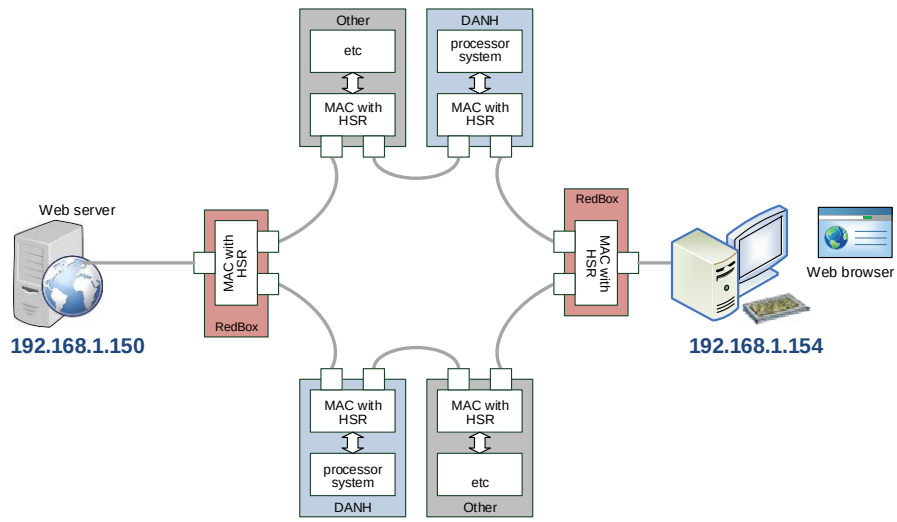
DANH to DANH



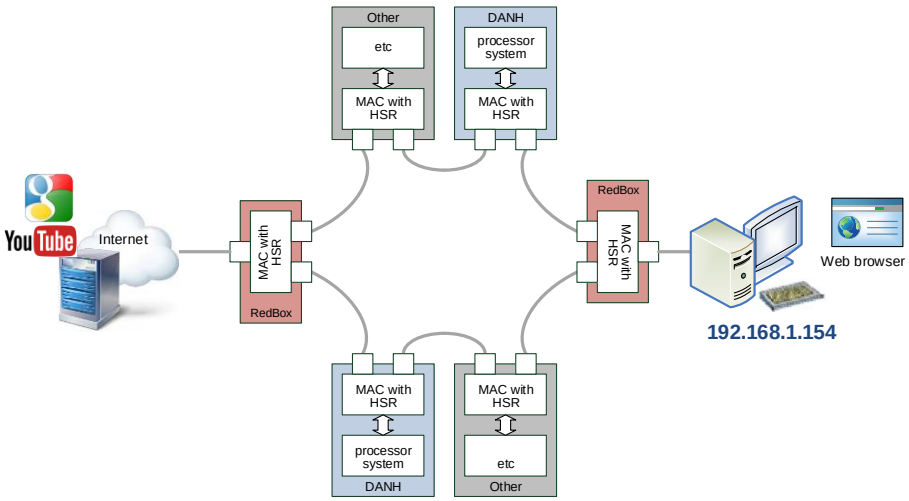
Using single board computer: PING



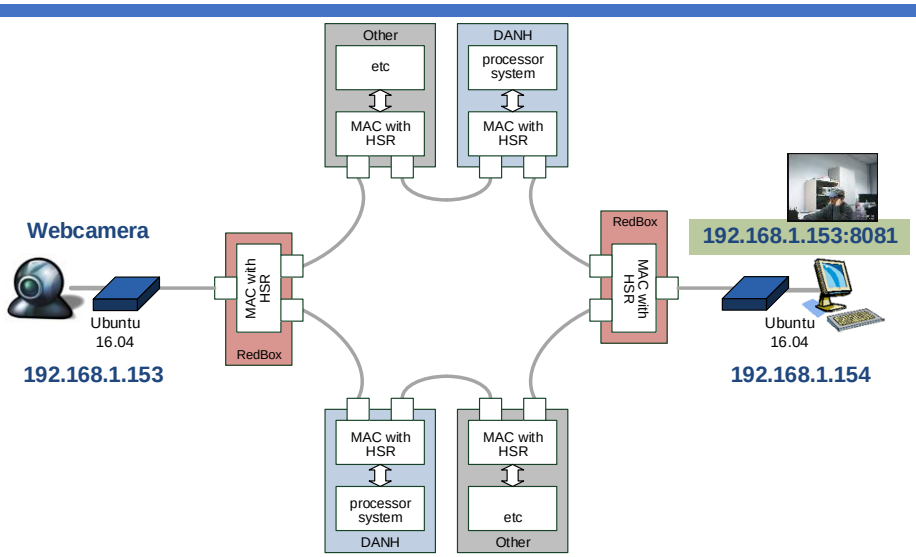
Web browsing: local



Web browsing: external



Webcam



㈜퓨쳐디자인시스템
34051 대전광역시 유성구 문지로 193, KAIST 문지캠퍼스, F723호
(042) 864-0211~0212 / contact@future-ds.com / www.future-ds.com

Future Design Systems, Inc.
Faculty Wing F723, KAIST Munji Campus, 193 Munji-ro, Yuseong-gu, Daejeon 34051, Korea
+82-042-864-0211~0212 / contact@future-ds.com / www.future-ds.com

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