Enhanced Use Cases for Scaling Deterministic Networks

draft-zhao-detnet-enhanced-use-cases-00

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Agenda

- Introduction
- Enhanced Use Cases and Network Requirements
- Classification of the Differentiated Applications
- Next Steps

DetNet Use Cases in RFC8578

- **Existing use cases and network requirements in RFC8578：**

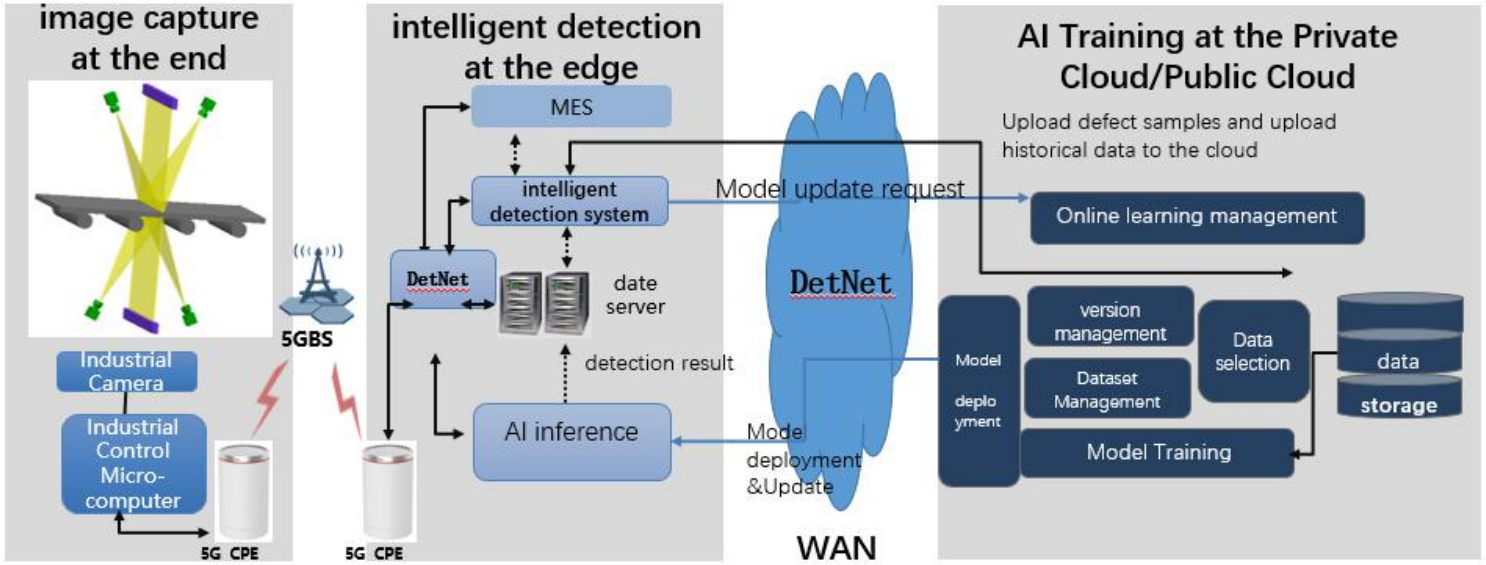
1. pro audio and video
2. Electrical Utilities
3. Building Automation Systems (BASs)
4. Wireless for Industrial Applications
5. Cellular Radio
6. Industrial Machine to Machine (M2M)
7. Mining Industry
8. Private Blockchain
9. Network Slicing

Introduction

- provides use cases and network requirements for scaling deterministic networks which is not covered in RFC8578：
  1. Industrial Internet
     - Machine Vision
     - Remote Control
     - AGV intelligent control
     - AR Assistance
  2. High Experience Video
     - Cloud VR and AR
     - Cloud Games
     - Cloud Live Streaming
  3. Computing-aware Applications
     - HPC and big data applications
     - DC remote disaster recovery
- analyzes the SLAs requirements and desired behaviors in enhanced DetNet for the three typical use cases and applications.

Use Case 1: Industrial Internet-Machine Vision

- The scenario of Machine Vision



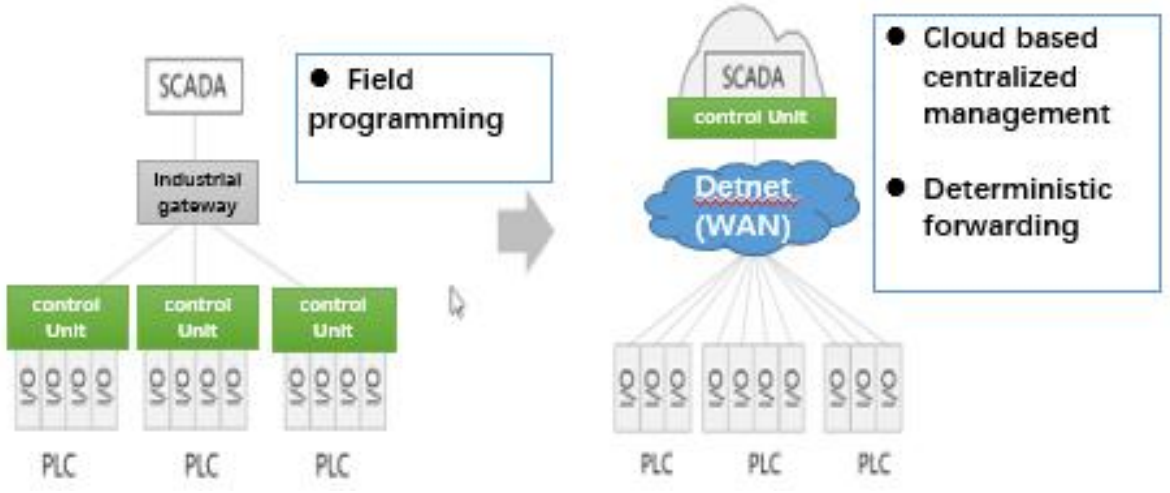
- real-time remote monitoring function, which requires high-speed connectivity characteristics
- Industrial camera images require high definition, with little or no compression, and high bandwidth requirements,

- Requirements of Machine Vision

Applications	Deterministic Network Requirements				
	bandwidth	delay	Availability	Note	
Machine Vision	Real time upload of image information:>50M	<10ms	99.99%	(1) Bandwidth sensitive (2) Cloud deployment and wide area bearing requirements	

Use Case 2: Industrial Internet-Remote Control

- The scenario of Remote Control



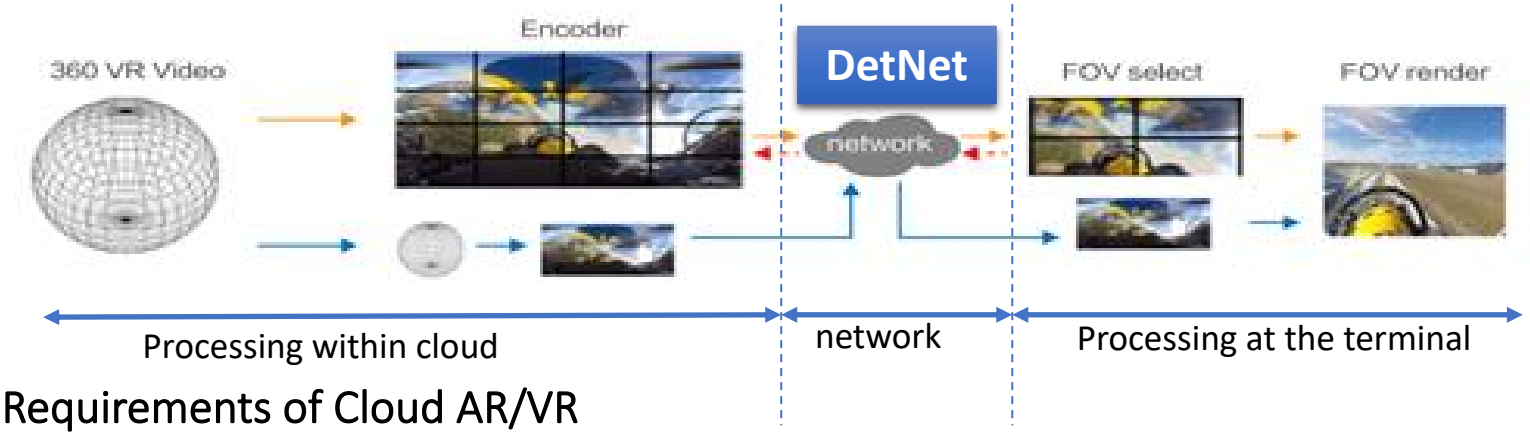
- The typical application of Remote Control is Cloud-based PLC (Programmable Logic Controller).
- jitter sensitive .

- Requirements of Remote Control

Applications	Deterministic Network Requirements				
	bandwidth	delay	jitter	Availability	Note
Remote Control	• Image/video stream upload, uplink>50Mbps; • PLC control command issued, downstream>50kbps;	• Within workshop level equipment<1ms • Workshop level equipment room<10ms • Remote operation in the park/city/wide area: image uplink<20ms; Command issuance<10ms;	<100us	99.999%	(1) Jitter sensitive type (2) Cloud based PLC has a need for wide area hosting

Use Case 3: High Experience Video-Cloud AR/VR

- The scenario of Cloud AR/VR



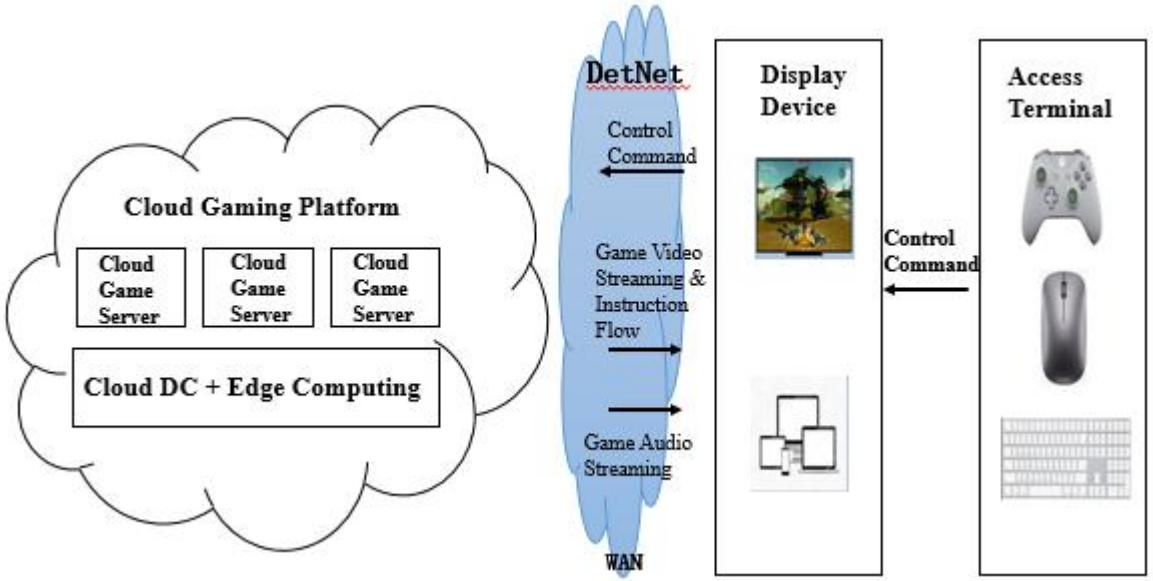
- rendering and streaming latency :cloud processing, network transmission, and terminal processing

- Requirements of Cloud AR/VR

Applications	Scenarios	Deterministic Network Requirements		
		bandwidth	delay	Packet loss rate
Cloud VR/AR	Cloud VR/AR Video_ Comfortable experience_ FOV	FOV: downstream≥ 75Mbps	≤50ms	≤1E-5
	Cloud VR/AR Video_ Comfortable experience_ Full perspective	Full view: downstream ≥ 140Mbps	≤50ms	≤1E-5
Cloud VR/AR with strong interaction	CloudVR/AR Strong Interaction_ Comfortable experience_ I frame	downstream ≥ 260Mbps	≤15ms	≤1E-5
	CloudVR/AR Strong Interaction_ Comfortable experience_ P frame	downstream≥ 260Mbps	≤15ms	≤1E-5
	CloudVR/AR Strong Interaction_ 8K Ideal Experience_ I frame	downstream ≥ 1Gbps (8K)	≤8ms	≤1E-6
	CloudVR/AR Strong Interaction_ 8K Ideal Experience_ P frame	Downstream ≥ 1Gbps (8K)	≤ 8ms	≤ 1E-6

Use Case 4: High Experience Video-Cloud Games

- The scenario of Cloud Games



- The online gaming technology based on cloud computing.
- enables lightweight devices to run high-quality games.
- gaming experience relies on a high-quality, low latency network environment.

- Requirements of Cloud Games

Applications			bandwidth	delay
Level of experience		Video resolution		
Cloud Games	Junior level	720P	8M	≤150ms
	3A professional level	1080P	12M	≤60ms
	Level of esports	4K	40M	≤60ms

Use Case 5: High Experience Video-Cloud Live Streaming

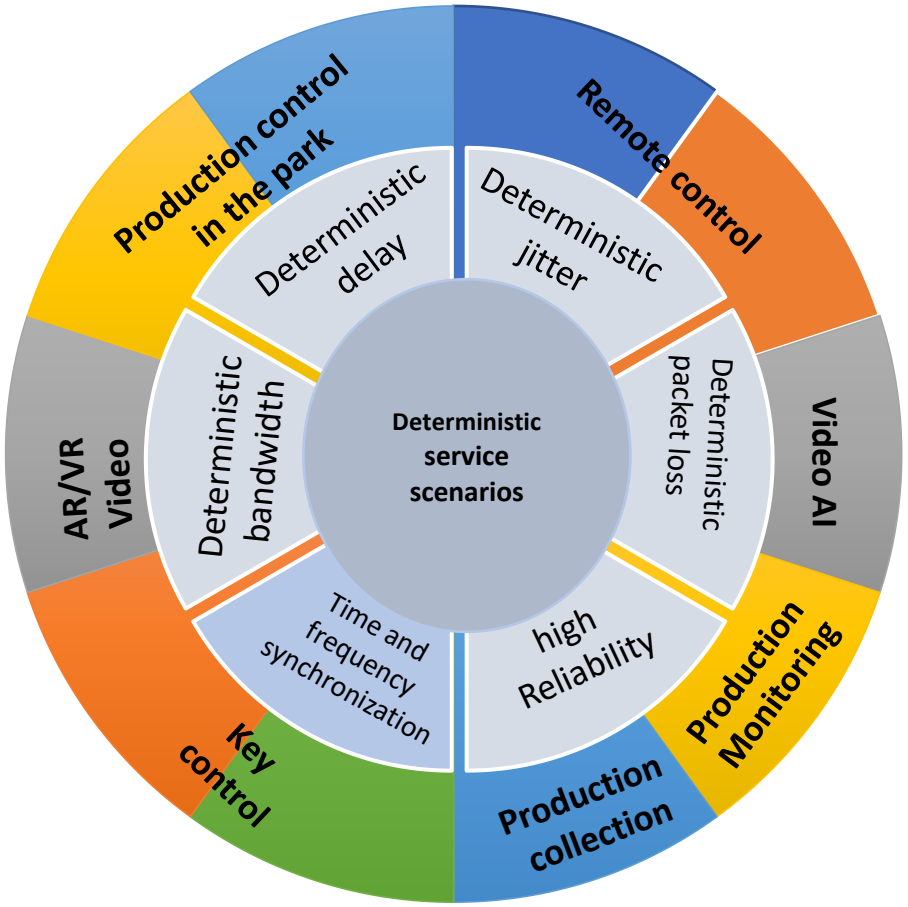
- The scenario of Cloud Live Streaming

- For scenarios such as concerts, press conferences, sports events, cloud live streaming uses 5G uplink high bandwidth to transmit 8K/VR videos.

- Requirements of Cloud Live Streaming

Applications	Cloud Video Application Scenarios	Deterministic Network Requirements			
		Frame rate	bandwidth	Delay	Availability
Cloud Live Streaming	8K live streaming 8K video Backhaul	60	Uplink 100Mbps	≤200ms	99.9%

Summry: Classification of the Differentiated Applications



7 typical scenarios:

Typical Scenarios	Industry Applications	Bearing characteristics	Differentiated SLA				
			bandwidth	delay	jitter	Isolation	Reliability
1.Production control in the park	Industrial Internet PLC, etc	Local area: low jitter+ low latency+ low bandwidth	<=N*2M bps	<=2ms	<100us	TDM hard isolation	99.9999%
2. Remote control	Industrial Internet Cloud PLC, etc	Local/metropolitan/wide area: low jitter+ low latency+ low bandwidth	<=N*2M bps	<=5ms	<100us	TDM hard isolation	99.9999%
3.Production collection	Industry IoT data collection, etc	Local/metropolitan/wide area: deterministic latency+ large connections+ low speeds	<=N*2M bps	<=50ms	——	Soft isolation	99.9%
4.Production Monitoring	Industry production and safety video monitoring, etc	Local/metropolitan/wide area: determine medium bandwidth+ determine medium latency	<=N*50M bps	<=20ms	<5ms	Soft isolation	99.999%
5. AR/VR high experience video	Industry AR/VR assistance, consumer AR/VR, high experience cloud games, and cloud live streaming	Local/metropolitan/wide area: deterministic high bandwidth+ deterministic low latency	<=N* 100M~1G bps	<=3ms (high quality)	<10ms	Soft isolation	99.999%
6. AI for video	machine vision and high-definition quality inspection for Industry scenarios	Local/metropolitan/wide area: deterministic large bandwidth+ low latency jitter + high reliability	<=N*100Mbps	<=10ms	——	Soft isolation	99.9999%
7.Key control	Physical isolation class of power grid: differential protection, etc., critical control class related to life safety in the industry	Local/metropolitan/wide area: ultra high reliability and isolation	<=N* 100M~1G bps	<=3ms (high quality)	<10ms	TDM hard isolation	99.9999%

- **Cloud-based applications and remote control** :strict delay/jitter deterministic and high reliability ;
- **Smart grid:** high isolation+low latency+low jitter+high-precision synchronization;
- **Industrial Internet :** low latency+low jitter+high reliability+high bandwidth;
- **Consumer entertainment:** high bandwidth+low latency;
- **Computing-aware Applications：** high bandwidth+low latency/Jitter +high reliability;

Next step

- Ask for WG feedback and suggestions.
- Comments and discussions are very welcome!

Thank You