Automatic Service Recording System Using Network-Based Monitoring Approach

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Background:

- **TTRS (Thai Telecommunication Relay Service) is a public organization offering Video Relay Services (VRS) to persons who are deaf, hard of hearing, having speech disabilities.**
- **USO (Universal Service Obligation) is a fundamental consumer protection policy in most countries to ensure that everyone has access to telecommunication services.**
- **With 4G/5G communication, VRS users can make a video call to TTRS. The agent (a signed language interpreter) helps to place a call and relay the conversation to any person.**
- **The VRS service is very efficient and most preferred by the deaf community because the flow of conversation is much more quickly than the text-based relay option.**

Targets:

- **The project goal is to record and archive video relay services at TTRS.**
- **The needs include service evaluation, verification, improvement, interpreter training, examination in case of appeal.**
- **Existing workflow requires the agent to involve in the process manually, which has an impact on workload and efficiency.**
- **The target is to make the whole process fully automated. So, the agent can focus on providing the VRS services.**
- **The process must also be intelligent to identify the caller, type of services, collect and save the details of the corresponding services.**

Proposed Method:

- **Network-based monitoring approach to capture network traffic.**
- **The system analyzes network packets, call signaling, and related protocols.**
- **Call signaling is based on SIP (Session Initiation Protocol), SDP (Session Description Protocol). We can detect call activities, collect call information and details.**
- **Audio stream is based on RTP (Real-Time Transport Protocol), G.711 encoding (Ref. RFC 7655).**
- **Video stream is based on RTP, H.264 encoding (Ref. RFC 6184).**
- **The system reassembles relevant media streams and create raw audio, video files.**
- **These files are edited and recomposed to create the final video file that captures the whole VRS conversation.**
- **The video file and call details are automatically uploaded to the cloud storage.**

Proposed Method:

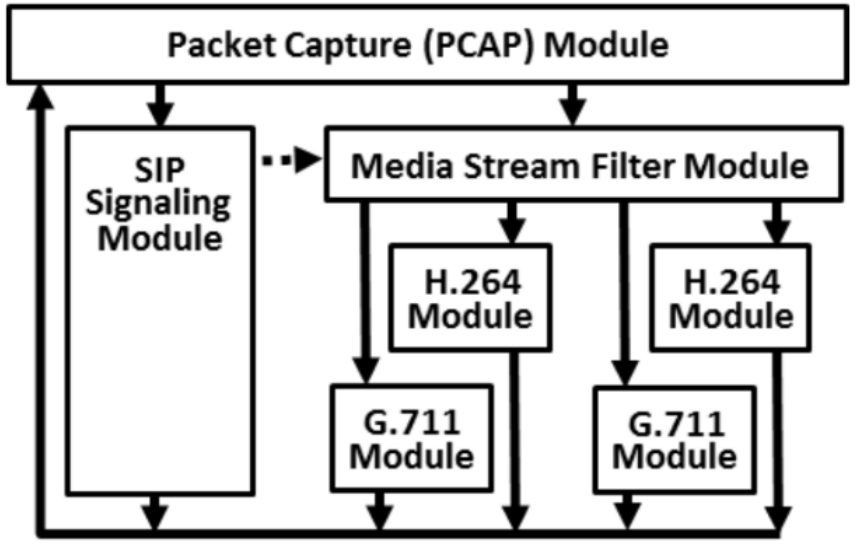
- **The system can analyze and visualize the call signaling and media streams with details.**

Time	Call IN 3570200184415 (เกรียงชัย กันธิยะ)		Agent ttrs videoone			Call OUT 0617364588
16:37:40.00	203.150.245.41 @ 5060	SIP INVITE/OK →	192.168.1.62 @ 62526			
16:37:43.87	203.150.245.41 @ 17510	← RTP/G711U	192.168.1.62 @ 7092			
16:37:44.20	203.150.245.41 @ 12610	RTP/H264 →	192.168.1.62 @ 9090			
16:37:44.23	203.150.245.41 @ 17510	RTP/G711U →	192.168.1.62 @ 7092			
16:37:44.23	203.150.245.41 @ 12610	← RTP/H264	192.168.1.62 @ 9090			
16:37:51.54				192.168.1.62 @ 62526	SIP INVITE/OK →	203.150.245.41 @ 5060
16:38:16.31				192.168.1.62 @ 7082	← RTP/G711U	203.150.245.41 @ 17990
16:38:16.37				192.168.1.62 @ 7082	RTP/G711U →	203.150.245.41 @ 17990

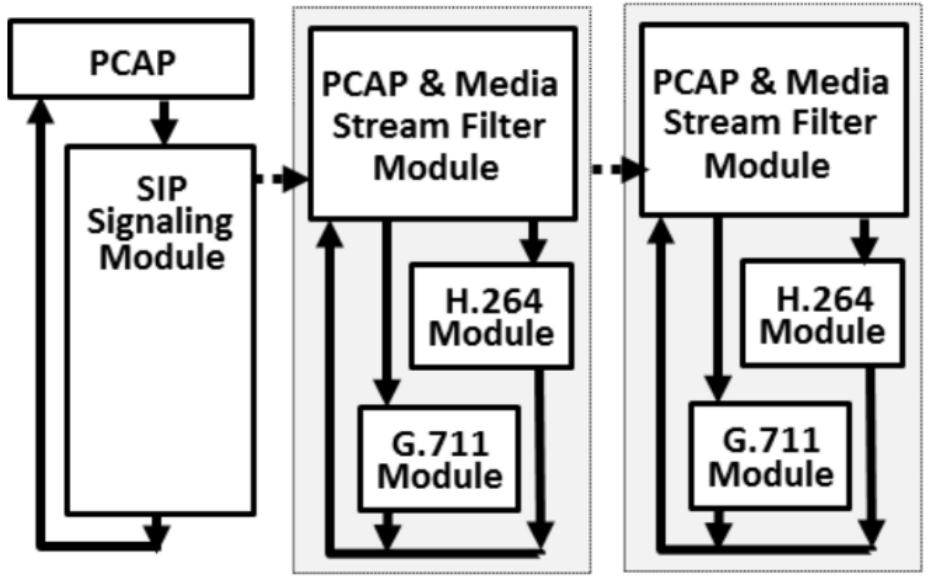
Demonstration of VRS call signaling and audio/video stream analysis

Implementation:

- **The implementation is based on Java, PCAP (Packet Capture), and ffmpeg library.**
- **A challenge is how to process many real-time interactive multi flows of media streams.**
- **The optimization is vital. The processing must be swift in time, without causing the buffer overflow problem.**
- **We propose a new methodology called Multiple Buckets (vs. traditional Single Bucket).**



Traditional Single Bucket PCAP



Multiple Bucket PCAP Architecture

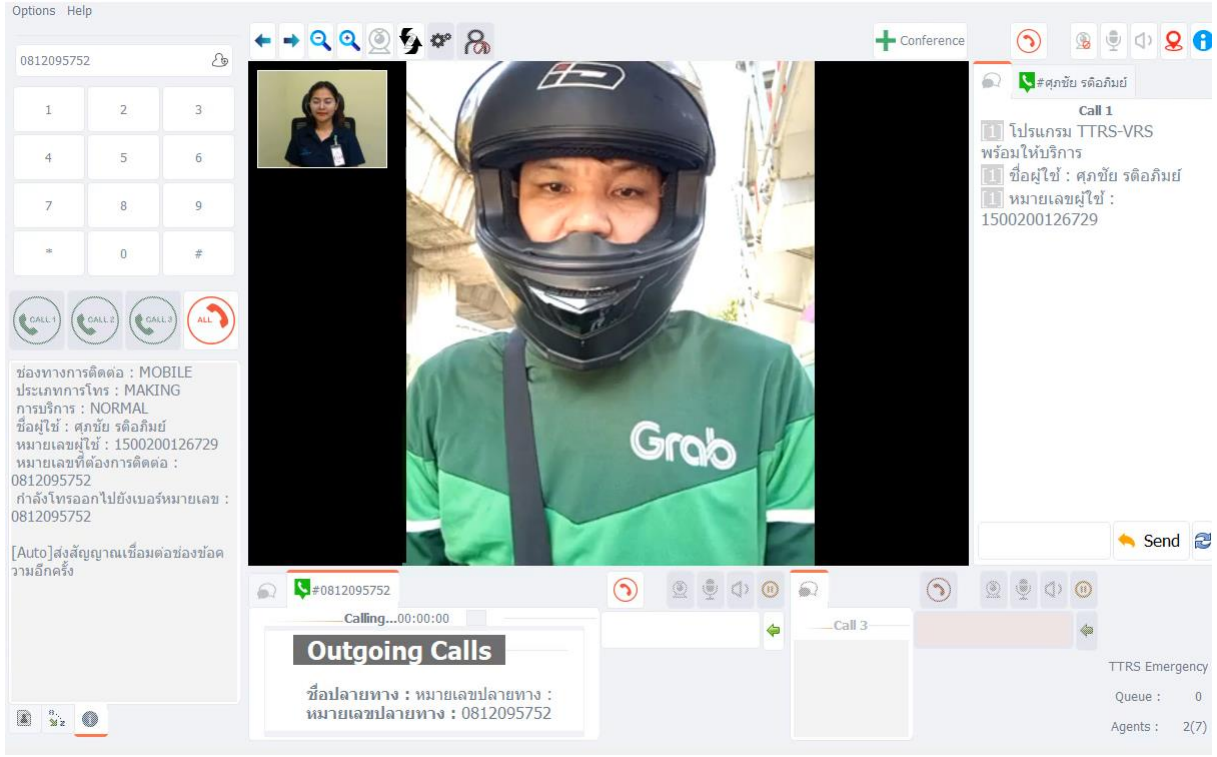
Impact:

- **We monitored the input, output rates and utilization of PCAP buffers.**
- **Output rates are slower because of processing time, causing buffers to build up.**
- **Longer call durations need more buffer, but PCAP buffer is limited.**
- **The experiment showed that Multiple Buckets can reduce buffer utilization around 65%.**

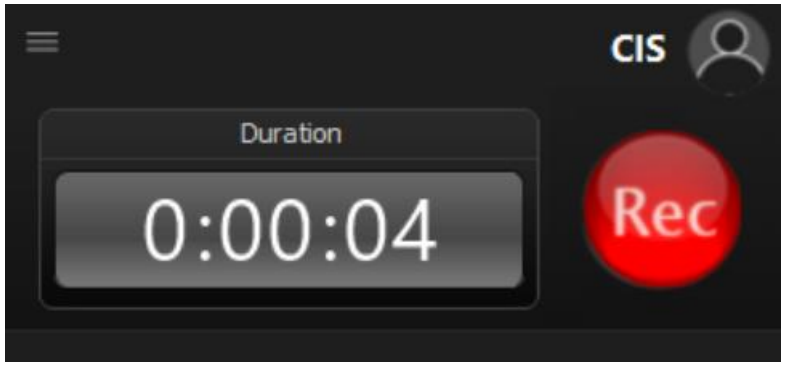
	Single Bucket			Multiple Buckets					
				Bucket 1			Bucket 2		
Call Duration (min)	Input Rate (KB/s)	Output Rate (KB/s)	Buffer Util (KB)	Input Rate (KB/s)	Output Rate (KB/s)	Buffer Util (KB)	Input Rate (KB/s)	Output Rate (KB/s)	Buffer Util (KB)
9.30	67.80	66.08	961.43	32.97	32.27	392.83	34.83	34.20	350.36
16.29	70.15	68.48	1,630.26	31.80	31.24	547.70	38.35	37.87	469.55
29.40	74.99	73.19	3,189.74	35.87	35.26	1,064.72	39.13	38.59	950.49
45.76	77.01	75.07	5,345.86	36.70	36.03	1,819.05	40.32	39.72	1,639.03
64.78	75.01	73.10	7,433.53	35.70	35.03	2,606.67	39.31	38.71	2,338.78

Output/Outcome:

- **The interpreter agent provides VRS services via softphone-based application.**
- **The caller makes a video call in. The recorder detects it and starts recording automatically.**
- **The recorder continues to record while the agent makes an outgoing call to a third party.**



Application UI of the Agent

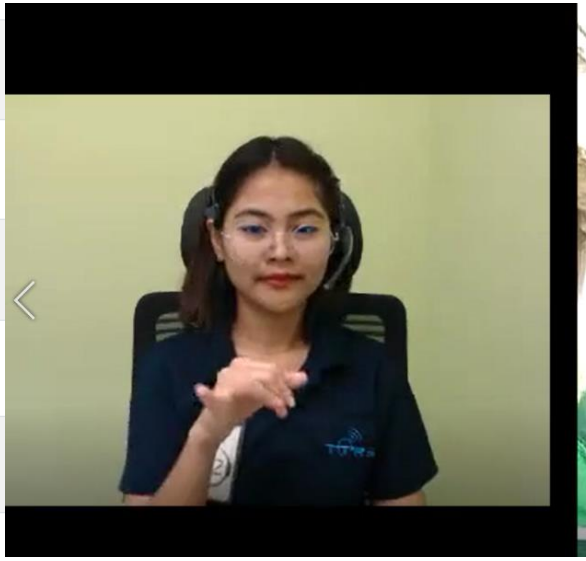


The Recorder UI

Output/Outcome:

- **The recorder portal allows the admins to easily monitor the VRS services.**
- **They can search for videos, corresponding service info, and technical details.**
- **They can click to play the videos in sharp, native resolution.**

วันที่ - เวลา	เจ้าหน้าที่	ผู้ติดต่อ	บริการ	รูปแบบ	เน็ตดาต้า	คุณภาพ	บันทึกการรับเรื่อง	ข้อมูลเทคนิค
11/11/2022 - 20:04:35	ttrs vdozero	3570200184415 (เกรียงชัย กันธิยะ)	VRS/v: 0891914140	App	1.06 Mbps	4.0	5:58 m / 15 MB	เพิ่มเติม / Log
10/11/2022 - 14:55:05	ttrs user	1480200037786 (บัวลอย อินทรี)	VRS/v: 0639030966	App	1.01 Mbps	4.0	5:03 m / 6.91 MB	เพิ่มเติม / Log
03/11/2022 - 11:58:58						4.0	5:03 m / 6.91 MB	เพิ่มเติม / Log
10/11/2022 - 14:00:55						4.0	5:03 m / 6.9 MB	เพิ่มเติม / Log
10/11/2022 - 08:12:49						4.0	5:01 m / 13 MB	เพิ่มเติม / Log
09/11/2022 - 17:11:31						4.0	4:41 m / 7.05 MB	เพิ่มเติม / Log
16/11/2022 - 13:27:16						4.0	3:52 m / 8.22 MB	เพิ่มเติม / Log



Conclusion:

- **We presented our R&D project under cooperation of NECTEC and TTRS.**
- **TTRS (Thai Telecommunication Relay Service) provides Video Relay Service to persons who are deaf or have speech disabilities.**
- **The project goal is to record and archive VRS services for evaluation, improvement, etc.**
- **The whole process must be fully automated and intelligent to record the relevant video and phone calls among the parties.**
- **We proposed the network-based monitoring approach, which can automatically detect the calls, analyze audio/video streams, and create video files of the VRS services.**
- **The project helps to reduce the agent workload. The agent can focus on the VRS services to the callers. The overall efficiency and utilization at TTRS are improved significantly.**
- **Finally, this work can be connected and extended in other projects that involve network traffic capture for analytical processes.**