

CR-Form-v12.1

CHANGE REQUEST

22.261 CR 0611 rev 2 Current version: 18.4.0

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<http://www.3gpp.org/Change-Requests>.

Proposed change affects: UICC apps ME Radio Access Network Core Network

Title:	Introduction of text for Tactile and multi-modal communication service		
Source to WG:	China Mobile, InterDigital, Huawei		
Source to TSG:	SA WG1		
Work item code:	TACMM	Date:	2021-10-25
Category:	B	Release:	Rel-18
	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
	F (correction)		Rel-8 (Release 8)
	A (mirror corresponding to a change in an earlier release)		Rel-9 (Release 9)
	B (addition of feature),		Rel-10 (Release 10)
	C (functional modification of feature)		Rel-11 (Release 11)
	D (editorial modification)		...
	Detailed explanations of the above categories can be found in 3GPP TR 21.900 .		Rel-15 (Release 15)
			Rel-16 (Release 16)
			Rel-17 (Release 17)
			Rel-18 (Release 18)

Reason for change: Normative requirements and KPIs for tactile and multi-modal communication service is missing.

Summary of change: Normative requirements and KPIs for tactile and multi-modal communication service is added.

Consequences if not approved: Service not available in Rel-18

Clauses affected: 2, 3.1, 6.43 (new), 6.43.1 (new), 6.43.2 (new), 7.10 (new)

Other specs affected: (show related CRs)	Y	N				
	<input checked="" type="checkbox"/>	<input type="checkbox"/>			Other core specifications	TS/TR ... CR ...
	<input checked="" type="checkbox"/>	<input type="checkbox"/>			Test specifications	TS/TR ... CR ...
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O&M Specifications	TS/TR ... CR ...		

Other comments:

This CR's revision history:

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] NGMN 5G White Paper v1.0, February 2015.
- [3] 3GPP TS 22.011: "Service accessibility".
- [4] NGMN, "Perspectives on Vertical Industries and Implications for 5G, v2.0", September 2016.
- [5] 3GPP TS 22.278: "Service requirements for the Evolved Packet System (EPS)".
- [6] 3GPP TS 22.101: "Service aspects; Service principles".
- [7] 3GPP TS 22.146: "Multimedia Broadcast/Multicast Service (MBMS)".
- [8] 3GPP TS 22.246: "Multimedia Broadcast/Multicast Service (MBMS) user services".
- [9] 3GPP TS 22.186: "Enhancement of 3GPP support for V2X scenarios".
- [10] NGMN, "Recommendations for NGMN KPIs and Requirements for 5G", June 2016
- [11] 3GPP TS 22.115: "Service aspects; Charging and billing".
- [12] Communication network dependability engineering. IEC 61907:2009.
- [13] Soriano, R., Alberto, M., Collazo, J., Gonzales, I., Kupzo, F., Moreno, L., & Lorenzo, J. OpenNode. Open Architecture for Secondary Nodes of the Electricity Smartgrid. In Proceedings CIRED 2011 21st International Conference on Electricity Distribution, CD1. June 2011.
- [14] North American Electric Reliability Council. Frequently Asked Questions (FAQs) Cyber Security Standards CIP-002-1 through CIP-009-1. Available: http://www.nerc.com/docs/standards/sar/Revised_CIP-002-009_FAQs_06Mar06.pdf. 2006.
- [15] McTaggart, Craig, et al. "Improvements in power system integrity protection schemes". Developments in Power System Protection (DPSP 2010). Managing the Change, 10th IET International Conference on. IET, 2010.
- [16] IEEE Power Engineering Society – Power System Relaying Committee – System Protection Subcommittee Working Group C-6. Wide Area Protection and Emergency Control.
- [17] Begovic, Miroslav, et al. "Wide-area protection and emergency control". Proceedings of the IEEE 93.5, pp. 876-891, 2005.
- [18] ITU-T Recommendation G.1000 "Communications quality of service: A framework and definitions".
- [19] IEC 61907, "Communication network dependability engineering".
- [20] NIST, "Framework for Cyber-Physical Systems", 2016.

- [21] 3GPP TS 22.104: "Service requirements for cyber-physical control applications in vertical domains".
- [22] 3GPP TS 22.262: "Message Service within the 5G System".
- [23] 3GPP TS 22.289: "Mobile Communication System for Railways".
- [24] 3GPP TS 22.071: "Location Services".
- [25] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".
- [26] 3GPP TS 22.125: "Unmanned Aerial System (UAS) support in 3GPP".
- [27] 3GPP TS 22.468: "Group Communication System Enablers (GCSE)".
- [28] 3GPP TS 22.263: "Service requirements for Video, Imaging and Audio for Professional Applications (VIAPA)".
- [29] 3GPP TS 22.263: "Service requirements for Video, Imaging and Audio for Professional Applications".
- [30] 3GPP TS 22.179: "Mission Critical Push to Talk (MCPTT)".
- [31] IEEE 1588-2019, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.
- [32] IEC 61850-9-3-2016 - IEC/IEEE International Standard - Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation.
- [33] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN"
- [34] ATIS-0900005: "Technical Report on GPS Vulnerability",
https://access.atis.org/apps/group_public/download.php/36304/ATIS-0900005.pdf
- [35] European Commission, Regulatory Technical Standard 25. Level of accuracy of business clocks
https://ec.europa.eu/finance/securities/docs/isd/mifid/rt/160607-rt-25_en.pdf (annex
https://ec.europa.eu/finance/securities/docs/isd/mifid/rt/160607-rt-25-annex_en.pdf)
- [36] 5G-ACIA, "Exposure of 5G capabilities for Connected Industries and Automation Applications", 5G-ACIA white paper, February 2021, https://5g-acia.org/wp-content/uploads/2021/04/5G-ACIA_ExposureOf5GCapabilitiesForConnectedIndustriesAndAutomationApplications.pdf
- [37] 3GPP TS 22.173: "IP Multimedia Core Network Subsystem (IMS) Multimedia Telephony Service and supplementary services".
- [38] [ITU-T, "Technology Watch Report: The Tactile Internet", August 2014.](#)
- [39] [D. Soldani, Y. Guo, B. Barani, P. Mogensen, I. Chih-Lin, S. Das, "5G for ultra-reliable low-latency communications". IEEE Network, 2018 Apr 2, 32\(2\):6-7.](#)
- [40] [O. Holland et al., "The IEEE 1918.1 "Tactile Internet" Standards Working Group and its Standards.-" Proceedings of the IEEE, vol. 107, no. 2, Feb. 2019.](#)
- [41] [Altinsoy, M. E., Blauert, J., & Treier, C., "Inter-Modal Effects of Non-Simultaneous Stimulus Presentation." A. Alippi \(Ed.\), Proceedings of the 7th International Congress on Acoustics, Rome, Italy, 2001.](#)
- [42] [Hirsh I.J., and Sherrick C.E. 1961. J. Exp. Psychol 62, 423-432](#)
- [43] [Altinsoy, M.E. \(2012\). "The Quality of Auditory-Tactile Virtual Environments," Journal of the Audio Engineering Society, Vol. 60, No. 1/2, pp. 38-46, Jan.-Feb. 2012.](#)

[44] [M. Di Luca and A. Mahnan, "Perceptual Limits of Visual-Haptic Simultaneity in Virtual Reality Interactions," 2019 IEEE World Haptics Conference \(WHC\), 2019, pp. 67-72, doi: 10.1109/WHC.2019.8816173.](#)

[45] [K. Antonakoglou et al., "Toward Haptic Communications Over the 5G Tactile Internet", IEEE Communications Surveys & Tutorials, 20 \(4\), 2018.](#)

===== Second Change =====

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

5G enhanced positioning area: a subset of the 5G positioning service area that is assumed to be provided with additional infrastructure or deploy a particular set of positioning technologies to enhance positioning services.

NOTE 1: The enhanced positioning service area represents for example a factory plant, a dense urban area, an area along a road or railway track, a tunnel and covers both indoor and outdoor environments.

5G LAN-type service: a service over the 5G system offering private communication using IP and/or non-, i.e. UEs that are members of the same 5G LAN-VN IP type communications.

5G LAN-virtual network: a virtual network capable of supporting 5G LAN-type service.

5G satellite access network: 5G access network using at least one satellite.

5G positioning service area: a service area where positioning services would solely rely on infrastructures and positioning technologies that can be assumed to be present anywhere where 5G is present (e.g. a country-wide operator-supplied 5G network, GNSS, position/motion sensors). NOTE 2: This includes both indoor and any outdoor environments.

active communication: a UE is in active communication when it has one or more connections established. A UE may have any combination of PS connections (e.g. PDP contexts, active PDN connections).

activity factor: percentage value of the amount of simultaneous active UEs to the total number of UEs where active means the UEs are exchanging data with the network.

area traffic capacity: total traffic throughput served per geographic area.

authorised administrator: a user or other entity authorised to partially configure and manage a network node in a CPN (e.g. a PRAS, or eRG).

communication service availability: percentage value of the amount of time the end-to-end communication service is delivered according to a specified QoS, divided by the amount of time the system is expected to deliver the end-to-end service.

NOTE 3: The end point in "end-to-end" is the communication service interface.

NOTE 4: The communication service is considered unavailable if it does not meet the pertinent QoS requirements. For example, the communication service is unavailable if a message is not correctly received within a specified time, which is the sum of maximum allowed end-to-end latency and survival time.

Customer Premises Network: a network located within a premise (e.g. a residence, office or shop), which is owned, installed and/or (at least partially) configured by the customer of a public network operator.

direct device connection: the connection between two UEs without any network entity in the middle.

direct network connection: one mode of network connection, where there is no relay UE between a UE and the 5G network.

Disaster Condition: This is the condition that a government decides when to initiate and terminate, e.g. a natural disaster. When this condition applies, users may have the opportunity to mitigate service interruptions and failures.

Disaster Inbound Roamer: A user that (a) cannot get service from the PLMN it would normally be served by, due to failure of service during a Disaster Condition, and (b) is able to register with other PLMNs.

Disaster Roaming: This is the special roaming policy that applies during a Disaster Condition.

end-to-end latency: the time that it takes to transfer a given piece of information from a source to a destination, measured at the communication interface, from the moment it is transmitted by the source to the moment it is successfully received at the destination.

evolved Residential Gateway: a gateway between the public operator network (fixed/mobile/cable) and a customer premises network.

holdover: A clock A, previously synchronized/synchronized to another clock B (normally a primary reference or a Master Clock) but whose frequency is determined in part using data acquired while it was synchronized/synchronized to B, is said to be in holdover or in the holdover mode as long as it is within its accuracy requirements.

NOTE 4bis: holdover is defined in [31]

Holdover time: the time period that is available to repair the first priority timing source when it is lost (e.g., when the primary GNSS reference is lost). During this period the synchronization accuracy requirement should be guaranteed, e.g., by means of defining multiple synchronization references.

Hosted Service: a service containing the operator's own application(s) and/or trusted third-party application(s) in the Service Hosting Environment, which can be accessed by the user.

hybrid access: access consisting of multiple different access types combined, such as fixed wireless access and wireline access.

indirect network connection: one mode of network connection, where there is a relay UE between a UE and the 5G network.

IoT device: a type of UE which is dedicated for a set of specific use cases or services and which is allowed to make use of certain features restricted to this type of UEs.

NOTE 5: An IoT device may be optimized for the specific needs of services and application being executed (e.g. smart home/city, smart utilities, e-Health and smart wearables). Some IoT devices are not intended for human type communications.

network slice: a set of network functions and corresponding resources necessary to provide the required telecommunication services and network capabilities.

NG-RAN: a radio access network connecting to the 5G core network which uses NR, E-UTRA, or both.

non-public network: a network that is intended for non-public use.

NR: the new 5G radio access technology.

Personal IoT Network: A configured and managed group of at least one UE and one or more PIN Element that communicate with each other.

PIN Element: UE or non-3GPP device that can communicate within a PIN.

PIN direct connection: the connection between two PIN Elements without any 3GPP RAN or core network entity in the middle.

NOTE 5A: A PIN direct connection could internally be relayed by other PIN Elements.

NOTE 5B: When a PIN direct connection is between two PIN Elements that are UEs this direct connection is typically known as a direct device connection.

PIN Element with Gateway Capability: a UE PIN Element that has the ability to provide connectivity to and from the 5G network for other PIN Elements.

NOTE 5C: A PIN Element can have both PIN management capability and Gateway Capability.

PIN Element with Management Capability: A PIN Element with capability to manage the PIN.

positioning service availability: percentage value of the amount of time the positioning service is delivering the required position-related data within the performance requirements, divided by the amount of time the system is expected to deliver the positioning service according to the specification in the targeted service area.

positioning service latency: time elapsed between the event that triggers the determination of the position-related data and the availability of the position-related data at the system interface.

Premises Radio Access Station: a base station installed at a customer premises network.

priority service: a service that requires priority treatment based on regional/national or operator policies.

private communication: a communication between two or more UEs belonging to a restricted set of UEs.

private network: an isolated network deployment that does not interact with a public network.

private slice: a dedicated network slice deployment for the sole use by a specific third-party.

Ranging: refers to the determination of the distance between two UEs and/or the direction of one UE from the other one via direct device connection.

relative positioning: relative positioning is to estimate position relatively to other network elements or relatively to other UEs.

reliability: in the context of network layer packet transmissions, percentage value of the packets successfully delivered to a given system entity within the time constraint required by the targeted service out of all the packets transmitted.

satellite: a space-borne vehicle embarking a bent pipe payload or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO) typically at an altitude between 300 km to 2 000 km, Medium-Earth Orbit (MEO) typically at an altitude between 8 000 to 20 000 km, or Geostationary satellite Earth Orbit (GEO) at 35 786 km altitude.

satellite access: direct connectivity between the UE and the satellite.

satellite NG-RAN: a NG-RAN which uses NR in providing satellite access to UEs.

service area: geographic region where a 3GPP communication service is accessible.

NOTE 6: The service area can be indoors.

NOTE 7: For some deployments, e.g. in process industry, the vertical dimension of the service area can be considerable.

service continuity: the uninterrupted user experience of a service that is using an active communication when a UE undergoes an access change without, as far as possible, the user noticing the change.

NOTE 8: In particular service continuity encompasses the possibility that after a change the user experience is maintained by a different telecommunication service (e.g. tele- or bearer service) than before the change.

NOTE 9: Examples of access changes include the following. For EPS: CS/PS domain change. For EPS and 5G: radio access change, switching between a direct network connection and an indirect network connection.

Service Hosting Environment: the environment, located inside of 5G network and fully controlled by the operator, where Hosted Services are offered from.

synchronization threshold: A multi-modal synchronization threshold can be defined as the maximum tolerable temporal separation of the onset of two stimuli, one of which is presented to one sense and the other to another sense, such that the accompanying sensory objects are perceived as being synchronous.

NOTE 10: This definition is based on [410].

survival time: the time that an application consuming a communication service may continue without an anticipated message.

Time to First Fix (TTFF): time elapsed between the event triggering for the first time the determination of the position-related data and the availability of the position-related data at the positioning system interface.

User Equipment: An equipment that allows a user access to network services via 3GPP and/or non-3GPP accesses.

user experienced data rate: the minimum data rate required to achieve a sufficient quality experience, with the exception of scenario for broadcast like services where the given value is the maximum that is needed.

wireless backhaul: a link which provides an interconnection between 5G network nodes and/or transport network using 5G radio access technology.

===== Third Change =====

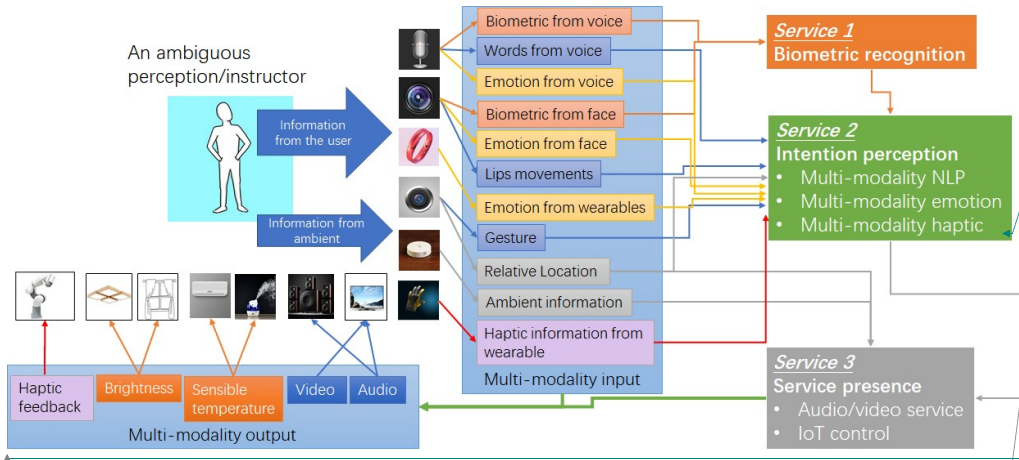
6.43 Tactile and multi-modal communication service

6.43.1 Description

The tactile and multi-modal communication service combines input / output from multiple sources and enable multi-modal interactions, combining ultra-low latency with extremely high availability and reliability. The tactile and multi-modal communication service can be applied in multiple fields, e.g. industry, robotics and telepresence, virtual reality, augmented reality, healthcare, road traffic, serious gaming, education, culture and smart grid [38]. These services support applications enabling input from more than one sources and/or output to more than one destinations to convey information more effectively. As Fig-figure 6.43.1-1 illustrates, the input and output may can be different modalities including: The benefit of combining input from more than one source and/or output to more than one destination, is that the communication can be more accurate and faster and responses can be quicker. This provides a communication service that is smoother and more natural.

For a typical tactile and multi-modal communication service, there can be different modalities affecting the user experience, e.g.:

- Video/Audio media;
- Information re-perceived by sensors about the environment, e.g. brightness, temperature, humidity, etc.;
- Haptic data: can be feelings when touching a surface (e.g., pressure, texture, vibration, temperature), or kinaesthetic senses (e.g. gravity, pull forces, sense of position awareness).



서식 있음: 영어(미국)
 서식 있음: 표준, 글머리 기호 또는 번호 없이

Skillset sharing low-dynamic robotics (including teleoperation) Controller to controlee	5-10ms	0.8 - 200 kbit/s (with compression)	[99.999%] [40][45]	1 DoF: 2-8 3 DoFs: 6-24 6 DoFs: 12-48	Stationary or Pedestrian	100 km ²	Haptic (position, velocity)
Skillset sharing low-dynamic robotics (including teleoperation) Controlee to controller	5-10ms	0.8 - 200 kbit/s (with compression)	[99.999%] [40][45]	1 DoF: 2-8 10 DoFs: 20-80 100 DoFs: 200-800	Stationary or Pedestrian	100 km ²	Haptic feedback
	10ms	1-100 Mbit/s	[99.999%] [40] [45]	1500	Stationary or Pedestrian	100 km ²	Video
	10ms	5-512 kbit/s	[99.9%] [40] [45]	50	Stationary or Pedestrian	100 km ²	Audio
Skillset sharing Highly dynamic/mobile robotics Controller to controlee	1-5ms	16 kbit/s -2 Mbit/s (without haptic compression encoding); 0.8 - 200 kbit/s (with haptic compression encoding)	[99.999%] (with compression) [40][45] [99.9%] (w/o compression) [40] [45]	1 DoF: 2-8 3 DoFs: 6-24 6 DoFs: 12-48	high-dynamic	4 km ²	Haptic (position, velocity)
Skillset sharing Highly dynamic/mobile robotics Controlee to controller	1-5ms	0.8 - 200 kbit/s	[99.999%] (with compression) [40] [45] [99.9%] (w/o compression) [40] [45]	1 DoF: 2-8 10 DoFs: 20-80 100 DoFs: 200-800	high-dynamic	4 km ²	Haptic feedback
	1-10ms	1-10 Mbit/s	[99.999%] [40] [45]	2000-4000	high-dynamic	4 km ²	Video
	1-10ms	100-500 kbit/s	[99.9%] [40] [45]	100	high-dynamic	4 km ²	Audio
Immersive multi-modal navigation applications Remote Site → Local Site (DL)	50 ms [39]	16 kbit/s -2 Mbit/s (without haptic compression encoding); 0.8 - 200 kbit/s (with haptic compression encoding)	[99.999 %] [40]	1 DoF: 2 to 8 10 DoF: 20 to 80 100 DoF: 200 to 800	Stationary or Pedestrian	≤ 100 km ² (note 5)	Haptic feedback
	<400 ms [39]	1-100 Mbit/s	[99.999 %] [40]	1500	Stationary/ or Pedestrian	≤ 100 km ² (note 5)	Video
	<150 ms [39]	5-512 kbit/s	[99.9 %] [40]	50	Stationary or Pedestrian	≤ 100 km ² (note 5)	Audio
	<300 ms	600 Mbit/s	[99.9 %] [40]	MTU1500	Stationary or Pedestrian	≤ 100 km ² (note 5)	VR
Local Site → Remote Site (UL)	<300 ms	12 kbit/s [26]	[99.999 %] [40]	1500	Stationary or Pedestrian	≤ 100 km ² (note 5)	Biometric / Affective
	<400 ms [39]	1-100 Mbit/s	[99.999 %] [40]	1500	Workers: Stationary/ or Pedestrian UAV: [30-300mph]	≤ 100 km ² (note 5)	Video
	<150 ms [39]	5-512 kbit/s	[99.9 %] [40]	50	Stationary or Pedestrian	≤ 100 km ² (note 5)	Audio
	<300 ms	600 Mbit/s	[99.9 %] [40]	MTU1500	Stationary or Pedestrian	≤ 100 km ² (note 5)	VR

NOTE 1: Motion-to-photon delay (the time difference between the user's motion and corresponding change of the video image on display) ~~should be~~ less than 20 ms, and the communication latency for transferring the packets of one audio-visual media is less than 10 ms, e.g. the packets corresponding to one video/audio frame are transferred to the devices within 10 ms.

NOTE 2: ~~Refer~~According to IEEE 1918.1 [40] as for haptic feedback, the latency ~~should be~~ less than 25 ms for accurately completing haptic operations. As rendering and hardware introduce some delay, the communication delay for haptic modality ~~should~~can be reasonably less than 5 ms, i.e. the packets related to one haptic feedback are transferred to the devices within 10 ms.

NOTE 3: Haptic feedback is typically haptic signal, such as force level, torque level, vibration and texture.

NOTE 4: The latency requirements are expected to be satisfied even when multimodal communication for skillset sharing is via indirect network connection (i.e., relayed by one UE to network relay).

NOTE 5: In practice, the service area depends on the actual deployment. In some cases a local approach (e.g. the application servers are hosted at the network edge) is preferred in order to satisfy the requirements of low latency and high reliability.

To support immersive multi-modal VR applications, the 5G system shall enable synchronisation may be required between audio/visual and tactile components, in order to avoid having a negative impact on the user experience (i.e. detecting lack of synchronisation). The typical synchronisation thresholds [41] [42] [43] [44] are summarised in table 7.10-2.

NOTE: Synchronization can be made either in application, or jointly with network assistance.

Table 7.10-2: Typical synchronization thresholds for immersive multi-modality VR applications

<u>Media components</u>	<u>synchronisation threshold (note 1)</u>	
<u>audio-tactile</u>	<u>audio delay:</u> {50 ms}	<u>tactile delay:</u> {25 ms}
<u>visual-tactile</u>	<u>visual delay:</u> {15 ms}	<u>tactile delay:</u> {50 ms}
<u>NOTE 1: for each media component, "delay" refers to the case where that media component is delayed compared to the other.</u>		

===== End of Changes =====