

P.R. 3-1(c) EXHIBIT 8

U.S. Patent No. 11,424,792: Samsung Devices¹

Claim 8	Analysis	Select Evidence						
An apparatus for providing flexible channel bandwidth in mobile radio communications, comprising:	The Samsung Galaxy S22 ("Galaxy S22") is a non-limiting example of an apparatus that uses 5G cellular communications.	 Galaxy S22, 128GB (Unlocked) SM-S901UZKAXAA ★★★★★ 3.9 (1358) Write a review Share your product experience *** <table> <tr> <td> Network 2G GSM GSM850,GSM900,DCS1800,PC S1900 </td><td> 3G UMTS B1(2100),B2(1900),B4(AWS),B5 (850),B8(900) </td><td> 4G FDD LTE B1(2100),B2(1900),B3(1800),B 4(AWS),B5(850),B7(2600),B8(9 00),B12(700),B13(700),B14(70 0),B18(800),B19(800),B20(800),B25(1900),B26(850),B28(700),B29(700),B30(2300),B66(AWS -3),B71(600) </td></tr> <tr> <td> 4G TDD LTE B38(2600),B39(1900),B40(230 0),B41(2500),B46(5200),B48(3 600) </td><td> 5G FDD Sub6 N1(2100),N3(1800),N5(850),N7 (2600),N8(900),N20(800),N28 (700),N66(AWS-3),N71(600) </td><td> 5G TDD Sub6 N260(39GHz),N261(28GHz) </td></tr> </table> Source: https://www.samsung.com/us/business/mobile/phones/galaxy-s/galaxy-s22-128gb-unlocked-sm-s901uzkaxaa/#specs (GC0007293-94; GC0007311)	Network 2G GSM GSM850,GSM900,DCS1800,PC S1900	3G UMTS B1(2100),B2(1900),B4(AWS),B5 (850),B8(900)	4G FDD LTE B1(2100),B2(1900),B3(1800),B 4(AWS),B5(850),B7(2600),B8(9 00),B12(700),B13(700),B14(70 0),B18(800),B19(800),B20(800),B25(1900),B26(850),B28(700),B29(700),B30(2300),B66(AWS -3),B71(600)	4G TDD LTE B38(2600),B39(1900),B40(230 0),B41(2500),B46(5200),B48(3 600)	5G FDD Sub6 N1(2100),N3(1800),N5(850),N7 (2600),N8(900),N20(800),N28 (700),N66(AWS-3),N71(600)	5G TDD Sub6 N260(39GHz),N261(28GHz)
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¹ This chart applies to all Samsung devices, including those listed in Appendix A and identified in the Complaint at paragraph 25. Other Samsung 5G-enabled devices, including any recently discontinued 5G-enabled devices, infringe this patent in a substantially similar, if not identical, manner.

Claim 8	Analysis	Select Evidence																	
at least one processor; and	The Galaxy S22 includes a Qualcomm Snapdragon 8 Gen 1 chipset with processor.	<table><tr><td rowspan="5">PLATFORM</td><td>OS</td><td>Android 12, upgradable to Android 14, One UI 6.1</td></tr><tr><td>Chipset</td><td>Exynos 2200 (4 nm) - Europe Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm) - ROW</td></tr><tr><td>CPU</td><td>Octa-core (1x2.8 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.8 GHz Cortex-A510) - Europe Octa-core (1x3.00 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.80 GHz Cortex-A510) - ROW</td></tr><tr><td>GPU</td><td>Xclipse 920 - Europe Adreno 730 - ROW</td></tr><tr><td rowspan="3">MEMORY</td><td>Card slot</td><td>No</td></tr><tr><td>Internal</td><td>128GB 8GB RAM, 256GB 8GB RAM UFS 3.1</td></tr></table> Source: https://www.gsmarena.com/samsung_galaxy_s22_5g-11253.php (GC0007380) Ground-breaking innovations in AI, photography, gaming, and connectivity—for the premium experiences your devices deserve. The Snapdragon® 8 Gen 1 Mobile Platform is our most advanced 5G platform ever, with our Snapdragon® X65 5G Modem-RF System ushering in unprecedented speeds up to 10 Gbps while supp... * * * * <table><tr><td>Memory</td></tr><tr><td>Speed: 3200 MHz⁵</td></tr><tr><td>Type: LPDDR5</td></tr></table> Source: https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007688)	PLATFORM	OS	Android 12, upgradable to Android 14, One UI 6.1	Chipset	Exynos 2200 (4 nm) - Europe Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm) - ROW	CPU	Octa-core (1x2.8 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.8 GHz Cortex-A510) - Europe Octa-core (1x3.00 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.80 GHz Cortex-A510) - ROW	GPU	Xclipse 920 - Europe Adreno 730 - ROW	MEMORY	Card slot	No	Internal	128GB 8GB RAM, 256GB 8GB RAM UFS 3.1	Memory	Speed: 3200 MHz ⁵	Type: LPDDR5
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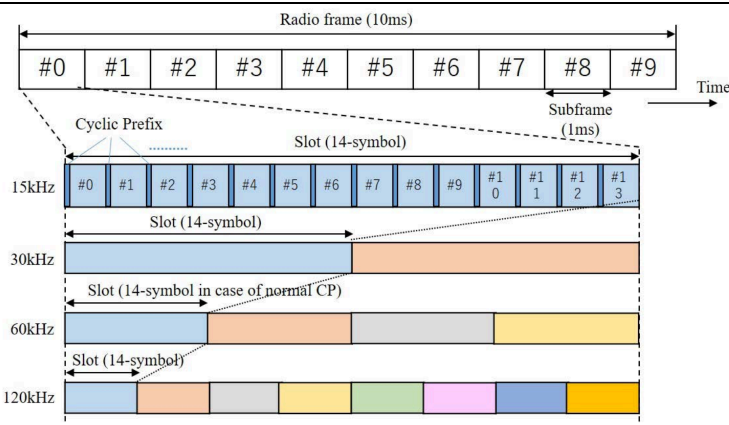
Claim 8	Analysis	Select Evidence
	Devices that use 5G adhere to the 5G specification. The 5G specification allows for different subcarrier spacings and bandwidth depending on the scenario.	The very simple definition of Numerology based on the usage of the term in 3GPP specification would be 'subcarrier spacing type', also often called as SCS. In LTE, we don't need any specific terminology to indicate the subcarrier spacing since there is only one subcarrier spacing, but in NR there are several different types of subcarrier spacing * * * * - In OFDM, number of subcarrier that can be packed into a specific frequency range is directly related to spectrum efficiency (how many bits can be transmitter per Hz per second). The more subcarriers you can pack into a frequency range (i.e, the narrow subcarrier spacing you use), the more data you can transmit (or recieve). - Based on Physics(anti-proportional relationship between subcarrier spacing and OFDM symbo length), Narrow subcarrier spacing means longer OFDM symbol length. With longer OFDM symbol, we can assign more room for CP(Cyclick Prefic). With longer CP, we can make the signal more tolerable to fading channel(Ref [33]). - In lower frequency (like sub 3Ghz, sub 6 Ghz), we don't have much wide band spectrum left for this new technology. In order to pack as many subcarriers as possible in these limited spectrum, we need to get subcarrier spacing as small as possible. That's why we use small subcarrier spacing like 15 Khz, 30 Khz, 60 Khz in NR numerology. - Then, why we don't use even smaller subcarrier like 10 Khz, 5 Khz etc ? As you know, in OFDM maintaining orthogonolity between subcarriers is critical (See Overview section of OFDM page). The transmitted signal would go through various fading channel causing the drift of each subcarrier and the degree of the drift gets even more serious when the transmitter or reciever moves faster. So the narrower of subcarrier spacing you use, the tolerance to fading gets weaker. - Then we need very wide subcarrier spacing like 120 Khz or 240 Khz ? It is for the operation in very high frequency like mmWave. As carrier frequency gets higher, the degree of frequency drift by moving transmitter or reciever gets higher (i.e, Doppler spread gets wider as carrier frequency gets higher). To tolerate this kind of wide range of frequency drift (or shift), we need to use wider subcarrier spacing. - There is another reason for wider subcarrier spacing in mmWave. For the reason as explained here, we would use beamforming (Massive MIMO based beamforming), for the implementaion of beamforming controlling the phase of the signal is critical and it is difficult to control the phase of the signal with narrow subcarrier spacing (Ref [33]). - As frequency goes higher, the degree of phase noise would increase. So we need to implement more sophisticated mechanism for phase noise estimation and correction. It is easier to implement this kind mechanism with wider subcarrier spacing(Ref [33]). Source: https://www.sharetechnote.com/html/5G/5G_Phy_Numerology.html#:~:text=Numerology%20in%205G%20NR%20refers,%2C%20480%2C%20960%20Khz (GC0005162, GC5164) - In lower frequency bands, like Sub-3GHz, Sub-6 GHz, we don't have wider spectrum. So to get as many subcarriers as possible in these limited spectrum, we need to use subcarrier spacing as small as possible. That's why we use small subcarrier spacing like 15 Khz, 30 Khz, 60 Khz in lower bands - When operating in very high frequency like mmWave, as carrier frequency gets higher, the degree of frequency drift by moving transmitter or reciever gets higher i.e, Doppler spread gets wider as carrier frequency gets higher. To tolerate this kind of wide range of frequency drift (or shift), we need to use wider subcarrier spacing. So 3GPP provided option to use very wide subcarrier spacing like 120 Khz or 240 Khz - As frequency goes higher, the degree of phase noise would increase. So we need to implement more sophisticated mechanism for phase noise estimation and correction. It is easier to implement this kind mechanism with wider subcarrier spacing Source: https://www.techplayon.com/5g-nr-numerology-subcarrier-spcaing-scs/ (GC0005132)

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at least one non-transitory computer-readable memory in electronic communication with the at least one processor, and instructions stored in the at least one memory, the instructions executable by the at least one processor for:	The Galaxy S22 has at least one non-transitory computer-readable memory in communication with the processor. The memory stores executable instructions for using the 5G cellular network.	<table><tr><td rowspan="5">PLATFORM</td><td>OS</td><td>Android 12, upgradable to Android 14, One UI 6.1</td></tr><tr><td>Chipset</td><td>Exynos 2200 (4 nm) - Europe Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm) - ROW</td></tr><tr><td>CPU</td><td>Octa-core (1x2.8 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.8 GHz Cortex-A510) - Europe Octa-core (1x3.00 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.80 GHz Cortex-A510) - ROW</td></tr><tr><td>GPU</td><td>Xclipse 920 - Europe Adreno 730 - ROW</td></tr><tr><td rowspan="2">MEMORY</td><td>Card slot</td><td>No</td></tr><tr><td>Internal</td><td>128GB 8GB RAM, 256GB 8GB RAM UFS 3.1</td></tr></table> Source: https://www.gsmarena.com/samsung_galaxy_s22_5g-11253.php Ground-breaking innovations in AI, photography, gaming, and connectivity—for the premium experiences your devices deserve. The Snapdragon® 8 Gen 1 Mobile Platform is our most advanced 5G platform ever, with our Snapdragon® X65 5G Modem-RF System ushering in unprecedented speeds up to 10 Gbps while supp... * * * * <table><tr><td>Memory</td></tr><tr><td>Speed: 3200 MHz⁵</td></tr><tr><td>Type: LPDDR5</td></tr></table> Source: https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform	PLATFORM	OS	Android 12, upgradable to Android 14, One UI 6.1	Chipset	Exynos 2200 (4 nm) - Europe Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm) - ROW	CPU	Octa-core (1x2.8 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.8 GHz Cortex-A510) - Europe Octa-core (1x3.00 GHz Cortex-X2 & 3x2.50 GHz Cortex-A710 & 4x1.80 GHz Cortex-A510) - ROW	GPU	Xclipse 920 - Europe Adreno 730 - ROW	MEMORY	Card slot	No	Internal	128GB 8GB RAM, 256GB 8GB RAM UFS 3.1	Memory	Speed: 3200 MHz ⁵	Type: LPDDR5
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provisioning a set of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers for mobile radio communications;	The Galaxy S22 provisions a consecutive series of OFDM subcarriers for uplink or downlink, as specified by the 5G standard. Similar to LTE, 3GPP defines one 5G resource block to consist of 12 consecutive OFDM subcarriers.	4.4.2 Resource grid For each numerology and carrier, a resource grid of $N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}$ subcarriers and $N_{\text{subframe},\mu}^{\text{subframe},\mu}$ OFDM symbols is defined, starting at common resource block $N_{\text{grid}}^{\text{start},\mu}$ indicated by higher-layer signalling. There is one set of resource grids per transmission direction (uplink or downlink) with the subscript x set to DL and UL for downlink and uplink, respectively. When there is no risk for confusion, the subscript x may be dropped. There is one resource grid for a given antenna port p, subcarrier spacing configuration μ, and transmission direction (downlink or uplink). The carrier bandwidth $N_{\text{grid}}^{\text{size},\mu}$ for subcarrier spacing configuration μ is given by the higher-layer parameter <i>carrierBandwidth</i> in the <i>SCS-SpecificCarrier</i> IE. The starting position $N_{\text{grid}}^{\text{start},\mu}$ for subcarrier spacing configuration μ is given by the higher-layer parameter <i>offsetToCarrier</i> in the <i>SCS-SpecificCarrier</i> IE. The frequency location of a subcarrier refers to the center frequency of that subcarrier. * * * * 4.4.4 Resource blocks 4.4.4.1 General <u>A resource block is defined as $N_{\text{sc}}^{\text{RB}} = 12$ consecutive subcarriers in the frequency domain.</u> Source: https://www.etsi.org/deliver/etsi_ts/138200_138299/138211/15.02.00_60/ts_138211v150200p.pdf (GC0004361, GC0004362)

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encoding data symbols with polyphase codes derived from a discrete Fourier transform to produce encoded data symbols; and	The Galaxy S22 encodes data symbols with polyphase codes generated from a discrete Fourier transform, resulting in encoded data symbols. The 5G specification requires a transform precoding step, which encodes data symbols (“complex-valued symbols x....”) with polyphase codes using a DFT to generate encoded data symbols (“complex-valued symbols y....”). The exponential used in the DFT employs polyphase codes.	6.3.1.4 Transform precoding If transform precoding is not enabled according to 6.1.3 of [6, TS38.214], $y^{(\lambda)}(i) = x^{(\lambda)}(i)$ for each layer $\lambda = 0, 1, \dots, v-1$. If transform precoding is enabled according to 6.1.3 of [6, TS38.214], $v = 1$ and $\tilde{x}^{(0)}(i)$ depends on the configuration of phase-tracking reference signals. If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are not being used, the block of complex-valued symbols $x^{(0)}(0), \dots, x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ for the single layer $\lambda = 0$ shall be divided into $M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one OFDM symbol and $\tilde{x}^{(0)}(i) = x^{(0)}(i)$. If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used, the block of complex-valued symbols $x^{(0)}(0), \dots, x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ shall be divided into sets, each set corresponding to one OFDM symbol, and where set l contains $M_{\text{sc}}^{\text{PUSCH}} - \varepsilon_l N_{\text{samp}}^{\text{group}} N_{\text{group}}^{\text{PTRS}}$ symbols and is mapped to the complex-valued symbols $\tilde{x}^{(0)}(l M_{\text{sc}}^{\text{PUSCH}} + i')$ corresponding to OFDM symbol l prior to transform precoding, with $i' \in \{0, 1, \dots, M_{\text{sc}}^{\text{PUSCH}} - 1\}$ and $i' \neq m$. The index m of PT-RS samples in set l, the number of samples per PT-RS group $N_{\text{samp}}^{\text{group}}$, and the number of PT-RS groups $N_{\text{group}}^{\text{PTRS}}$ are defined in clause 6.4.1.2.2.2. The quantity $\varepsilon_l = 1$ when OFDM symbol l contains one or more PT-RS samples, otherwise $\varepsilon_l = 0$. * * * * Transform precoding shall be applied according to $y^{(0)}(l \cdot M_{\text{sc}}^{\text{PUSCH}} + k) = \frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}} \sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}} - 1} \tilde{x}^{(0)}(l \cdot M_{\text{sc}}^{\text{PUSCH}} + i) e^{-j \frac{2\pi i k}{M_{\text{sc}}^{\text{PUSCH}}}}$ $k = 0, \dots, M_{\text{sc}}^{\text{PUSCH}} - 1$ $l = 0, \dots, M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}} - 1$ resulting in a block of complex-valued symbols $y^{(0)}(0), \dots, y^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$. The variable $M_{\text{sc}}^{\text{PUSCH}} = M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil $M_{\text{RB}}^{\text{PUSCH}} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5}$ where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers. Source: https://www.etsi.org/deliver/etsi_ts/138200_138299/138211/15.02.00_60/ts_138211v150200p.pdf (GC0004373)

Claim 8	Analysis	Select Evidence
modulating the encoded data symbols onto the OFDM subcarriers to produce a superposition signal that resembles a single-carrier signal	The Galaxy S22 modulates the encoded data symbols onto OFDM subcarriers during the OFDM baseband signal generation step required by the 5G specification. A person of ordinary skill in the art at the time of the invention would understand that an OFDM signal is a superposition of subcarriers. The OFDM baseband generation step uses an IFFT for transforming from the frequency-domain to the time-domain transformation. Each input symbol to an IFFT is modulated onto a particular subcarrier frequency, and the output of the IFFT is a discrete-time signal. If multiple encoded data symbols are input to the IFFT at the same time, the output discrete-time signal is a sum (i.e., superposition) of the subcarrier frequencies modulated with their corresponding symbols such that the signal resembles a single carrier.	5.3.1 OFDM baseband signal generation for all channels except PRACH The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port p and subcarrier spacing configuration μ for OFDM symbol $l \in \{0, 1, \dots, N_{\text{slot}}^{\text{subframe}, \mu} N_{\text{ymb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by $s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size}, \mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi(k+k_0^{\mu} - N_{\text{grid},x}^{\text{size}, \mu} N_{\text{sc}}^{\text{RB}}/2)\Delta f(t - N_{\text{CP},J}^{\mu} T_c - t_{\text{start},l}^{\mu})}$ $k_0^{\mu} = (N_{\text{grid},x}^{\text{start}, \mu} + N_{\text{grid},x}^{\text{size}, \mu}/2) N_{\text{sc}}^{\text{RB}} - (N_{\text{grid},x}^{\text{start}, \mu_0} + N_{\text{grid},x}^{\text{size}, \mu_0}/2) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$ where $t_{\text{start},l}^{\mu} \leq t < t_{\text{start},l}^{\mu} + (N_{\text{u}}^{\mu} + N_{\text{CP},J}^{\mu})T_c$ is the time within the subframe, $N_{\text{u}}^{\mu} = 2048\kappa \cdot 2^{-\mu}$ $N_{\text{CP},J}^{\mu} = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^{\mu} \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \neq 0 \text{ and } l \neq 7 \cdot 2^{\mu} \end{cases}$ Δf is given by clause 4.2, μ is the subcarrier spacing configuration, and μ_0 is the largest μ value among the subcarrier spacing configurations provided to the UE for this carrier. The starting position of OFDM symbol l for subcarrier spacing configuration μ in a subframe is given by Source: https://www.etsi.org/deliver/etsi_ts/138200_138299/138211/15.02.00_60/ts_138211v150200p.pdf (GC0004368) DOES 5G USE SC FDMA? Unlike LTE, 5G NR also supports CP-OFDM in the uplink direction. <u>But LTE's discrete Fourier transform spread OFDM (DFT-s-OFDM) uplink scheme, better known as single carrier frequency division multiplex (SC-FDMA), is still a valid access scheme and support is mandatory for any 5G terminal.</u> Source: https://high-techs-base.com/article/which-modulation-scheme-is-used-in-5g (GC0007288)

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and has one of a plurality of different symbol durations;	As described above 5G standard specifies the subcarrier spacing to be selected from 15kHz, 30kHz, 60kHz, 120kHz and 240 kHz. The 5G standard specifies the duration of one subframe to be 1ms and Number of OFDM symbols per slot to be 14 (except when having extended CP at 60kHz SCS). When the subcarrier spacing changes, the number of slots in one subframe changes. For example, OFDM symbol duration is approximately 66.6 μs for 15kHz SCS, and the OFDM symbol duration is halved when SCS is doubled (see below).	 Figure 5.5.4.1-1: Frame structure in NR In turn, each subframe consists of 1/2/4/8/16 slots -shown in different colors- depending on the selected SCS/numerology. The figure shows the cases of SCS values of 15; 30; 60 and 120 KHz, while the table below provides the full list of possible numerologies in NR. As shown in the figure for the 15 kHz case, each slot consists of 14 OFDM symbols (independently of the SCS) preceded by a cyclic prefix (CP). * * * * Table 5.5.4.1-2: Multiple numerologies in NR <table><tr><th>Cyclic Prefix</th><th>subcarrier spacing (SCS) [kHz]</th><th>Number of subframes per radio frame</th><th>Number of slots per subframe</th><th>Number of OFDM symbols per slot</th><th>Applicable frequency range</th></tr><tr><td>normal</td><td>15</td><td>10</td><td>1</td><td>14</td><td>FR1</td></tr><tr><td>normal</td><td>30</td><td>10</td><td>2</td><td>14</td><td>FR1</td></tr><tr><td>normal</td><td>60</td><td>10</td><td>4</td><td>14</td><td>FR1 and FR2</td></tr><tr><td>extended</td><td>60</td><td>10</td><td>4</td><td>12</td><td>FR1 and FR2</td></tr><tr><td>normal</td><td>120</td><td>10</td><td>8</td><td>14</td><td>FR2</td></tr><tr><td>normal</td><td>240</td><td>10</td><td>16</td><td>14</td><td>FR2</td></tr></table> Note: Additional specific numerologies are defined for PRACH, as described in Section 5.5.4.3. Note that, for the 60 kHz SCS, an extended CP is possible. The extended CP is approximately four times longer than the normal CP and is used for cells having large delay spread. In this case, one slot consists of only 12 OFDM symbols. <u>The OFDM symbol duration and CP length are inversely proportional of the SCS. E.g. for 15 kHz SCS, the OFDM symbol duration is approximately 66.6 μs and the CP length is approximately 4.7 μs. When the SCS is doubled, i.e. 30 kHz, the OFDM and CP lengths are approximately divided by two compared to the 15kHz SCS.</u> Source: https://www.etsi.org/deliver/etsi_tr/121900_121999/121915/15.00.00_60/tr_121915v150000p.pdf (GC0004860)	Cyclic Prefix	subcarrier spacing (SCS) [kHz]	Number of subframes per radio frame	Number of slots per subframe	Number of OFDM symbols per slot	Applicable frequency range	normal	15	10	1	14	FR1	normal	30	10	2	14	FR1	normal	60	10	4	14	FR1 and FR2	extended	60	10	4	12	FR1 and FR2	normal	120	10	8	14	FR2	normal	240	10	16	14	FR2
Cyclic Prefix	subcarrier spacing (SCS) [kHz]	Number of subframes per radio frame	Number of slots per subframe	Number of OFDM symbols per slot	Applicable frequency range																																							
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extended	60	10	4	12	FR1 and FR2																																							
normal	120	10	8	14	FR2																																							
normal	240	10	16	14	FR2																																							

Claim 8	Analysis	Select Evidence																																																
wherein provisioning comprises selecting one of a plurality of different selectable subcarrier spacings, to provide for the one of the plurality of different symbol durations.	5G standard supports multiple OFDM numerologies, subcarrier spacings can be selected from 15kHz, 30kHz, 60kHz, 120kHz and 240kHz.	4.2 Numerologies Multiple OFDM numerologies are supported as given by Table 4.2-1 where μ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter <i>subcarrierSpacing</i> and <i>cyclicPrefix</i>, respectively. Table 4.2-1: Supported transmission numerologies. <table><tr><th>μ</th><th>$\Delta f = 2^\mu \cdot 15$ [kHz]</th><th>Cyclic prefix</th></tr><tr><td>0</td><td>15</td><td>Normal</td></tr><tr><td>1</td><td>30</td><td>Normal</td></tr><tr><td>2</td><td>60</td><td>Normal, Extended</td></tr><tr><td>3</td><td>120</td><td>Normal</td></tr><tr><td>4</td><td>240</td><td>Normal</td></tr></table> **** Δf Subcarrier spacing **** μ Subcarrier spacing configuration, $\Delta f = 2^\mu \cdot 15$ [kHz] Source: https://www.etsi.org/deliver/etsi_ts/138200_138299/138211/15.02.00_60/ts_138211v150200p.pdf (GC0004359, GC0004357) OFDM Symbol Duration <table><tr><th>Parameter / Numerology (μ)</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Subcarrier Spacing (Khz)</td><td>15</td><td>30</td><td>60</td><td>120</td><td>240</td></tr><tr><td>OFDM Symbol Duration (us)</td><td>66.67</td><td>33.33</td><td>16.67</td><td>8.33</td><td>4.17</td></tr><tr><td>Cyclic Prefix Duration (us)</td><td>4.69</td><td>2.34</td><td>1.17</td><td>0.57</td><td>0.29</td></tr><tr><td>OFDM Symbol including CP (us)</td><td>71.35</td><td>35.68</td><td>17.84</td><td>8.92</td><td>4.46</td></tr></table> Source: https://www.sharetechnote.com/html/5G/5G_FrameStructure.html (GC0005145)	μ	$\Delta f = 2^\mu \cdot 15$ [kHz]	Cyclic prefix	0	15	Normal	1	30	Normal	2	60	Normal, Extended	3	120	Normal	4	240	Normal	Parameter / Numerology (μ)	0	1	2	3	4	Subcarrier Spacing (Khz)	15	30	60	120	240	OFDM Symbol Duration (us)	66.67	33.33	16.67	8.33	4.17	Cyclic Prefix Duration (us)	4.69	2.34	1.17	0.57	0.29	OFDM Symbol including CP (us)	71.35	35.68	17.84	8.92	4.46
μ	$\Delta f = 2^\mu \cdot 15$ [kHz]	Cyclic prefix																																																
0	15	Normal																																																
1	30	Normal																																																
2	60	Normal, Extended																																																
3	120	Normal																																																
4	240	Normal																																																
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Subcarrier Spacing (Khz)	15	30	60	120	240																																													
OFDM Symbol Duration (us)	66.67	33.33	16.67	8.33	4.17																																													
Cyclic Prefix Duration (us)	4.69	2.34	1.17	0.57	0.29																																													
OFDM Symbol including CP (us)	71.35	35.68	17.84	8.92	4.46																																													

Claim 9	Analysis	Select Evidence																		
The apparatus of claim 8, wherein at least one of the plurality of different selectable subcarrier spacings equals at least one other of the plurality of different selectable subcarrier spacings multiplied by a scaling factor that is a power of two.	As described above, the 5G standard specifies the subcarrier spacing to be selected from 15kHz, 30kHz, 60kHz, 120kHz and 240 kHz. As shown to the right, subcarrier spacing $\Delta f = 2^\mu \cdot 15[\text{kHz}]$ wherein the scaling factor is the subcarrier spacing configuration μ.	4.2 Numerologies Multiple OFDM numerologies are supported as given by Table 4.2-1 where μ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter <i>subcarrierSpacing</i> and <i>cyclicPrefix</i>, respectively. Table 4.2-1: Supported transmission numerologies. <table> <tr> <th>μ</th><th>$\Delta f = 2^\mu \cdot 15[\text{kHz}]$</th><th>Cyclic prefix</th></tr> <tr> <td>0</td><td>15</td><td>Normal</td></tr> <tr> <td>1</td><td>30</td><td>Normal</td></tr> <tr> <td>2</td><td>60</td><td>Normal, Extended</td></tr> <tr> <td>3</td><td>120</td><td>Normal</td></tr> <tr> <td>4</td><td>240</td><td>Normal</td></tr> </table> * * * * Δf Subcarrier spacing * * * * μ Subcarrier spacing configuration, $\Delta f = 2^\mu \cdot 15[\text{kHz}]$ Source: https://www.etsi.org/deliver/etsi_ts/138200_138299/138211/15.02.00_60/ts_138211v150200p.pdf (GC0004359, GC0004357)	μ	$\Delta f = 2^\mu \cdot 15[\text{kHz}]$	Cyclic prefix	0	15	Normal	1	30	Normal	2	60	Normal, Extended	3	120	Normal	4	240	Normal
μ	$\Delta f = 2^\mu \cdot 15[\text{kHz}]$	Cyclic prefix																		
0	15	Normal																		
1	30	Normal																		
2	60	Normal, Extended																		
3	120	Normal																		
4	240	Normal																		

Claim 10	Analysis	Select Evidence
The apparatus of claim 8, further comprising instructions stored in the at least one non-transitory computer-readable memory, the instructions executable by the at least one processor for adding a cyclic prefix to the superposition signal.	The Galaxy S22 is further configured to add a cyclic prefix to the SC-FDMA signal prior to transmit. As shown to the right, a cyclic prefix of length $N_{CP,l}^\mu$ is added when converting the SC-FDMA frequency domain signal into time domain signal.	<u>$N_{CP,l}^\mu$</u> Cyclic prefix length; see clause 5.3.1 *** 5.3 OFDM baseband signal generation 5.3.1 OFDM baseband signal generation for all channels except PRACH The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port p and subcarrier spacing configuration μ for OFDM symbol $l \in \{0, 1, \dots, N_{\text{slot}}^{\text{subframe}, \mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by $s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size}, \mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi \left(k + k_0^\mu - N_{\text{grid},x}^{\text{size}, \mu} N_{\text{sc}}^{\text{RB}} / 2 \right) \Delta f \left(t - N_{CP,l}^\mu T_c - t_{\text{start},l}^\mu \right)}$ $k_0^\mu = \left(N_{\text{grid},x}^{\text{start}, \mu} + N_{\text{grid},x}^{\text{size}, \mu} / 2 \right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start}, \mu_0} + N_{\text{grid},x}^{\text{size}, \mu_0} / 2 \right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$ where $t_{\text{start},l}^\mu \leq t < t_{\text{start},l}^\mu + (N_u^\mu + N_{CP,l}^\mu) T_c$ is the time within the subframe, $N_u^\mu = 2048\kappa \cdot 2^{-\mu}$ $N_{CP,l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \neq 0 \text{ and } l \neq 7 \cdot 2^\mu \end{cases}$ Source: https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.07.00_60/ts_136211v080700p.pdf (GC0004358, GC0004368)

APPENDIX A

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
Galaxy A25 5G	SM-A256E, SM-A256E/DS, SM-A256E/DSN, SM-A256B, SM-A256B/DS, SM-A256B/DSN, SM-A256U, SM-A256U1	Exynos 1280 (5 nm)	https://semiconductor.samsung.com/processor/mobile-processor/exynos-1280/ (GC0007225-37)	https://www.gsmarena.com/_galaxy_a25-12555.php (GC0007327-29)
Galaxy A33 5G	SM-A336E, SM-A336B, SM-A336B/DS, SM-A336B/DSN, SM-A336E/DS, SM-A336M, SM-A3360	Exynos 1280 (5 nm)	https://semiconductor.samsung.com/processor/mobile-processor/exynos-1280/ (GC0007225-37)	https://www.gsmarena.com/_galaxy_a33_5g-11429.php (GC0007597-99)
Galaxy A53 5G	SM-A536B, SM-A536B/DS, SM-A536U, SM-A536U1, SM-A5360, SM-A536E, SM-A536E/DS, SM-A536V, SM-A536W, SM-A536N, SM-S536DL	Exynos 1280 (5 nm)	https://semiconductor.samsung.com/processor/mobile-processor/exynos-1280/ (GC0007225-37)	https://www.gsmarena.com/_galaxy_a53_5g-11268.php (GC0007238-40)
Galaxy A14 5G	SM-A146B, SM-A146B/DS, SM-A146P, SM-A146P/DS, SM-A146U, SM-A146U1, SM-A146U1/DS, SM-A146W, SM-A146P/N, SM-A146P/DSN, SM-S146VL, SM-A146M	Exynos 1330 (5 nm) - SM-A146B	https://semiconductor.samsung.com/processor/mobile-processor/exynos-1330/ (GC0007553-63)	https://www.gsmarena.com/_galaxy_a14_5g-12004.php (GC0007594 - GC0007596)
Galaxy A54 5G	SM-A546V, SM-A546U, SM-A546U1, SM-A546B, SM-A546B/DS, SM-A546E, SM-A546E/DS, SM-A5460, SM-A546M, SM-A546M/DS	Exynos 1380 (5 nm)	https://semiconductor.samsung.com/us/processor/mobile-processor/exynos-1380/ (GC0007407-20)	https://www.gsmarena.com/_galaxy_a54-12070.php (GC0007607 - GC0007609)
Galaxy A13	SM-A135F, SM-A135F/DS, SM-A135M, SM-A135U, SM-	Exynos 850 (8 nm)	https://semiconductor.samsung.com/us/processor/mobile-processor/exynos-850/ (GC0007244-53)	https://www.gsmarena.com/_galaxy_a13-11402.php (GC0007348-50)

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
	A135U1, SM-A135N			
Galaxy Watch3	SM-R850, SM-R840, SM-R855F, SM-R845F, SM-R855U, SM-R845U	Exynos 9110 (10 nm)	https://semiconductor.samsung.com/us/processor/wearable-processor/exynos-9110/ (GC0007421-28)	https://www.gsmarena.com/_galaxy_watch3-10315.php (GC0007663 - GC0007665)
Galaxy Watch4	SM-R860, SM-R870	Exynos W920 (5 nm)	https://semiconductor.samsung.com/us/processor/wearable-processor/exynos-w920/ (GC0007525-31)	https://www.gsmarena.com/_galaxy_watch4-11045.php (GC0007404 - GC0007406)
Galaxy Watch5	SM-R915F, SM-R905F	Exynos W920 (5 nm)	https://semiconductor.samsung.com/us/processor/wearable-processor/exynos-w920/ (GC0007525-31)	https://www.gsmarena.com/_galaxy_watch5-11748.php (GC0007273 - GC0007275)
Galaxy Watch6	SM-R930, SM-R940	Exynos W930 (5 nm)	https://semiconductor.samsung.com/processor/wearable-processor/exynos-w930/ (GC0007215-24)	https://www.gsmarena.com/_galaxy_watch6-12437.php (GC0007268 - GC0007270)
Galaxy 5G	SM-A346E, SM-A346B, SM-A346B/DS, SM-A346B/DSN, SM-A346E/DS, SM-A346E/DSN, SM-A346M, SM-A346M/N, SM-A346M/DSN, SM-A346O	Mediatek Dimensity 1080 (6 nm)	https://i.mediatek.com/dimensity-1080 (GC0007532-41)	https://www.gsmarena.com/_galaxy_a34-12074.php (GC0007383 - GC0007385)
Galaxy A13 5G	SM-A136U, SM-A136U1, SM-A136W, SM-A136B, SM-S136DL	Mediatek Dimensity 700 (7 nm)	https://www.mediatek.com/products/smartphones-2/dimensity-700 (GC0007473-77)	https://www.gsmarena.com/_galaxy_a13_5g-11149.php (GC0007457 - GC0007459)
Galaxy A22 5G	SM-A226B, SM-A226B/DS, SM-A226B/DSN, SM-A226BR, SM-A226BR/N, SM-A226L, SC-56B	Mediatek Dimensity 700 (7 nm)	https://www.mediatek.com/products/smartphones-2/dimensity-700 (GC0007473-77)	https://www.gsmarena.com/_galaxy_a22_5g-10873.php (GC0007345 - GC0007347)
Galaxy A15	SM-A155F, SM-A155F/DSN, SM-A155M, SM-A155M/DS, SM-A155P, SM-A155R	Mediatek Helio G99 (6 nm)	https://www.mediatek.com/products/smartphones-2/mediatek-helio-g99 (GC0007333-36)	https://www.gsmarena.com/_galaxy_a15-12637.php (GC0007600 - GC0007602)
Galaxy A02	SM-A022F, SM-A022F/DS, SM-A022M, SM-A022M/DS, SM-A022G, SM-A022G/DS	Mediatek MT6739W (28 nm)	https://www.mediatek.com/products/smartphones-2/mt6739 (GC0007603-06)	https://www.gsmarena.com/_galaxy_a02-10708.php (GC0007438-40)

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
Galaxy A22	SM-A225F, SM-A225F/DS, SM-A225M, SM-A225M/DS	Mediatek MT6769V/CU Helio G80 (12 nm)	https://www.mediatek.com/products/smartphones-2/mediatek-helio-g80 (GC0007542-45)	https://www.gsmarena.com/galaxy_a22-10948.php (GC0007196 - GC0007198)
Galaxy A32	SM-A325F, SM-A325F/DS, SM-A325M, SM-A325N	Mediatek MT6769V/CU Helio G80 (12 nm)	https://www.mediatek.com/products/smartphones-2/mediatek-helio-g80 (GC0007542-45)	https://www.gsmarena.com/galaxy_a32-10753.php (GC0007386 - GC0007388)
Galaxy A05	SM-A055F, SM-A055F/DS, SM-A055M, SM-A055M/DS	Mediatek MT6769V/CZ Helio G85 (12 nm)	https://www.mediatek.com/products/smartphones-2/mediatek-helio-g85 (GC0007337-42)	https://www.gsmarena.com/galaxy_a05-12583.php (GC0007432-34)
Galaxy Tab A7 Lite	SM-T225, SM-T220, SM-T225N, SM-T227U	Mediatek MT8768T Helio P22T (12 nm)	https://www.mediatek.com/products/tablets/mt8768t (GC0007501-03)	https://www.gsmarena.com/galaxy_tab_a7_lite-10933.php (GC0007429 - GC0007431)
Galaxy A23	SM-A235F, SM-A235F/DS, SM-A235F/DSN, SM-A235M, SM-A235M/DS, SM-A235N	Qualcomm SM6225 Snapdragon 680 4G (6 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-6-series-mobile-platforms/snapdragon-680-4g-mobile-platform (GC0007460-65)	https://www.gsmarena.com/galaxy_a23-11373.php (GC0007610 - GC0007612)
Galaxy A52	SM-A525F, SM-A525F/DS, SM-A525M, SM-A525M/DS	Qualcomm SM7125 Snapdragon 720G (8 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-7-series-mobile-platforms/snapdragon-720g-mobile-platform (GC0007570-76)	https://www.gsmarena.com/galaxy_a52-10641.php (GC0007241 - GC0007243)
Galaxy A72	SM-A725F, SM-A725F/DS, SM-A725M, SM-A725M/DS	Qualcomm SM7125 Snapdragon 720G (8 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-7-series-mobile-platforms/snapdragon-720g-mobile-platform (GC0007570-76)	https://www.gsmarena.com/galaxy_a72-10469.php (GC0007395 - GC0007397)
Galaxy A52 5G	SM-A526B, SM-A526B/DS, SM-A5260, SM-A526W, SM-A526U, SM-A526U1	Qualcomm SM7225 Snapdragon 750G 5G (8 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-7-series-mobile-platforms/snapdragon-750g-5g-mobile-platform (GC0007493-7500)	https://www.gsmarena.com/galaxy_a52_5g-10631.php (GC0007330 - GC0007332)
Galaxy Tab S7 FE	SM-T730, SM-T733, SM-T736B, SM-T735	Qualcomm SM7225 Snapdragon 750G 5G (8 nm) - 5G model	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-7-series-mobile-platforms/snapdragon-750g-5g-mobile-platform (GC0007493-7500)	https://www.gsmarena.com/galaxy_tab_s7_fe-10922.php (GC0007190 - GC0007192)

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
Galaxy A52s 5G	SM-A528B, SM-A528B/DS, SM-A528N	Qualcomm SM7325 Snapdragon 778G 5G (6 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-7-series-mobile-platforms/snapdragon-778g-5g-mobile-platform (GC0007577-83)	https://www.gsmarena.com/galaxy_a52s_5g-11039.php (GC0007398 - GC0007400)
Galaxy A73 5G	SM-A736B, SM-A736B/DS	Qualcomm SM7325 Snapdragon 778G 5G (6 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-7-series-mobile-platforms/snapdragon-778g-5g-mobile-platform (GC0007577-83)	https://www.gsmarena.com/galaxy_a73_5g-11257.php (GC0007567 - GC000756)
Galaxy S20 FE	SM-G781B, SM-G781B/DS, SM-G781U, SM-G781U1, SM-G781W, SM-G7810, SM-G781N, SM-G781V	Qualcomm SM8250 Snapdragon 865 5G (7 nm+)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-865-5g-mobile-platform (GC0007171-79)	https://www.gsmarena.com/galaxy_s20_fe_5g-10377.php (GC0007351 - GC0007353)
Galaxy S20	SM-G981, SM-G981F, SM-G981F/DS, SM-G981B/DS, SM-G981U, SM-G981U1, SM-G981N, SM-G981B, SM-G9810, SM-G981W, SC-51A, SCG01	Qualcomm SM8250 Snapdragon 865 5G (7 nm+) - USA	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-865-5g-mobile-platform (GC0007171-79)	https://www.gsmarena.com/galaxy_s20_5g-10044.php (GC0007168 - GC0007170)
Galaxy S20 Ultra	SM-G988, SM-G988U, SM-G988U1, SM-G9880, SM-G988B/DS, SM-G988N, SM-G988B, SM-G988W, SCG03	Qualcomm SM8250 Snapdragon 865 5G (7 nm+) - USA	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-865-5g-mobile-platform (GC0007171-79)	https://www.gsmarena.com/galaxy_s20_ultra_5g-10040.php (GC0007564 - GC0007566)
Galaxy S20+	SM-G986, SM-G986F, SM-G986F/DS, SM-G986U, SM-G986U1, SM-G9860, SM-G986B/DS, SM-G986N, SM-G986B, SM-G986W, SCG02	Qualcomm SM8250 Snapdragon 865 5G (7 nm+) - USA	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-865-5g-mobile-platform (GC0007171-79)	https://www.gsmarena.com/galaxy_s20+_5g-10041.php (GC0007165 - GC0007167)

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
Galaxy Tab S7	SM-T870, SM-T875, SM-T876B	Qualcomm SM8250 Snapdragon 865 5G+ (7 nm+)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-865-5g-mobile-platform (GC0007171-79)	https://www.gsmarena.com/galaxy_tab_s7-10337.php (GC0007657 - GC0007659)
Galaxy Tab S7+	SM-T970, SM-T976B, SM-T975	Qualcomm SM8250 Snapdragon 865 5G+ (7 nm+)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-865-5g-mobile-platform (GC0007171-79)	https://www.gsmarena.com/galaxy_tab_s7+-10336.php (GC0007504 - GC0007506)
Galaxy S21	SM-G990F, SM-G990F/DS	Qualcomm SM8350 Snapdragon 888 5G (5 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-888-5g-mobile-platform (GC0007284-92)	https://www.gsmarena.com/galaxy_s21-10693.php (GC0007401 - GC0007403)
Galaxy Z Flip3 5G	SM-F711B, SM-F711N, SM-F711U, SM-F711U1, SM-F711W, SM-F7110	Qualcomm SM8350 Snapdragon 888 5G (5 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-888-5g-mobile-platform (GC0007284-92)	https://www.gsmarena.com/galaxy_z_flip3_5g-11044.php (GC0007680 - GC0007682)
Galaxy Z Fold3 5G	SM-F926B, SM-F926B/DS, SM-F926U, SM-F926U1, SM-F926W, SM-F9260, SM-F926N	Qualcomm SM8350 Snapdragon 888 5G (5 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-888-5g-mobile-platform (GC0007284-92)	https://www.gsmarena.com/galaxy_z_fold3_5g-10906.php (GC0007673 - GC0007676)
Galaxy S21 Ultra	SM-G998B, SM-G998B/DS, SM-G998U, SM-G998U1, SM-G998W, SM-G998N, SM-G9980	Qualcomm SM8350 Snapdragon 888 5G (5 nm) - USA/China	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-888-5g-mobile-platform (GC0007284-92)	https://www.gsmarena.com/galaxy_s21_ultra_5g-10596.php (GC0007389 - GC0007391)
Galaxy S21+	SM-G996B, SM-G996B/DS, SM-G996U, SM-G996U1, SM-G996W, SM-G996N, SM-G9960	Qualcomm SM8350 Snapdragon 888 5G (5 nm) - USA/China	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-888-5g-mobile-platform (GC0007284-92)	https://www.gsmarena.com/galaxy_s21+_5g-10625.php (GC0007660 - GC0007662)

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
Galaxy S21 FE	SM-G990B, SM-G990B/DS, SM-G990U, SM-G990U1, SM-G990W, SM-G990E, SM-G9900, SM-G990B2, SM-G990U2, SM-G990W2, SM-G990U3	Qualcomm SM8350 Snapdragon 888 5G (5 nm) - Version 1	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-888-5g-mobile-platform (GC0007284-92)	https://www.gsmarena.com/galaxy_s21_fe_5g-10954.php (GC0007654 - GC0007656)
Galaxy Tab S8	SM-X700, SM-X706, SM-X706B, SM-X706U, SM-X706N	Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	https://www.gsmarena.com/galaxy_tab_s8-11343.php (GC0007271 - GC0007272)
Galaxy Tab S8 Ultra	SM-X900, SM-X906, SM-X906B, SM-X906U, SM-X906N	Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	https://www.gsmarena.com/galaxy_tab_s8_ultra-11274.php (GC0007507 - GC0007509)
Galaxy Tab S8+	SM-X800, SM-X806, SM-X806B, SM-X806U, SM-X806N	Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	https://www.gsmarena.com/galaxy_tab_s8+-11342.php (GC0007193 - GC0007195)
Galaxy S22	SM-S901B, SM-S901B/DS, SM-S901U, SM-S901U1, SM-S901W, SM-S901N, SM-S9010, SM-S901E, SM-S901E/DS	Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm) - ROW	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	https://www.gsmarena.com/galaxy_s22_5g-11253.php (GC0007380 - GC0007382)
Galaxy S22 Ultra	SM-S908B, SM-S908B/DS, SM-S908U, SM-S908U1, SM-S908W, SM-S908N, SM-S9080, SM-S908E, SM-S908E/DS	Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm) - ROW	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	https://www.gsmarena.com/galaxy_s22_ultra_5g-11251.php (GC0007651 - GC0007653)
Galaxy S22+	SM-S906B, SM-S906B/DS, SM-S906U, SM-	Qualcomm SM8450 Snapdragon 8	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	https://www.gsmarena.com/galaxy_s22+_5g-11252.php (GC0007370 - GC0007372)

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
	S906U1, SM-S906W, SM-S906N, SM-S9060, SM-S906E, SM-S906E/DS	Gen 1 (4 nm) - ROW	series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	
Galaxy S23 FE	SM-S711B, SM-S711B/DS, SM-S711U1, SM-S711U, SM-S711W, SM-S7110	Qualcomm SM8450 Snapdragon 8 Gen 1 (4 nm) - USA	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0007683-90)	https://www.gsmarena.com/galaxy_s23_fe-12520.php (GC0007392 - GC0007394)
Galaxy Z Flip 4	SM-F721B, SM-F721B/DS, SM-F721N, SM-F721U, SM-F721U1, SM-F721W, SM-F7210	Qualcomm SM8475 Snapdragon 8+ Gen 1 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0004687-88)	https://www.gsmarena.com/galaxy_z_flip4-11538.php (GC0007180 - GC0007182)
Galaxy Z Fold 4	SM-F936B, SM-F936B/DS, SM-F936U, SM-F936U1, SM-F936N, SM-F936W, SM-F9360	Qualcomm SM8475 Snapdragon 8+ Gen 1 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-1-mobile-platform (GC0004687-88)	https://www.gsmarena.com/galaxy_z_fold4-11737.php (GC0007677 - GC0007679)
Galaxy S23	SM-S911B, SM-S911B/DS, SM-S911U, SM-S911U1, SM-S911W, SM-S911N, SM-S9110, SM-S911E, SM-S911E/DS	Qualcomm SM8550-AC Snapdragon 8 Gen 2 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform (GC0007354-60)	https://www.gsmarena.com/galaxy_s23-12082.php (GC0007670 - GC0007672)
Galaxy S23 Ultra	SM-S918B, SM-S918B/DS, SM-S918U, SM-S918U1, SM-S918W, SM-S918N, SM-S9180, SM-S918E, SM-S918E/DS	Qualcomm SM8550-AC Snapdragon 8 Gen 2 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform (GC0007354-60)	https://www.gsmarena.com/galaxy_s23_ultra-12024.php (GC0007549 - GC0007552)
Galaxy S23+	SM-S916B, SM-S916B/DS, SM-S916U, SM-S916U1, SM-S916W, SM-S916N, SM-S9160, SM-	Qualcomm SM8550-AC Snapdragon 8 Gen 2 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform (GC0007354-60)	https://www.gsmarena.com/galaxy_s23+-12083.php (GC0007373 - GC0007375)

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
	S916E, SM-S916E/DS			
Galaxy Z Flip 5	SM-F731B, SM-F731B/DS, SM-F731U, SM-F731U1, SM-F731W, SM-F731N	Qualcomm SM8550-AC Snapdragon 8 Gen 2 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform (GC0007354-60)	https://www.gsmarena.com/galaxy_z_flip5-12252.php (GC0007691 - GC0007693)
Galaxy Z Fold 5	SM-F946B, SM-F946B/DS, SM-F946U, SM-F946U1, SM-F946N, SM-F946W, SM-F9460	Qualcomm SM8550-AC Snapdragon 8 Gen 2 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform (GC0007354-60)	https://www.gsmarena.com/galaxy_z_fold5-12418.php (GC0007183 - GC0007186)
Galaxy S24 Ultra	SM-S928B, SM-S928B/DS, SM-S928U, SM-S928U1, SM-S928W, SM-S928N, SM-S9280, SM-S928E, SM-S928E/DS	Qualcomm SM8650-AC Snapdragon 8 Gen 3 (4 nm)	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-3-mobile-platform (GC0007361-69)	https://www.gsmarena.com/galaxy_s24_ultra-12771.php (GC0007546 - GC0007548)
Galaxy S24	SM-S921B, SM-S921B/DS, SM-S921U, SM-S921U1, SM-S921W, SM-S921N, SM-S9210, SM-S921E, SM-S921E/DS	Qualcomm SM8650-AC Snapdragon 8 Gen 3 (4 nm) - USA/Canada/China	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-3-mobile-platform (GC0007361-69)	https://www.gsmarena.com/galaxy_s24-12773.php (GC0007376 - GC0007379)
Galaxy S24+	SM-S926B, SM-S926B/DS, SM-S926U, SM-S926U1, SM-S926W, SM-S926N, SM-S9260, SM-S926E, SM-S926E/DS	Qualcomm SM8650-AC Snapdragon 8 Gen 3 (4 nm) - USA/Canada/China	https://www.qualcomm.com/products/mobile/snapdragon/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-3-mobile-platform (GC0007361-69)	https://www.gsmarena.com/galaxy_s24+-12772.php (GC0007666 - GC0007669)
Galaxy A03	SM-A035F, SM-A035F/DS, SM-A035M, SM-A035G	Unisoc T606 (12 nm)	https://www.unisoc.com/en-us/home/TZNSJ-T606-6 (GC0007589-93)	https://www.gsmarena.com/galaxy_a03-11244.php (GC0007435-37)
Galaxy Tab A8 10.5	SM-X200, SM-X205	Unisoc Tiger T618 (12 nm)	https://www.unisoc.com/en-us/home/TZNSJ-T618-2-0 (GC0007584-88)	https://www.gsmarena.com/galaxy_tab_a8_10_5_(2021)-11265.php (GC0007187 - GC0007189)
Galaxy Tab A7 10.4 (2022)	SM-T509	Unisoc UMS512 T618 (12 nm)	https://www.unisoc.com/en-us/home/TZNSJ-T618-2-0 (GC0007584-88)	https://www.gsmarena.com/galaxy_tab_a7_10_4_(2022)-

Product	Model Nos.	Chipset	Chipset Info (Bates)	Product Specifications (Bates)
				11988.php (GC0007343 - GC0007344)