

Effective Handling of Low Memory Scenarios in Android

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The National Mission on
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(NME-ICT)

Agenda

- Objective
- Process Management in Android
- Effective Memory Management
 - Telephone Hardware Checking
 - Improved Activity Manager Service
- Low Memory Killer in Android
 - How does Low Memory Killer work
 - Problems in Low Memory Killer
- Conclusion

Objective

In **low memory scenarios**, **low memory killer** and **Activity Manager** kill some of the applications in the system.

- Don't kill applications, in which **user interesting**
- Improve **speed** of device
- Increase memory utilization

Process Management in Android

Classification of Processes

- **Foreground**(active) – user currently focused.
- **visible process** – Bounded to foreground process.

Process Management in Android

Classification of Processes

- **Service Process** – Running on background (playing music).
- **Hidden Process** – which is not visible(background).









Process Management in Android

Classification of Processes:

- **Content Provider** – Provides structural data (contacts)
- **Empty process** which was already terminated. It is still present in main memory.

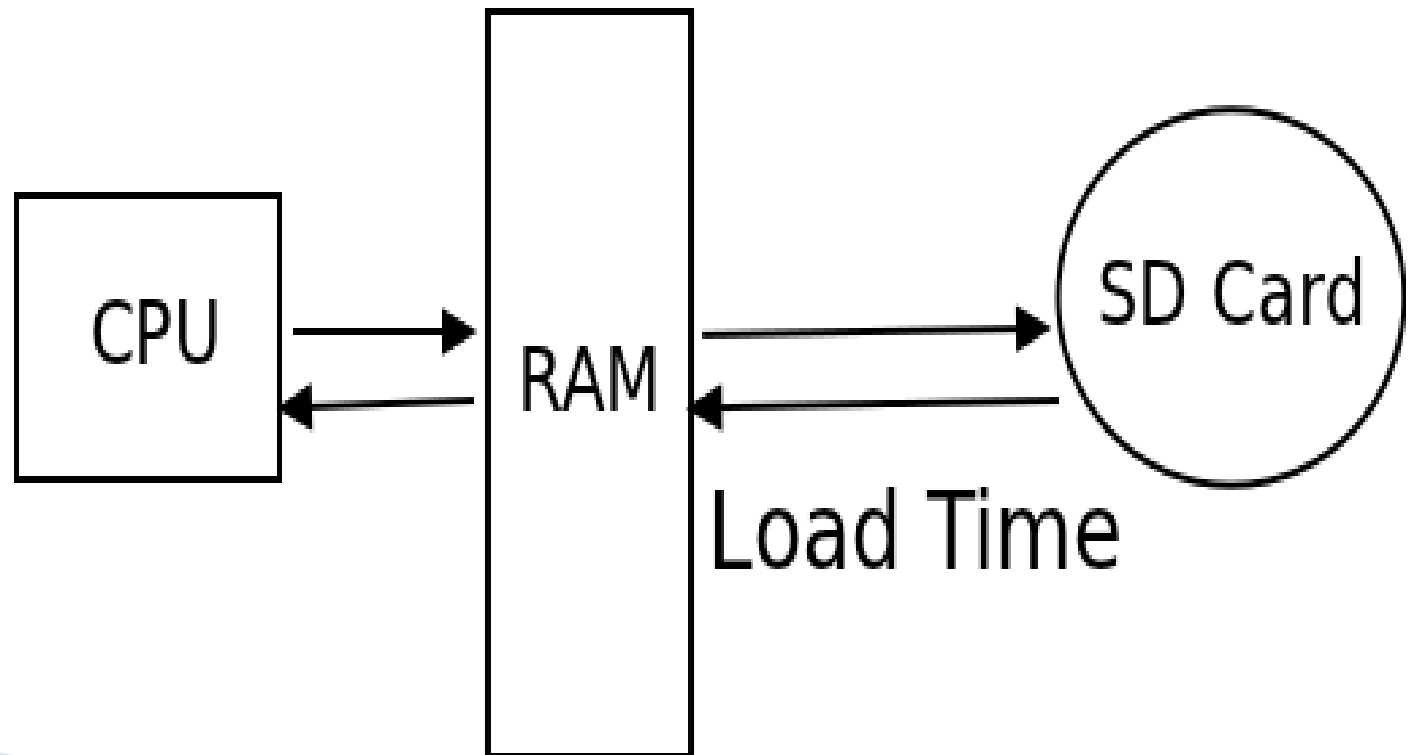
Process Management in Android

Different Groups of Apps in RAM

	Android keyboard (oom: 2, pid: 307)	3.3 MB Secondary
	Android System (oom: -16, pid: 149)	19.11 MB Foreground
	android.process.media (oom: 9, pid: 292)	3.32 MB Content Provider
	AutoKiller Memory Optimizer (oom: 0, pid: 501)	13.24 MB Foreground
	BotBrew Basil (oom: 12, pid: 775)	3.26 MB Empty App
	Calendar (oom: 10, pid: 964)	4.28 MB Empty App
	Calendar Storage (oom: 10, pid: 981)	3.53 MB Empty App
	Calibration (oom: 13, pid: 691)	3.24 MB Empty App
	Call Assistant (oom: 12, pid: 893)	3.23 MB Empty App
	com.android.smpush (oom: 1, pid: 431)	3.24 MB Visible
	com.google.process.gapps (oom: 9, pid: 275)	7.84 MB Content Provider
	Contacts (oom: 11, pid: 906)	3.6 MB Empty App
	F-Droid (oom: 13, pid: 760)	3.25 MB Empty App

Advantages of Empty Applications

- Reduce load time, power consumption

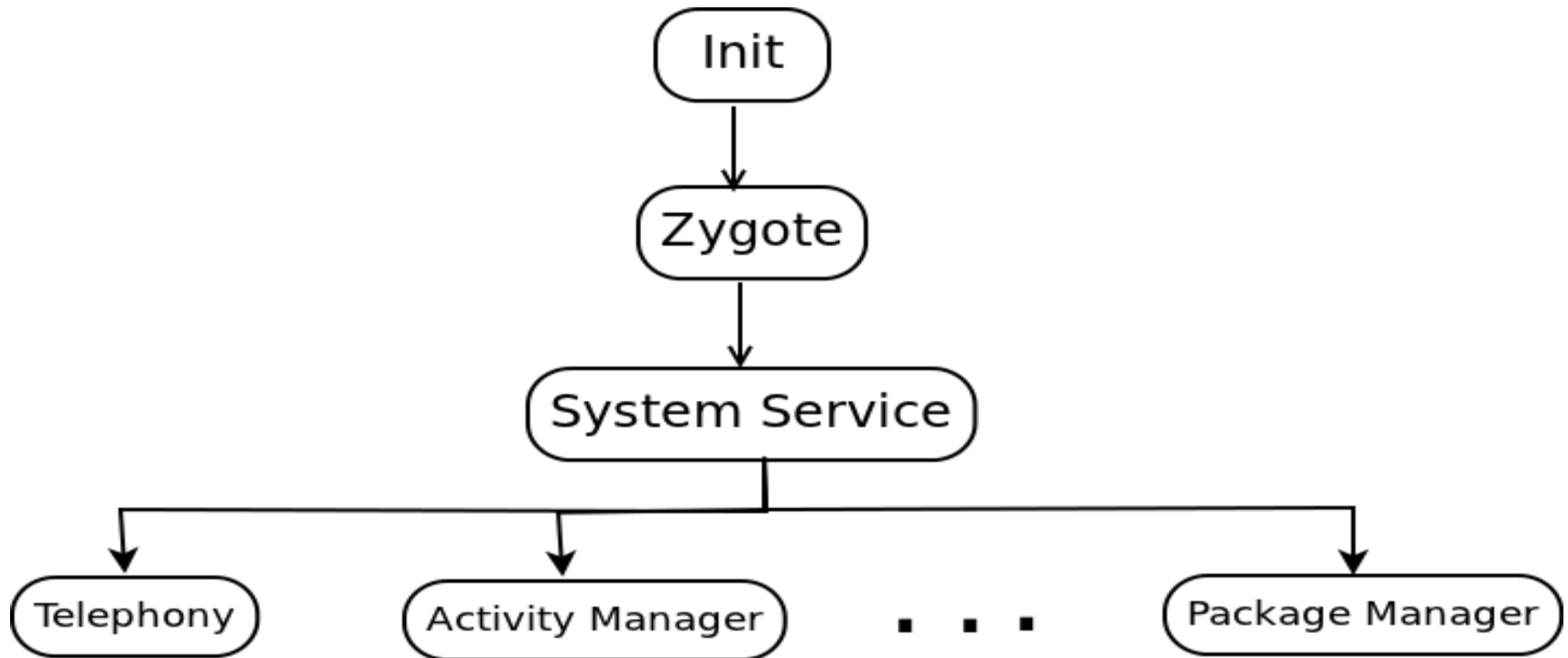


Disadvantages of Empty Applications

- Low free memory
- Too much off Empty Apps increases load time for Apps which are not there in RAM














Effective Memory Management

- Loading Services during Booting



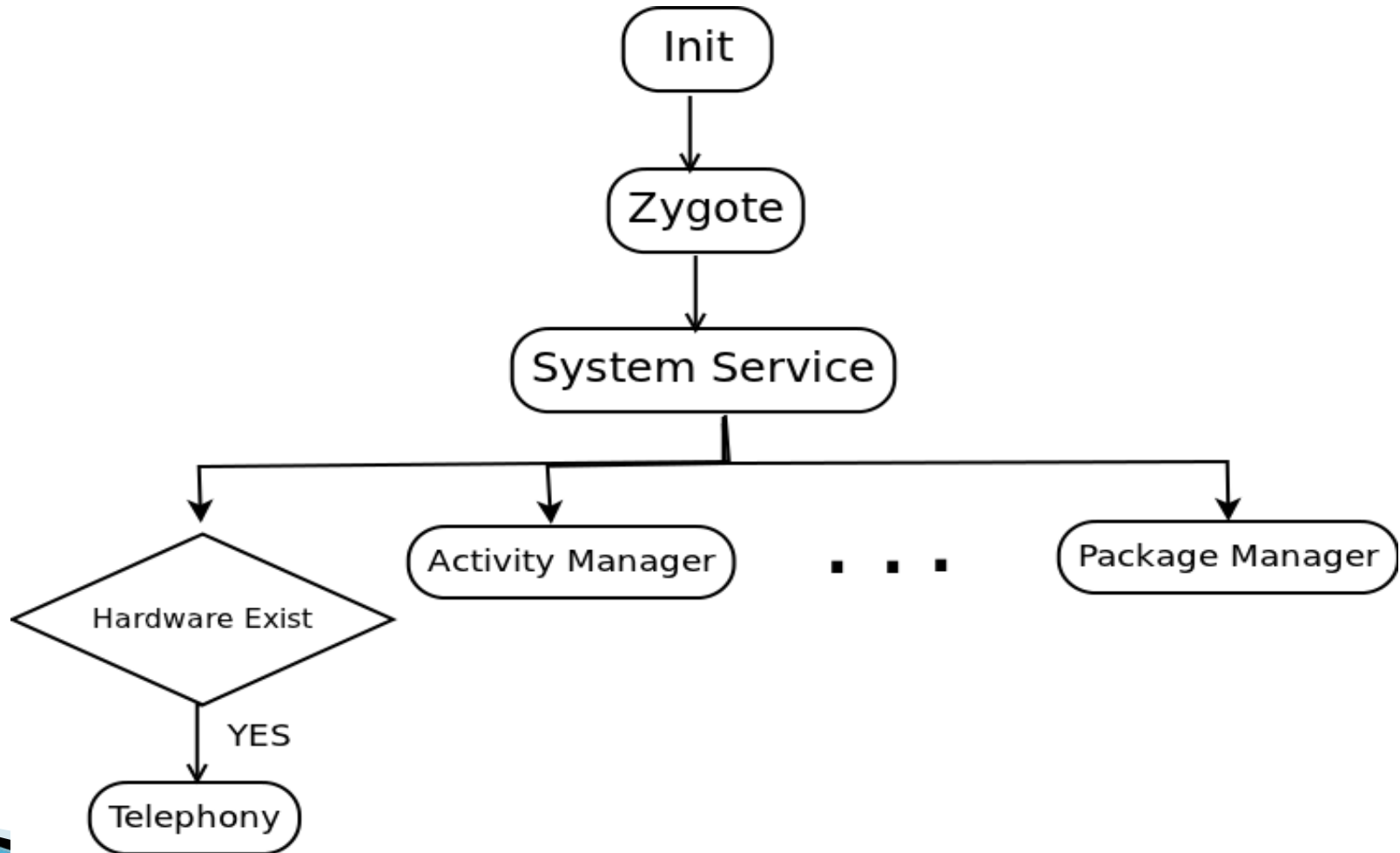
Effective Memory Management

List of
Phone
Related
Apps
Loaded
in RAM

	Call Assistant	3.25 MB
	com.android.smspush	3.24 MB
	com.google.process.gapps	7.84 MB
	Contacts	3.6 MB
	F-Droid	3.25 MB
	Gmail	5.91 MB
	Google Account Manager	4.35 MB
	Google Partner Setup	3.77 MB
	Google Play Store	7.71 MB
	HD Player	3.54 MB
	Launcher	5.53 MB
	Mobile Data	5.07 MB
	ROM Manager	3.28 MB

Effective Memory Management

- Remove Phone Related Apps from RAM
















Effective Memory Management

Functionality of Activity Manager Service

- Launching Applications
- Updating Application status
- Killing Applications

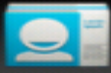










Effective Memory Management

List of
Apps
Loaded
into RAM
By
Activity
Manager
Service

	Android keyboard	3.3 MB
	(oom: 2, pid: 307)	Secondary
	Android System	19.11 MB
	(oom: -16, pid: 149)	Foreground
	android.process.media	3.92 MB
	(oom: 9, pid: 292)	Content Provider
	AutoKiller Memory Optimizer	13.24 MB
	(oom: 9, pid: 591)	Foreground
	BotBrew Basil	3.26 MB
	(oom: 12, pid: 775)	Empty App
	Calendar	4.28 MB
	(oom: 10, pid: 964)	Empty App
	Calendar Storage	3.53 MB
	(oom: 10, pid: 981)	Empty App
	Calibration	3.24 MB
	(oom: 13, pid: 691)	Empty App
	Call Assistant	3.25 MB
	(oom: 12, pid: 893)	Empty App
	com.android.smspash	3.24 MB
	(oom: 1, pid: 431)	Visible
	com.google.process.gapps	7.84 MB
	(oom: 9, pid: 275)	Content Provider
	Contacts	3.6 MB
	(oom: 11, pid: 906)	Empty App
	F-Droid	3.25 MB
	(oom: 13, pid: 760)	Empty App

Effective Memory Management

List of
Apps
Loaded
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Activity
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	Contacts (oom: 11, pid: 906)	3.6 MB Empty App
	F-Droid (oom: 13, pid: 760)	3.25 MB Empty App
	Gmail (oom: 10, pid: 736)	5.91 MB Empty App
	Google Account Manager (oom: 11, pid: 244)	4.35 MB Empty App
	Google Partner Setup (oom: 13, pid: 464)	3.77 MB Empty App
	Google Play Store (oom: 5, pid: 704)	7.71 MB Content Provider
	HD Player (oom: 9, pid: 921)	3.54 MB Content Provider
	Launcher (oom: 6, pid: 339)	5.53 MB Content Provider
	Mobile Data (oom: -12, pid: 323)	5.07 MB Foreground
	ROM Manager (oom: 8, pid: 791)	3.28 MB Content Provider
	Settings (oom: 11, pid: 935)	3.34 MB Empty App
	Superuser (oom: 12, pid: 809)	3.29 MB Empty App
	System UI (oom: -12, pid: 217)	3.55 MB Foreground

Effective Memory Management

- Permissions needed to load an App during booting

- `< application android:persistent="true" >`

- `< uses-permission
android:name="android.
permission. RECEIVE_BOOT_COMPLETED" >`

Effective Memory Management

- How can we improve speed and reduce page faults

Improved Activity Manager Service {

1. Maintain **Log history** of Apps
2. **Preload** user interesting Apps after boot based on time
3. **Increase priority** of user interesting Apps during runtime

}

Low Memory Killer in Android

- How does Low Memory Killer work (values in below table are taken from **Aakash** tablet, with RAM 512MB.)

<i>Group Name</i>	<i>oom _Adj Threshold</i>	<i>Minfree Thresholds</i>
Foreground	0	1 MB
Visible	1	3MB
Secondary	2	4MB
Hidden	4	7MB
Content Provider	9	8MB
Empty	15	10MB

Low Memory Killer in Android

- Low Minfree Thresholds

<i>Pros</i>	<i>Cons</i>
Improves degree of multi programming	Increases Lag time
Reduces response time of frequently accessed applications	Increases number of page faults

Low Memory Killer in Android

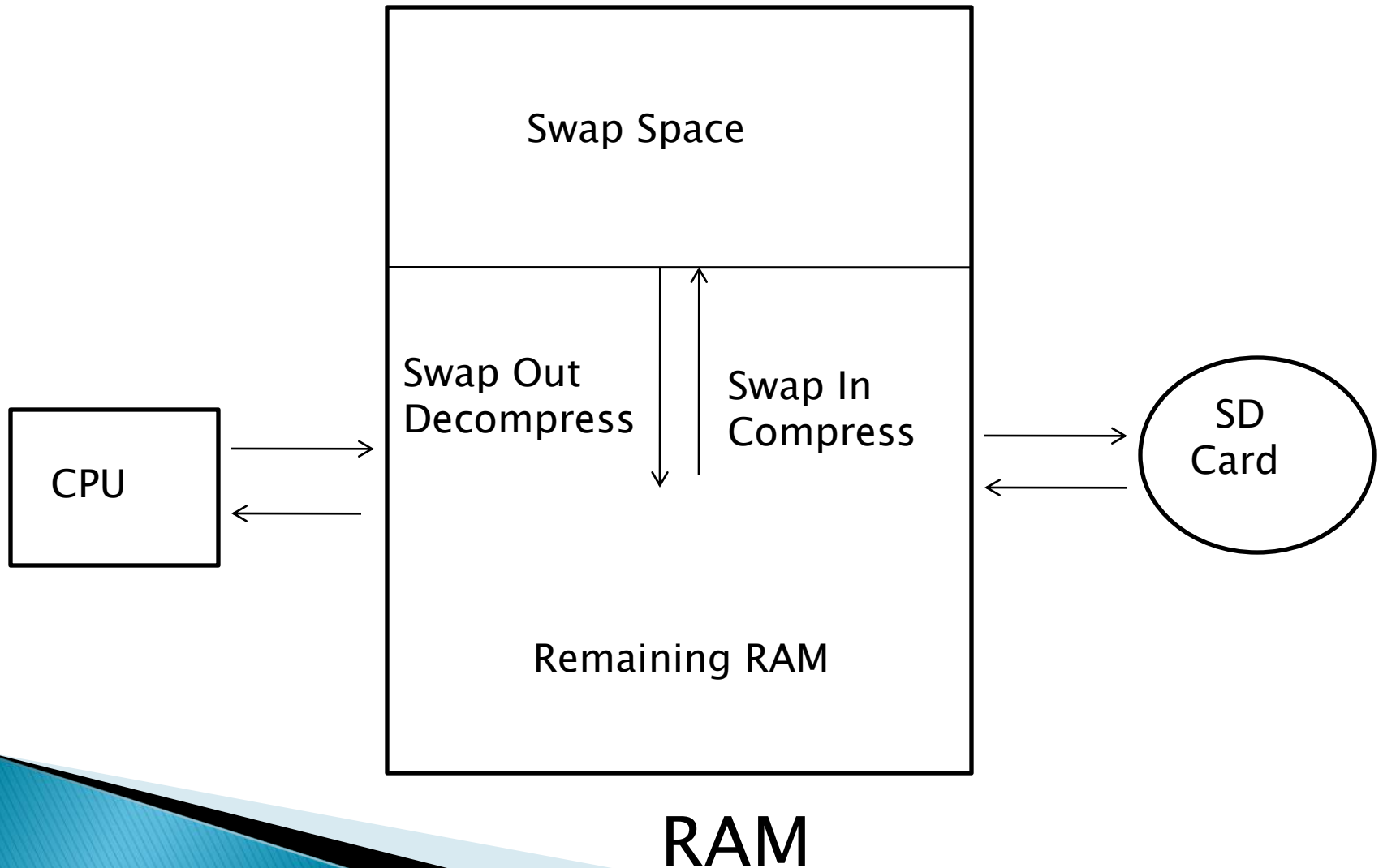
- High Minfree Thresholds

<i>Pros</i>	<i>Cons</i>
Decreases Lag time	Decreases degree of multi programming
Less number of page faults	Increases response time of frequently accessed applications

Problems in Low Memory Killer in Android

- **Complaint** from Android users[4]
Default minfree values in their system, do not give good performance
- **Static minfree** values suitable in not all the situations.

Compressed Cache



Conclusions

- Improves user experience
- Decreases **load time** of applications.
- Achieves effective memory utilization (not too much of free memory and **less page faults**)

References

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5. *CompCache , Compressed Cache for linux*
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